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Problem-Based Learning with Gallery Walk Oriented to Improve Students' Communication Skills on Ecology and Biodiversity Topics

Yunita[1], Nanang Winarno[2*], Saprudin[3], Nia Kurniati[4]
[1]Science Teacher Professional Education, Universitas Pendidikan Indonesia, Indonesia
[2]Department of Science Education, Universitas Pendidikan Indonesia, Indonesia
[3]Department of Physics Education, Universitas Khairun, Indonesia
[4]SMP Negeri 11 Bandung, Indonesia
*Corresponding Author: nanang_winarno@upi.edu

ABSTRACT

In the 21st century, education emphasizes not only knowledge acquisition but also the development of essential skills such as communication. This study aims to examine the potential effect of the Problem-Based Learning (PBL) model integrated with the Gallery Walk technique on students' communication skills. The research employed a pre-experimental one-group pretest–posttest design involving 30 seventh-grade students (15 male and 15 female) from a junior high school in Bandung, Indonesia. Participants were selected through convenience sampling based on class availability. Data were collected using the Communication Skill Scale (CSS) questionnaire and analyzed through the Shapiro–Wilk normality test, paired-sample t-test, and N-Gain score. The results showed an increase in students' communication skills from a pretest average of 67% to a posttest average of 70%. The paired-sample t-test result ($p = 0.006 < 0.05$) indicates a statistically significant difference, while the overall N-Gain score (0.08) falls within the low category. These findings suggest that the PBL model with Gallery Walk positively influences students' communication skills, although the improvement remains limited within the short duration of the intervention. Overall, the PBL model with Gallery Walk shows potential as an alternative learning to support the development of students' communication skills in science education.

Keywords: students' communication skills, problem-based learning, gallery walk

INTRODUCTION

In the 21st century, educational excellence is more crucial than ever before. To effectively respond to the ever-changing demands of the modern world, educational institutions must prioritize excellence in teaching and the development of curricula that align with the real-world challenges students will face in the future. An educated and dedicated educator can provide students with the guidance and resources they need to navigate these challenges and achieve success in the 21st century, equipping them with the knowledge and skills necessary for lifelong learning and success in a rapidly evolving global society (Erdogan, 2019). The 2030 Learning

Framework, as outlined by the OECD, asserts that education is a fundamental component in the development of knowledge, skills, attitudes, and values that facilitate societal contributions to and benefits from an inclusive and sustainable future. The National Education Association (2015) reports that what was considered a good education a few years ago is not long enough for success in college, career, and citizenship in the 21st century. In order for learners in the contemporary era to compete in a global society, it is imperative that they master the four skills that are currently required communication, collaboration, critical and creative thinking (4Cs). It is the responsibility of educators to ensure that all subjects are equipped with the 4Cs in order to prepare current and future generations for the challenges of the modern world. Among the foundational 4C skills is communication, the development of communication skills is not separate from critical thinking, creativity or collaborative learning, as students will use communication skills to logically present facts in oral or written form (Yusuf & Adeoye, 2012).

At the educational level, these communication skills are important in the learning process. Communication is an interactive process and essential for teaching and learning in general (Yusuf & Adeoye, 2012). Through communication, students can carry out the learning process better, such as in the process of exchanging ideas, points of view, or other information, so that the feelings or ideas conveyed can be conveyed and influence others (Pramusinta and Dewi, 2023). In addition, students' communication skills also play a role in improving students' social skills in the learning environment and society (Wahyuningsih et al., 2022). Several studies have shown that good communication skills, such as active listening, expressing ideas clearly, and showing empathy, help students regulate their emotions and interact effectively with others. These abilities are essential parts of social competence because they enable students to build understanding, respect, and cooperation with their peers (Wieczorek et al., 2025). Moreover, systematic communication training has also been proven to improve students' interpersonal performance and social abilities, showing that communication is one of the main foundations for developing social skills (Nincevic & Juric, 2023).

