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THE EFFECT OF THE GALLET PROBLEM-SOLVING MODEL ON COLLABORATIVE AND PROBLEM-SOLVING ABILITIES IN SALT HYDROLYSIS TOPIC

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ABSTRAK

Penelitian ini bertujuan untuk mengetahui bagaimana model pembelajaran problem-solving Gallet memengaruhi kemampuan kolaboratif dan kemampuan memecahkan masalah siswa pada topik hidrolisis garam. Model Gallet belum banyak diujikan pada hidrolisis garam, sehingga keefektifannya belum pasti. Studi ini menggunakan metode *quasi-experimental* dengan desain *non-equivalent control group*. Sampel terdiri dari 35 siswa kelas XII SAINKES 2 sebagai kelas eksperimen dan 35 siswa kelas XII SAINKES 4 sebagai kelas kontrol di sebuah sekolah menengah negeri di Kabupaten Bogor. Kemampuan memecahkan masalah diukur dengan soal esai, sedangkan keterampilan kolaboratif diukur dengan lembar observasi. Data dianalisis menggunakan uji Mann-Whitney. Hasil menunjukkan bahwa model problem-solving Gallet secara signifikan meningkatkan kemampuan kolaboratif dan memecahkan masalah siswa ($p < 0,05$; $p = 0,000$). Kelas eksperimen memiliki skor kolaboratif lebih tinggi (21,24 dari 35) daripada kelompok kontrol (12,68 dari 35). Skor postes rata-rata kelas eksperimen untuk kemampuan memecahkan masalah (84,00) juga lebih tinggi daripada kelas kontrol (65,00). Kelas eksperimen memiliki skor N-Gain lebih tinggi (0,54, kategori sedang) daripada kelas kontrol (0,25, kategori rendah). Hasil menunjukkan bahwa model problem-solving Gallet efektif untuk pembelajaran hidrolisis garam.

ABSTRACT

This study aimed to determine how the Gallet problem-solving learning model affects students' collaborative and problem-solving abilities in the salt hydrolysis topic. The Gallet model has not been widely tested on salt hydrolysis, making its effectiveness uncertain. This study used a quasi-experimental methodology with a non-equivalent control group design. The sample consisted of 35 students in class XII SAINKES 2 as the experimental class and 35 students in XII SAINKES 4 as the control class at a public high school in Bogor Regency. Essay questions measured problem-solving abilities, and observation sheets measured collaborative skills. The Mann-Whitney test analyzed the data. Findings show that the Gallet-type problem-solving model significantly improves students' collaborative and problem-solving abilities ($p < 0.05$; $p = 0.000$). The experimental class had a higher collaborative score (21.24 out of 35) than the control class (12.68 out of 35). The experimental class average posttest score for problem-solving abilities (84.00) was higher than the control class (65.00). The experimental class had a higher N-Gain score (0.54, moderate category) than the control class (0.25, low category). Results show that the Gallet-type problem-solving model is effective for learning salt hydrolysis.

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INTRODUCTION

In the 21st century, science and technology are advancing at an unprecedented pace. Schools can no longer focus solely on teaching facts. They must also equip students with critical thinking abilities and the capacity to work effectively with others. Education plays a vital role in preparing human resources who can think critically, solve problems creatively, communicate clearly, and collaborate well when facing global challenges (Mahrunnisya, 2023). This aligns with the purpose of Sustainable Development Goals (SDGs), particularly Goal 4, which emphasizes quality education as the foundation for sustainable development (UNESCO, 2017).

Within 21st-century learning, collaborative skills and problem-solving skills stand out as two essential competencies that must be developed together. Collaborative skills refer to the ability that encourages students to actively participate in cooperation, communicate effectively, and reach compromises during learning to deepen their understanding of the subject matter (Junita & Wardani, 2020). Meanwhile, problem-solving skills represent an individual's effort to address a problem and understand the solving process by drawing on their knowledge and abilities (Siswanto & Meiliasari, 2024). This ability is closely tied to higher-order thinking since it involves mental activities like analysis, evaluation, and decision-making (Jariyah, Wahyudiati, & Riyandari, 2022). Both skills are crucial for students to tackle difficult problems in school and daily life.