A limitation in students' communication skills can cause obstacles in the learning process in conveying information so that learning becomes less or ineffective and will affect learning outcomes (Putra et al., 2020). Based on several studies in Indonesia, including the results of Haryanti & Suwarma (2018) showed that the majority of junior high school students were still in the intermediate category for written communication and did not meet the standards for oral communication skills. In addition, the research of Zulfa & Rosydah (2020) also shows that the communication skills of junior high school students are still in the low or below average category, and the research of Rohmatin et al (2023) also shows similar, namely the initial results of observations of junior high school students communication skills in the very low category. Therefore, educators or teachers should be able to design learning activities that encourage students to communicate, one of which is using a learning model that can involve active communication in the learning process (Putri & Ardi, 2023).

One of the models that can be used is the learning model that is often used this century, namely Problem-Based Learning (PBL), which is a teaching and learning approach that has been

used for more than 40 years (Strobel and Barneveld, 2015). This model actively engages students in solving real-world challenges, fostering teamwork and critical thinking (Wurdinger & Qureshi, 2015). PBL is a pedagogical approach that aims to develop soft skills, including communication skills. These skills are further beneficial to students in the future when they are employed, as they assist them in managing their professional responsibilities effectively. These communication skills will facilitate effective communication, collaboration, time management, teamwork, and problem-solving abilities (Deep et al., 2019).

Communication skills are a crucial component of PBL, as the learning process often involves teamwork. It is, therefore, crucial to recognise the importance of interaction between individuals in order to find information and solutions, which is a fundamental aspect of learning (Judge et al., 2011). Those with well-developed communication skills are more effective in dealing with daily problems, problem-solving, and finding interpersonal communication solutions (Akuzzu & Akkaya, 2014). The utilization of problem-based learning (PBL) in the educational process can facilitate more focused learning, away from passive observation and waiting to see the outcome of others. PBL does not lack for cognitive activities that contribute toward the development of problem-solving skills. This approach also encourages students to develop effective communication skills throughout the learning process (Schwartz, 2013).

Several studies have reported that PBL improves students' communication skills (Judge et al, 2011; Najah et al, 2019; Awang et al, 2015; Ngoc Le, 2023; Deep, 2019, Li et al, 2019). In Najah's research, PBL learning was able to improve students' oral communication skills in the 1st cycle to the 3rd cycle with lesson study, while Awang et al's research (2015) showed that during the 8-week learning stage using PBL was able to significantly improve students' communication skills. Other than that, to support student-centered learning in communication skills, it can involve a gallery walk method that stimulates critical thinking, enhances student discussion, and improves students' ability to evaluate new information critically (Kennedy et al., 2012). This method requires students to display their group's work, transforming the classroom into an interactive space for communication where peers can observe, provide feedback, and actively collaborate through discussion (Indah, 2021). According to McCafferty & Beaudry (2017) gallery walk is an active learning strategy specifically designed to spark communication and celebrate student effort. This approach involves students, often working collaboratively in groups, rotating between different stations that feature various prompts, questions, or materials

Through student-centered PBL learning, it is expected that students can develop and improve their oral communication skills through group discussions by conveying and receiving information obtained to solve existing problems. To get a more interesting and professional communication learning experience, the use of gallery walk can be used and selected to improve students' communication skills. Learning with the PBL model with gallery walk has been carried out by several researchers including Prihatin (2022), Febriani (2022), and Karyatin (2016), but the skills measured are critical thinking, understanding of mathematical concepts, and learning outcomes.

However, although Problem-Based Learning and the Gallery Walk strategy have been examined separately to improve various learning outcomes, limited research has explored the combined use of these two approaches to specifically target communication skills in science learning. The integration of PBL supports collaborative problem-solving and argumentation, whereas the Gallery Walk provides structured opportunities for students to articulate, present, and defend their ideas publicly. This combination is particularly relevant in ecology and biodiversity topics, which require students to communicate solutions to real-world environmental issues. Preliminary observations at SMP Negeri 11 Bandung also indicated that junior high school students still struggle to communicate scientific ideas effectively. Therefore, this study addresses this gap by investigating the potential of integrating PBL with Gallery Walk to improve students' communication skills.

METHOD

The method used in this research is pre-experimental using one research group without a control class. This study did not include a control group because it was conducted in only one available class, making it impossible to provide a comparison group. The design was intended as a preliminary investigation to see the potential effect of the PBL model with Gallery Walk on students' communication skills. However, the absence of a control group may limit the internal validity of the findings, as other external factors might also influence the results. The research design used in this study is a one-group pretest-posttest design. According to McMillan & Schumacher (2014), one-group pretest-posttest is when one group of subjects is given a pretest (O_1), then given treatment (X) and at the end given a posttest (O_2), with the same pretest and posttest questions, but the time is different. The results will be determined based on the results of changes in the pretest and post-test.

Table 1. One Group Pretest Postest Design

Pretest	**Treatment**	**Posttest**
O_1	X	O_2

Description:

X: Treatment with PBL model with Gallery walk

O_1: Initial test before treatment

O_2: Final test after treatment

The one-group pretest-postest design is shown in Table 1. In this design, the independent variable is the PBL model with Gallery Walk (treatment X), and the dependent variable is students' communication skills (O_1–O_2).The research was conducted at SMP Negeri 11 Bandung in the even semester of the 2023/2024 academic year. The subjects of this study were students in one of the schools in Bandung City, Indonesia with a total sample of 30 people, aged 13-14 years, consisting of 15 female students (50%) and 15 male students (50%) in the same class.

In the planning stage, the researcher first formulated the research problem and then identified the variables of the study. The independent variable was the *Problem-Based Learning (PBL) model with the Gallery Walk technique*, which served as the treatment given to the students. The dependent variable was the students' *communication skills*, measured using the Communication Skill Scale (CSS) questionnaire developed by Akuzzu and Akkaya (2014). During the implementation stage, the researcher administered a Likert-scale pretest questionnaire on communication skills to the students, applied the PBL procedure from Wang (2021) during the learning process, and then conducted a posttest to examine the improvement or effect of the treatment.

This study was conducted over two meetings, consisting of 2 × 45 minutes and 3 × 45 minutes respectively, on the ecology and biodiversity sub-topic related to the influence of humans on ecosystems. In the first meeting, students worked in groups of 4–5 to analyze an environmental issue using a worksheet aligned with the Problem-Based Learning syntax. After conducting discussions and information searches from various sources, each group briefly presented their preliminary findings. In the second meeting, the Gallery Walk strategy was implemented. Each group created a mind map summarizing their analysis and displayed it at designated stations around the classroom. Three members remained at their station to explain the content, while two members rotated among other groups to observe, ask questions, and record key points on a feedback sheet. Throughout the activity, the teacher facilitated questioning, monitored student participation, and observed indicators of oral communication performance.

Table 2. Problem-Based Learning Procedure

No.	Stages	Explanation
1	Demonstration or Problem Introduction	Students will start the learning by recognizing ecosystem problems that exist around them as students' initial knowledge.
2	Problem Analysis	Students begin to analyze various information about ecosystem problems in Indonesia in the form of causes and consequences. After that, students determine one ecosystem problem in Indonesia that they will solve.
3	Problem Exploration or Investigation	From the exploration of ecosystem problems, students then determine one problem that they will investigate further. Students will conduct an in-depth investigation of one ecosystem problem that they have determined starting from the formulation of the problem to the best solution based on the results of their analysis.
4	Solving the Problem	After students investigate one ecosystem problem that they have determined, then students will analyze and find out the various solutions that can be done to solve the ecosystem problem.

No.	Stages	Explanation
5	Evaluating the Problem	At this stage, students will determine one best solution from the various solutions they have found. The solution will be explained by the students starting from the solution to how the realization of the solution can be done in Indonesia.
6	Multiple Evaluation	Students will be evaluated with a variety of evaluation tools that have been determined by the teacher.

The instrument used in this study was the Communication Skill Scale (CSS) developed by Akuzzu and Akkaya (2014). To ensure the appropriateness of the instrument in the Indonesian junior high school context, the original items were translated and adapted into Indonesian through a forward translation process. The translated version was then reviewed by two experts in science education and educational assessment to examine the clarity, cultural relevance, and construct representation of each item. The questionnaire consisted of statements rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

In the original development of the CSS, validity and reliability were established through item analysis, Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA). The final instrument consists of 36 items measuring students' communication skills, which are divided into four dimensions, including the first dimension of competencies consisting of 12 statements. An example statement for the competencies dimension is *"When I speak, I pay attention to stress and tone rules"*. Second, the dimension of discouragement consists of 13 statements. Example statement for the dimension of self-confidence "*It is difficult for me to express my thoughts*". Third, the body language dimension consists of 5 statements. An example of a body language dimension statement is "*When I listen to or talk to someone, I make eye contact*". Fourth, dignification consists of 6 questions. An example of a dignification dimension statement is "*I am open to criticism when speaking*".