However, the reality of high school chemistry learning reveals that these two skills have not been developed optimally. The learning process remains dominated by conventional teacher-centered approaches, leaving students passive and accustomed to working individually (Handayani & Supardi, 2025). As a result, students struggle to analyze problems, design solutions, and apply chemical concepts in real-life contexts. Rohayah (2022) found that students often solve chemistry problems by guessing formulas without proper analysis, limiting them to simple problems only.

This issue becomes even more pronounced in salt hydrolysis material, which is abstract and requires a solid understanding of acid-base concepts as a prerequisite. According to Johnstone's theory, chemistry learning requires students to connect three levels of representation: macroscopic, submicroscopic, and symbolic. Students often experience difficulties because they must simultaneously interpret observable phenomena, particle-level processes, and symbolic equations. In salt hydrolysis, learners must understand the relationships among salt solution properties, ionic interactions in solution, and hydrolysis equations. Failure to connect these representations frequently leads to misconceptions and learning difficulties.

Nusi, Laliyo, Suleman, & Abdullah (2021) revealed that students often consider salt hydrolysis difficult because it demands strong analytical skills and thorough conceptual interconnectedness. Yet the concept of salt hydrolysis has high relevance in daily life, such as in agriculture, health, and water treatment, giving great potential as a tool for developing students' collaborative and problem-solving skills. One of the alternative learning models that is considered able to overcome these problems is the Gallet-type problem-solving model with 16 stages in learning. This model is based on constructivist learning theory, which emphasizes that students actively construct knowledge through experience, investigation, and interaction with their environment. In this approach, learning occurs when students engage in the process of identifying problems, analyzing information, testing ideas, and reflecting on the results obtained. This model emphasizes problem-solving-based learning through group work in a systematic and structured manner, thereby encouraging students to actively discuss, put forward ideas, and make decisions together in solving problems (Gallet, 1998).

Several learning models like Problem-Based Learning (PBL) and Collaborative Problem Solving (CPS) have been widely used to improve students' higher-order thinking and collaborative skills. However, these models generally provide broader procedural frameworks without detailed stage-by-stage guidance. In contrast, the Gallet-type problem-solving model consists of sixteen structured stages that explicitly guide students through problem identification, hypothesis formulation, experimentation, evaluation, and reflection. The 16-stage structure provides more detailed scaffolding than PBL or CPS frameworks, which may better support collaborative learning and scientific problem-solving, especially for abstract chemistry topics like salt hydrolysis where students must connect macroscopic, submicroscopic, and symbolic representations. Gallet's model also integrates collaborative activities with systematic scientific procedures (problem analysis, experimentation, evaluation, reflection), developing students' analytical and reflective thinking alongside collaboration. Its key advantages include structured support for beginning learners, explicit metacognitive reflection opportunities, balanced individual-group accountability, and systematic progression from problem identification to solution evaluation.

Several studies show that problem-solving-based and collaborative learning positively impacts students' collaborative skills and problem-solving abilities. Research by Ibrahim & Badli (2025) demonstrated that blended problem-based learning with STEM integration significantly strengthens problem-solving skills in chemistry, particularly when students connect abstract concepts to real-world applications. Lestari, Erika, & Rahmadani (2025) found that the Collaborative Problem Solving (CPS) model contributed positively to student collaboration, the experimental group scoring higher than the control group. Likewise, Simanjuntak, Hutahaean, Marpaung, & Ramadhani (2021) showed that combining simulation methods with problem-based learning is more effective than using a single method or conventional approaches. Furthermore, Adal, Çepni, Akylbekova, Ibraimov, Dong, Tlesbaeva, & Korganbaeva (2025) confirmed that integrated project-based and inquiry-based learning in STEM contexts substantially enhances research skills and problem-solving capabilities, preparing students for future workforce demand.