Data analysis in this study consisted of three stages: the normality test, paired-sample t-test, and N-Gain score analysis. The Shapiro–Wilk normality test was used to determine whether the pretest and posttest scores of students' communication skills were normally distributed (Sugiyono, 2017). If the significance value was greater than 0.05, the data were considered normally distributed; otherwise, if the value was below 0.05, the data were considered non-normal.

After confirming normality, a paired-sample t-test was conducted to compare the mean pretest and posttest scores in order to determine whether there was a significant difference in students' communication skills after the implementation of the PBL model with Gallery Walk (Widiyanto, 2013). The test was performed at a significance level of 0.05 ($\alpha = 5\%$), and the decision to accept or reject the null hypothesis (H_0) was based on whether the p-value was above or below 0.05.

Finally, the N-Gain score analysis was employed to measure the extent of improvement in students' communication skills following the treatment. The N-Gain value was calculated from the difference between the pretest and posttest scores and interpreted according to Meltzer and David (2002), where $g < 0.3$ indicates low, $0.3 \leq g \leq 0.7$ indicates medium, and $g > 0.7$ indicates high improvement.

$$\text{Skor N} - \text{Gain} = \frac{\text{Skor } Posttest - \text{Skor } Pretest}{\text{Skor Maksimum} - \text{Skor } Pretest}$$

Table 3. Interpretation of N-Gain Score (Meltzer & David, 2002)

Criteria	**N-gain points**
Low	g < 0.3
Medium	0.3 ≤ g ≤ 0.7
High	g > 0.7

RESULT AND DISCUSSION

In this study, students' communication skills were tested based on their self-awareness through a validated questionnaire the Communication Skill Scale (CSS) from Akuzzu & Akkaya (2014). There are 4 dimensions with 36 items or questions available to determine students' communication skills. Data collection was carried out in the form of pretests and posttests using the Problem-Based learning model with a Gallery Walk on Ecology and Biodiversity science material. After obtaining pretest and posttest data, the data results were tested with three types of statistical data analysis tests using SPPS version 27.

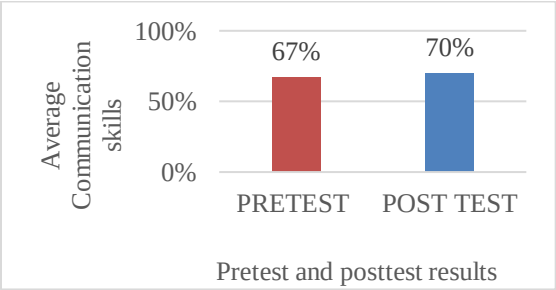


Figure 1. Average results of Pretest and Posttest

Based on Figure 1. the average results of students' communication skills measured using the CSS questionnaire were obtained, namely the pretest value of 67% and the posttest value of 70%. The increase in pretest and post-test results shows that students' skills have increased by 3% in 2 meetings for science material with a total of 5 JP.

Table 4. Normality Test Results

Treatment	Shapiro-Wilk		
	Statistic	**df**	**Sig.**
Pretest	0.970	30	0.531
Posttest	0.965	30	0.410

Based on Table 4. The first analysis test is the normality test using Shapiro-Wilk because the number of samples is less than 50. The results of the pretest significance value > 0.05 with a value of 0.531 and the posttest significance value > 0.05 with a value of 0.410. The pretest and posttest results with a significance level > 0.05 indicate that the data is normally distributed (Sugiyono, 2013).

Table 5. Paired-Sample T-Test Results

	Paired Differences				t	df	Sig. (2-tailed)
	Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**			
Pretest-posttest	-0.15000	0.27874	0.05089	-0.25408	-2.947	29	0.006

Based on Table 5. the results of the paired-sample T-test, the significance value of 0.006 < 0.05 is interpreted as H_0 is rejected and H_a can be accepted. If H_a is accepted then there is an influence or change. Thus, in this study, the results of the implementation of PBL learning with Gallery walk have a significant effect on student communication skills.

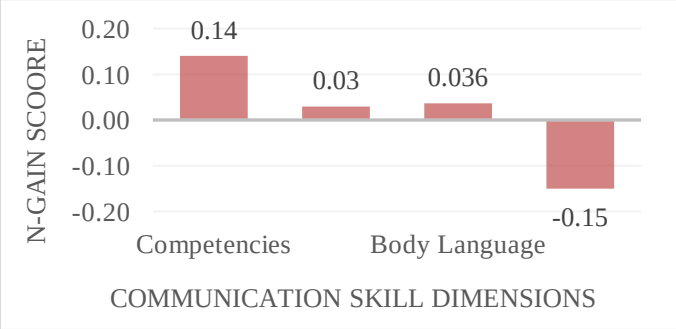


Figure 2. N-Gain Test Results of Communication Skills Dimension

Based on Figure 2. the total N-gain test results, a score of 0.08 was obtained. This score is less than < 0.3 with the interpretation including the low category. For the results of the N-gain

test for each dimension, each N-gain score obtained a lower N-gain score < 0.3. So the results of the N-gain score can be interpreted as the four dimensions obtained a low N-gain score. The highest N-gain score was obtained in the competency dimension with a value of 0.14 and the lowest was obtained in the dignification dimension with a value of -0.15.

Base on N-Gain results, the competency dimension has the highest value compared to the scores of other dimensions with a value of 0.14. This relates to students' skills in terms of communication or speaking skills, students' competency is closely associated with their communication and speaking abilities, including their capacity to select appropriate vocabulary, comprehend information, and convey it effectively to others. This aligns with Sabbah (2020), who emphasizes that communication skills involve expressing ideas clearly, understanding others, and sharing thoughts and feelings appropriately in social interactions. This dimension is highest because most students feel that they have quite good communication skills, as evidenced by the results of *the open-ended questions* they filled in, such as the results of the 6th respondent, namely, "*When communicating, I often remember my vocabulary clearly and I know what I am going to talk about. However, when I say it, I am often nervous. With this experience, I was able to figure out the factor why I was nervous, which was that I often spoke quickly. During junior high school, I started to get used to public speaking. Although it was easy, I still had many shortcomings. In this short time, I try to do my best,"* and the 20th respondent, *"I communicate by being able to understand the topic being discussed and the shortcomings are easily distracted by something"*.

While the lowest N-gain score result is dignification with a value of -0.15. The dignification dimension relates to how students build emotional communication made possible through mutual respect, trust and tolerance between speakers and listeners (Akuzzu and Akkaya, 2014). This dimension obtained the lowest score because some students felt that they often hesitated to express their opinions, were afraid and hesitant about criticism, and worried that what they said would hurt other people's emotional conditions. In the N-gain test results, negative data was obtained, which was different from the other data. This can be caused by a decrease in some data in the *posttest results* compared to the *pretest*, which results in a negative N-Gain score.

According to Sukarelawan (2024), the occurrence of a negative N-gain score is due to a decrease in learning outcomes. Because in this study, one of the learning outcomes is communication skills, some students may feel that in their dignification dimension, communication skills have decreased in terms of building emotional communication, such as through mutual respect, trust and tolerance. Some students feel that during learning, there are members of their group who are difficult to work with and dominate the group which it makes students hesitate to express their opinions and reduces their trust in their members and also some students still feel hesitant to express their opinions because they are afraid of rebuttals from others. These results are supported by the *open-ended* answers of students, namely respondent 25 *"When I speak, I want to express my opinion, but I am afraid of being offended and argued if I am not right.*"

The other two dimensions, self-confidence and body language are also other important dimensions of communication. The self-confidence dimension addresses negative perceptions and challenges associated with self-confidence, or difficulties encountered when communicating with others. This dimension relates to barriers that emerge during communication and hinder individuals from delivering or understanding messages effectively. One common barrier is low self-confidence, which can trigger speaking anxiety and reduce a learner's willingness to communicate. When students possess higher levels of self-confidence, these barriers decrease, allowing them to speak more clearly and engage more effectively in spoken interactions (Chang & Liu, 2020). For the body language dimension regarding how individuals or students show the role of body language in communication such as using facial expressions and body posture when conveying messages.