However, most studies focused on PBL, CPS, STEAM-based, or inquiry-based approaches. Research on Gallet-type problem-solving remains limited. A systematic literature search identified only two studies: Gallet (1998), which introduced the 16-stage model for chemistry laboratories, and Muslim (2015) applied the Gallet-type problem-solving model to salt hydrolysis and reported that it improved students' practical performance and their ability to write laboratory reports, while also training thinking skills and self-confidence. The study also found significant differences between the experimental and control groups, and students responded positively to the model. The evidence on its influence on both collaborative skills and problem-solving abilities simultaneously in salt hydrolysis learning remains scarce. Thus, further investigation is needed.

The hypothesis proposed in this study is that students who learn through the Gallet-type problem-solving model demonstrate significantly higher collaborative skills and problem-solving abilities than those who learn through conventional instruction. This study aims to provide both theoretical and practical contributions to advancing chemistry learning strategies that are more effective and relevant to 21^{st}-century education needs.

METHODS

This study uses a quantitative approach with a quasi-experimental design because the study subjects were not randomly placed into the experimental and control groups (Mendrofa & Susilowati, 2024). This design is used to get an idea of information that is close to the results of a real experiment, especially when conditions do not allow control or change of all the important variables involved (Kurniawati, 2019). The research design used is a non-equivalent control group design, which involves two groups, namely the experimental class and the control class (Sugiyono, 2019). The research was carried out in the even semester of the 2024/2025 school year at one of the senior high schools in Bogor, with the research subjects of 70 grade XII students, consisting of 35 students in grade XII SAINKES 2 as the experimental class and 35 students in grade XII SAINKES 4 as the control class. The sampling technique used purposive sampling, taking into consideration the similarity of class characteristics, learning materials, and learning schedules (Rusilowati, Yunan, & Baltasar, 2025).

The experimental class was given treatment in the form of the application of the Gallet-type problem-solving learning model, while the control class used direct learning. The experimental and control classes were formed based on existing classroom assignments that were determined by the teacher. This approach follows a quasi-experimental design with non-equivalent control groups, which is commonly used in classroom-based research when random assignment is not feasible. Before the treatment was implemented, a pretest was administered to measure students' initial abilities. The pretest scores were analyzed using the Mann-Whitney U test because the data did not meet the assumptions for parametric testing. The results showed a statistically significant difference between the experimental and control classes ($p = 0.000$), meaning that the two groups were not equivalent at the beginning of the study. The experimental class had a higher average pretest score compared to the control class.

The initial difference between groups is a potential limitation that may affect the internal validity of the study. However, to address this issue, the study did not rely solely on posttest scores. Instead, the Normalized Gain (N-Gain) score was calculated to measure the improvement of each student from pretest to posttest. The N-Gain approach accounts for the starting point of each student, so the comparison between groups reflects the actual learning improvement rather than just the final score. This method helps reduce the bias caused by the initial difference between the experimental and control groups. It is acknowledged that the non-random group assignment and the pre-existing difference in pretest scores represent limitations of this study. Future research could strengthen the design by using random assignment to ensure group equivalence before treatment. The Gallet type problem-solving model refers to the stages proposed by Gallet (1998), which emphasize problem solving through systematic group work. In this study, the application of the model was adjusted to the salt hydrolysis topic and learning conditions in schools without changing the main syntax of the referenced model.

The independent variable in this study is the Gallet-type problem-solving learning model, while dependent variables include students' collaborative skills and problem-solving abilities. Collaborative skills were measured using observation sheets compiled based on collaboration skill indicators according to Greenstein (2012), including active contribution, productive work, flexibility, responsibility, and mutual respect. Problem-solving ability was measured using essay tests developed based on problem-solving indicators according to Heller, Keith, & Anderson (1992), namely visualizing the problem, describing the problem in a physical description, planning the solution, executing the plan, and checking and evaluating. The research instruments used were observation sheets for collaborative skills as well as essay test questions and a student worksheet for problem-solving skills. The research instrument was first reviewed by four experts in chemistry education and one chemistry teacher to ensure its content appropriateness before being tested empirically. Empirical validity was then conducted using SPSS with the Pearson Product-Moment correlation. The test involved 15 items of problem-solving ability questions. All 15 items were valid, where the r calculated for each item ranged from 0.408 to 0.789, exceeding the critical r value of 0.308 ($\alpha = 0.05$, $n = 39$). The problem-solving test also showed high reliability, with a Cronbach's Alpha value of 0.921.