Although the overall N-Gain results show a value lower than 0.3, the results of students' open-ended questions in Google form show that most students feel better in terms of communication after doing PBL learning with Gallery Walk. This was also interesting and new for them because they could conduct, discuss, and ask short questions during the learning activities. The following are student answers including from the 22nd respondent "*Learning this time is very useful for me because it can make confidence, increase communication skills and make everyone able to express their opinions*" The 10th respondent "*Of course, because with this I can have confidence in communicating or explaining something*.", then the 26th respondent "*Yes, it is true, through group problem discussions with a gallery walk, I can increase my confidence when communicating with others*".

Learning using the PBL model with gallery walk-in research has proven significant in improving students' communication skills. These results are supported by several studies including research by Li et al (2019) learning through the problem-based learning model in 11 articles reviewed was able to improve communication skills or skills effectively, then research by Salari et al (2021) learning through PBL was able to improve communication skills compared to conventional methods, and in research by Najah et al (2019), PBL learning was able to improve student communication skills in three learning cycles assisted by lesson study. PBL learning is able to improve students' communication skills because students learn in groups to find problems in a case and work together to find relevant solutions. During this group discussion, students will give and receive opinions from other students (Carvalho et al., 2017).

The PBL learning model is able to develop student's communication skills to encourage better learning (Herpratiwi & Darsono, 2020), stimulating the use of communication in learning, especially in structured small groups or problem-based learning settings, strengthens their capacity to solve problems collaboratively, as are their skills in discussing and sharing information (Moussaid et al., 2018). Meanwhile, in the Gallery Walk section, students' communication skills will improve (Abdulaa, 2021), this is related to the process of displaying learning outcomes or student discussion results displayed by students to other students publicly. Through Gallery Walk students will do active learning by finding new information, organizing, which is meaningful and have the opportunity to explain it to others (McCafferty & Beaudry,

2017). This form of learning also is an effective active learning strategy that encourages social interaction and supports peer assessment by utilizing both written and oral communication (Vale & Barbosa, 2021).



Figure 3. Mind map and Gallery walk Process

Based on Figure 3. are mind maps during gallery walk activity. In this learning, Gallery Walk is supported by mind maps made by students to help them explain the problems and solutions offered to other students. Mind maps can encourage greater creativity in students because in addition to using plain text, the use of colors, images, symbols, codes, lines and so on are used in making mind maps (Aruselvi, 2017). The use of mind maps can also support students' communication skills in writing to support the expression or information they want to convey (Flanagan et al., 2013).

Based on the findings, learning through PBL integrated with the Gallery Walk strategy improved students' communication skills, even though the overall N-gain score was categorized as low. This improvement is also supported by students' responses to the open-ended questions, indicating that this learning approach increased their confidence in speaking in public, participating in discussions, and responding to questions, as well as their ability to receive and process information.

CONCLUSION

In this study, the implementation of the Problem-Based Learning model with Gallery Walk was able to improve students' communication skills. This improvement is shown by the increase in students' pretest and posttest scores from 67% to 70%. The paired sample t-test also supports this finding with a Sig. (2-tailed) value of 0.006 (< 0.05), indicating that H_0 is rejected and Ha is accepted. This means that the use of PBL with Gallery Walk has a significant effect on improving students' communication skills.

The results of the N-gain test for each dimension showed scores of 0.14 for competency, 0.03 for self-confidence, 0.036 for body language, and −0.35 for dignification, with the overall N-gain categorized as low. Although the N-gain score is low, students' responses to the open-ended questions indicate that they experienced improvements in public speaking, participating in discussions, asking and answering questions, and receiving information during the learning

process. Based on these results, the PBL model with Gallery Walk can be considered as an alternative strategy to support or improve students' communication skills in school.

However, this study has several limitations. The intervention was carried out over a short duration and involved a small sample from a single school. In addition, the absence of a control group reduces internal validity, and the use of self-reported questionnaires may introduce response bias. Future research is recommended to include a control group, extend the intervention period, and involve a larger sample size. The use of classroom action research (CAR) is also suggested, as this design allows longer interventions through multiple cycles and provides continuous feedback for monitoring students' communication skill development.

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