Data collection was carried out through the observation of collaborative skills during the learning process by two observers using a structured observation sheet. The scores from both observers were combined to reduce subjectivity, and the combined collaborative skills data were analyzed using a normality test, a homogeneity test, and hypothesis testing with a Mann-Whitney U test. Additionally, pretest and posttest were given to measure students' problem-solving abilities. Data analysis began with a normality test using a Kolmogorov–Smirnov test and a homogeneity test using Levene's test with a significance level of 0.05 (Sahir, 2021). Since the data are not normally distributed, hypothesis testing is carried out using nonparametric statistical tests, Mann–Whitney (Yahya, Dencik, & Antoni, 2019). In addition, the improvement of problem-solving skills was analyzed using N-Gain to determine the level of improvement in student learning outcomes (Sukarelawan, Indratno, & Ayu, 2024). The percentage scores were classified into five categories: 0-20% (Very Low), 21-40% (Low), 41-60% (Moderate), 61-80% (High), and 81-100% (Very High).

RESULTS AND DISCUSSION

The findings of this study were derived from collaborative skill observation data and the results of pretest and post-test assessments evaluating students' problem-solving abilities regarding the salt hydrolysis topic. This study aims to determine how students' collaborative skills and problem-solving related to the salt hydrolysis topic are influenced by the Gallet type problem-solving learning model. The observation of students' collaborative skills revealed a distinction between the experimental class and the control class. A summary of the scores for collaborative skills is given in Table 1.

Table 1 Results of Observation of Students' Collaborative Skills

Classes	Maximum Score	Lowest Score	Highest Score	Average
Experiment	35	8	35	21,24
Control	35	5	20	12,68

Based on Table 1, the average collaborative skills of students in the experimental class were higher than those in the control class. The maximum collaborative skills score was 35. The average score of the experimental class (21.24) represented 60.69% of the maximum score, whereas the control class average (12.68) represented 36.23%. This showed that the application of the Gallet type problem-solving model can encourage students to be more active in working together in groups. This model demands that students be directly involved in discussions, task sharing, and decision-making, so that collaborative skills develop naturally during the learning process. From Vygotsky's sociocultural perspective, this improvement may occur because learning takes place through social interactions. During group discussions, students exchange ideas, negotiate meanings, and support each other in solving problems. These interactions reflect the concept of the Zone of Proximal Development (ZPD), where students can achieve higher levels of performance through collaboration with peers that they could not achieve individually. Therefore, Gallet's problem-solving models provide opportunities for students to strengthen their collaborative skills through meaningful social engagement. Table 2 shows how well the experimental class and the control class did on each of the collaborative skill indicators.

Table 2 Percentage of Achievement of Collaborative Skills Indicators

Collaborative Skills Indicators	Experiment (%)	Category	Control (%)	Category
Actively contribute	38	Low	25	Low
Work productively	74	High	44	Moderate
Demonstrates flexibility	52	Moderate	32	Low
Demonstrate responsibility	73	High	42	Moderate
Showing appreciation	83	Very High	47	Low
Average	**64**	**High**	**38**	**Low**

The indicator shows that the experimental class has the highest percentage of students who have an attitude of appreciation. On the other hand, the indicator of actively contributing is still pretty low. These results indicate that while students are beginning to value their peers' perspectives, certain individuals still require conditioning to enhance their engagement in idea expression. In general, these results show that Gallet-type problem-solving-based learning is a good way to help students work together better. Interestingly, the actively contribute indicators obtained the lowest percentage among all the collaborative skills indicators. These findings that suggest that although students were willing to respect and appreciate the opinions of their peers, some students were still reluctant to express their own ideas during discussions.

The low percentage of students who actively contribute may indicate that some students were still adapting to collaborative learning environments. Students who are accustomed to teacher-centered instruction may feel less confident in sharing ideas or initiating discussions. Unequal participation within groups may have limited opportunities for some students to actively contribute. Although collaborative skills generally improved, active participation remains an aspect that requires further attention.

Hypothesis test results: Mann-Whitney. The observation sheet showed a significance value of 0.000, which was smaller than the significance level of 0.05, so it can be concluded that there is an influence of the problem-solving Gallet type learning model on students' collaborative skills in two classes. These findings show that learning with the problem-solving Gallet type contributes to improving the quality of student cooperation during the learning process. This learning requires students to work in groups, communicate actively, and help each other in solving the problems given. This is in line with the opinion Ilma, Al-Muhdhar, Rohman, & Saptasari (2022) which states that collaborative learning is able to increase interaction and mutual respect between students. This result is also consistent with Vygotsky's theory, which emphasizes that knowledge is socially constructed through interactions with others.

The achievement of students' collaborative skills indicators increased for each indicator, but the actively contributing indicators increased slightly, while the indicators of appreciating others increased rapidly. This is in line with the research conducted by Anggraeni, Aeni, & Ismail (2024), which found that only some students actively contribute during groups, while others tend to passively contribute during groups. The Gallet model facilitates group discussions to help students work together and develop two skills at once. This shows that 21st-century skills, such as collaboration and problem-solving, can be developed simultaneously through the right learning model. According to research by Azizah, Febriyanto, & Rasyid (2023), this is in line with the idea that by using group investigation, teachers can engage students in 21st-century skills such as collaboration skills by assigning students tasks in groups so that they can solve problems cooperatively.

The results of the problem-solving ability test showed a greater improvement in the experimental class than in the control class. The comparison of these increases is shown through the pretest and post-test values presented in Table 3. The data in the table is used as a basis to see the improvement of problem-solving skills in each class.

Table 3. Pretest and Posttest Results of Problem-Solving Ability

Data	Classes	Number of Students	Lowest Score	Highest Score	Average
Pretest	Experiment	35	30	86	64.00
	Control	35	16	73	52.00
Posttest	Experiment	35	65	97	84.00
	Control	35	41	76	65.00

According to Table 3, the experimental class's problem-solving skills improved more than those of the control class. The control class performed lower at pretest (mean = 52.00) compared to the experimental class (mean = 64.00). This difference may reflect variations in students' prior knowledge and initial problem-solving readiness before the implementation of the learning interventions. Although both classes studied the same subject matter, differences in students' academic backgrounds, learning experiences, or prior understanding of prerequisite concepts may have contributed to the variations in pretest performances. Prior knowledge is critical in problem-solving because it serves as the foundation for connecting new information, forming hypotheses, and applying appropriate strategies to solve complex problems.

This indicates that students who utilize the Gallet type problem-solving model enhance engagement in the staged and collaborative problem-solving phases. Table 4 shows how well each indicator of problem-solving ability was met based on the results of the pretest in the experimental and control classes. From a constructive perspective, this improvement may occur because students actively construct knowledge through problem analysis, experimentation, discussion, and evaluation. Rather than relying on connecting prior knowledge with new learning experiences. Through the process, students develop a deeper understanding of concepts and become more capable of solving problems systematically.

Table 4 Percentage of Achievement of Problem-Solving Ability Indicators Based on Experimental Class and Control Class Pretest Results

Problem-Solving Ability Indicators	Experiment (%)	Category	Control (%)	Category
Visualize the problem	84	Very High	77	High
Describe the problem in physics description	68	High	60	Moderate
Plan the solution	67	High	53	Moderate
Execute the plan	61	High	57	Moderate
Check and evaluate	58	Moderate	43	Moderate
Average	**68**	**High**	**58**	**Moderate**

According to Table 4, the average percentage of pretest scores in the experimental class was 68%, which is in the "high" range, and in the control class, it was 58%, which is in the "moderate" range. If you look at the percentage of the score for each problem-solving ability indicator, the experimental class had the highest score for the visualize the problem indicator, which was 84% with a very high rating. The experimental class's lowest score was check and evaluate, which was 58% in the moderate category. In the control class, the best way to show problem-solving ability was to see the problem, which was 77% in the high category. The worst way was to check and evaluate, which was 43% in the moderate category. The low achievement in the check and evaluate indicator suggest that students were not accustomed to reviewing and reflecting on the solutions they had produced. Many students tended to focus on obtaining answers rather than evaluating the accuracy of their reasoning process. This finding indicates that students are metacognitive skills, particularly self-monitoring and self-evaluation, still need further development.

Table 5 shows the post value, which is based on the percentage of how well the problem-solving ability indicator was met.

Table 5 Percentage of Achievement of Problem-Solving Ability Indicators Based on Experimental Class and Control Class Posttest Results

Problem-Solving Ability Indicators	Experiment (%)	Category	Control (%)	Category
Visualize the problem	95	Very High	84	Very High
Describe the problem in physics description	90	Very High	67	High
Plan the solution	79	High	64	High
Execute the plan	84	Very High	70	High
Check and evaluate	84	Very High	61	High
Average	**86**	**Very High**	**69**	**High**

According to Table 5, the test class's post-test score for the problem-solving ability indicator is 86% in the very high category, while the control class's post-test score is 69% in the high category. When looking at the percentage of each problem-solving ability indicator, the experimental class had the highest percentage, 95%, in the very high category for the visualize the problem indicator. The experimental class, on the other hand, had the lowest percentage, which was 79%, and the high category was found in the plan the solution indicator. In the control group, the highest score for problem-solving ability was 84% for visualize the problem, and the lowest score was 61% for check and evaluate. Although all indicators showed improvement after implementation of the Galle problem-solving models. Planning and evaluation skills remained relatively lower than problem visualization skills. This finding suggests that students found it easier to identify and understand problems than to evaluate alternative solutions critically. Higher-order thinking processes such as planning, monitoring, and evaluation generally require more practice and experiences to develop.

Results of the Mann-Whitney hypothesis test demonstrated a significant difference (Asymp. Sig. = 0.000 < α = 0.05) in the problem-solving abilities of the two classes post-treatment. This demonstrates that students' problem-solving abilities can be significantly enhanced through a Gallet-type learning model. The enhancement of problem-solving skills in the experimental class aligns with prior research by Wulandari, Hidayat, Hamimah, Wiryanto, & Habibie (2025) which indicates that problem solving can enhance students' mathematical problem solving abilities. Problem-solving ability is defined as a high level of intellectual activity where students are encouraged and given the opportunity to take the initiative and approach problems systematically by using the knowledge they have learned (Muhali, 2021). This finding also supports constructivist learning theory, which argues that meaningful learning occurs when students actively build knowledge through experiences. The stages included in the Gallet problem-solving model encourage students to formulate ideas, test hypotheses, analyze evidence, and evaluate outcomes. These learning experiences help students develop stronger reasoning and problem-solving abilities.

The Gallet-type problem-solving learning model provides a systematic structure for solving problems, starting from problem visualization, physical description of the problem, solution planning, plan implementation, and evaluation. Students' problem-solving skills can be developed with this structure. The improvements in students' problem-solving abilities may be explained by the structured nature of the Gallet-type problem-solving model. The sixteen stages function as a form of scaffolding that guides students through the processes of identifying problems, generating hypotheses, collecting evidence, testing solutions, and evaluating the outcomes. This mechanism is also consistent with Heller's cooperative group problem-solving approach, which combines an explicit problem-solving strategy with collaborative practice in mixed-ability groups. Heller, Keith, & Anderson (1992) explain that this approach helps students share conceptual and procedural knowledge, request explanations and justifications, and engage in mutual critique so that better problem solutions emerge.

Such guidance helps students regulate their thinking processes and reduces the cognitive difficulties often encountered when solving complex chemistry problems. This mechanism is consistent with Pólya's problem-solving framework, which emphasizes understanding the problem, devising a plan, carrying out the plan, and reviewing the solutions. By engaging students in each of these stages systematically, the Gallet model promotes more effective problem-solving behaviors. The collaborative activities embedded within the Gallet model support social constructivist learning. Through discussion, arguments, and the exchange of ideas, students are able to construct knowledge collectively and refine their understanding of chemical concepts. These interactions facilitate metacognitive regulation, as students are encouraged to justify their reasoning, evaluate alternative solutions, and reflect on the effectiveness of their problem-solving strategies. Consequently, students become more capable of approaching problems analytically and systematically.

Learning in the experimental class was carried out in 4 meetings, including the first meeting to conduct a pretest and define the problem, the second meeting to analyze the problem, the third meeting to do practicum, and the fourth meeting to do posters and fill out questionnaires. In the control class, learning was also carried out in 4 meetings, including the first meeting conducting a pretest, the second meeting regarding the concept of salt hydrolysis, the third meeting conducting practicum, and the fourth meeting conducting a posttest. The 16 stages of the Gallet type problem-solving learning model were taught in four meetings in the experimental class. In the first meeting, there are 3 stages, namely: (1) Problem Presentation Stage, (2) Problem Defining Stage, and (3) Group Decision Stage. The second meeting consisted of 5 stages, namely: (4) Problem Analysis Stage, (5) Group Distribution Stage, (6) Gathering Problem Solving Stage, (7) Determining the Best Procedure Stage, and (8) Choosing Experimental Procedure Stage. There are 4 stages in the third meeting: (9) Stage of Getting Experimental Guidance, (10) Stage of Conducting Experiments, (11) Stage of Group Analysis, and (12) Stage of Choosing the Best Procedure in the Test. The fourth meeting consisted of 4 stages, namely: (13) Practicum Exam Stage, (14) Practicum Report Making Stage, (15) Practicum Report Assessment Stage, and (16) Student Response Stage to Problem Solving Learning.

In addition to the percentage per indicator, the effectiveness of increasing problem-solving ability is also analyzed through the calculation of normalized gain (N-Gain). N-Gain analysis is an approach commonly used in educational research to assess the effectiveness of a learning process or intervention. The results of the comparison of the N-Gain values between the experimental class and the control class are presented in Table 6.

Table 6 Comparison of N-Gain Value of Problem-Solving Ability

Classes	Average N-Gain	Category
Experiment	0.54	Medium
Control	0.25	Low

The N-Gain value showed that the improvement in students' problem-solving ability in the experimental class was in the medium category, while the control class was in the low category. Test results Mann-Whitney N-Gain data showed a significance value smaller than 0.05 so that it can be concluded that there is an influence of the learning model problem solving Gallet type to improve students' problem-solving skills. These findings are in line with research Muslim (2015) which states that Gallet-type problem-solving learning is able to improve students' problem-solving abilities through active involvement in each stage of learning. Overall, the results of the study show that the Gallet type problem solving learning model has a positive influence on students' collaborative skills and problem-solving skills. This model encourages student-centered learning, emphasizes group discussions, and trains students to solve problems systematically and contextually.

CONCLUSION

The findings confirm that the Gallet-type problem-solving model effectively improves students' collaborative and problem-solving abilities in learning salt hydrolysis. For collaborative skills, the experimental class averaged 64% (high), compared to 38% (low) in control class. Showing appreciation was the strongest indicator (83%), whereas actively contribute was the lowest (38%), suggesting that the students are still reluctant to take initiative in group discussions. The experimental class also achieved an N-Gain of 0.54 (medium), higher than the control class at 0.25 (low). Among problem-solving indicators, visualize the problem showed the greatest improvement (95%), while check and evaluate remained the weakest (84%), indicating that students still lack the habit of reviewing their work. These results highlight the relevance of the Gallet-type problem-solving model for teaching abstract chemistry concepts such as salt hydrolysis, where processes occur at the ionic level and cannot be directly observed. However, additional support is needed to strengthen students' evaluative skills and encourage more active participation in collaborative learning.

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