Available online at: http://journal.uny.ac.id/index.php/jppm

JPPM (Jurnal Pendidikan dan Pemberdayaan Masyarakat)
13 (1), 2026, 60-72

Image Cloud Recognition Based on Public History as a Learning Media to Improve Historical Thinking of Non-Formal Education Students

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Received: 9 February 2026; Revised: 24 February 2026; Accepted: 15 March 2026

Abstract: Amid the increasing influence of global economic, technological, and cultural transformations, history education faces challenges in maintaining its relevance and meaningfulness for students. Although previous studies have emphasized the importance of contextual and technology-supported history learning, limited attention has been paid to integrating cloud-based image recognition technology with local public history content, particularly in secondary education in Indonesia. This study aims to develop and examine the effectiveness of public history–based Image Cloud Recognition (ICR) media in improving students' historical thinking skills. The research employed a research and development approach using the ADDIE model, combined with a quasi-experimental pretest–posttest design. The participants comprised 2 history teachers and 60 high school students in Semarang City, who were divided into experimental and control groups. Data were collected through questionnaires, interviews, and historical thinking tests and analyzed using an independent-samples t-test. The findings indicate that the use of ICR media significantly improves students' historical thinking skills compared to conventional learning, as evidenced by t-values of 8.778 and 10.239, which exceed the critical value (1.672) at $p < 0.05$. These results suggest that ICR media is effective in facilitating contextual, visually rich, and meaningful history learning, thereby enhancing students' critical engagement with historical events.

Keywords: image cloud recognition, history–based learning media, historical thinking skills, collaborative learning, history education

How to Cite: Amin, S., et al (2026). Image Cloud Recognition Based on Public History as a Learning Media to Improve Historical Thinking of Non-Formal Education Students. *JPPM (Jurnal Pendidikan dan Pemberdayaan Masyarakat), 13* (1), 60-72. doi: https://doi.org/10.21831/jppm.v13i1.95790

INTRODUCTION

In the context of rapid technological development and the increasing global circulation of knowledge, history learning is increasingly challenged to remain relevant and meaningful for students. Contemporary global dynamics, including climate change, migration, social inequality, and geopolitical conflicts, require learners not only to recognize present realities but also to understand their historical roots and implications (Kiasse, 2025). In this respect, history education plays a crucial role in enabling students to interpret social change critically and contextually. For Indonesia, this role is particularly significant because the country possesses a rich historical legacy and cultural diversity shaped by the interaction of local traditions and external influences (Putri, 2023). As the world's largest archipelagic nation with diverse ethnicities, languages, and religions, Indonesia offers abundant historical resources that can

enrich meaningful learning experiences. Accordingly, history learning should move beyond the mere transmission of factual knowledge and instead foster students' ability to analyze, interpret, and reflect on historical events within broader social contexts. This orientation highlights the importance of developing students' historical thinking skills as a central objective of contemporary history education.

Developing students' historical thinking skills is essential for preparing them to respond to the complexities of 21st-century life (López-García, 2023). Wilke et al., (2023) argue that one important prerequisite for learning processes that enhance historical thinking is the availability of historical data that students can examine and interpret. Through engagement with such data, students are encouraged to develop critical reflection and analytical reasoning as they examine historical evidence, both of which are fundamental to the development of historical thinking skills (López-García et al., 2024). Therefore, history learning needs to be supported by instructional media that provide rich, contextual, and analyzable historical data, enabling students to construct understanding rather than passively receive information.

History learning has frequently focused on the transmission of factual knowledge, which limits students' opportunities to actively and critically interpret historical events (Steiss et al., 2024). History instruction that is overly focused on traditional approaches, such as lectures and reading texts, can lead to a lack of active student involvement in the learning process (Wafa & Douglass, 2024). This low engagement can hinder the development of historical thinking skills, as students may be less motivated to reflect and ask questions.

In this context, a more comprehensive strategy is needed to address these challenges and foster students' historical thinking skills. Accordingly, engaging, pedagogically effective history learning may provide an important alternative. Contextual history learning will create a unique Classroom learning experience, fostering students' awareness and historical thinking skills through a critical approach (Parada-Ulloa & Burgos-Videla, 2025). This will result in a positive, reciprocal relationship between classroom teaching and historical-cultural environments, reinforcing the presence of historical artifacts and providing students with an understanding of the importance of the past and the efforts to preserve it (Miralles-Sánchez et al., 2025; Parellada et al., 2023).

However, the implementation of history learning in Indonesia still faces challenges in emphasizing the development of students' historical thinking skills. Since the 1960s, developed countries such as the United States and the United Kingdom have developed approaches to historical learning that are oriented towards inquiry, analysis of primary sources, and the interpretation of various intersecting historical perspectives. This approach positions students as active historical researchers by prompting them to explore open-ended questions and use authentic historical evidence, thereby enabling the systematic and sustainable development of historical thinking skills (Ofianto et al., 2023).

Like fellow Southeast Asian countries, Indonesia is also lagging. Singapore applies historical thinking skills by engaging students in learning history, prompting them to actively trace and reflect on past events, thereby honing their knowledge and historical thinking skills (Utami et al., 2023). In Malaysia, students were found to have higher levels of historical thinking skills than Indonesian students (Sulistyaningrum et al., 2023).

Similar challenges are evident in non-formal education contexts in Semarang City, where the development of students' historical thinking skills remains limited. Evaluation results indicate that students are generally more capable of recalling historical facts than of understanding, analyzing, and interpreting historical contexts in greater depth. In the Indonesian context, previous studies have highlighted the importance of integrating cultural literacy and digital-based learning approaches to enhance students' engagement and critical thinking (Sari et al., 2024; Tohani & Shofwan, 2022). However, instructional media that explicitly connect public history with emerging technologies are still rarely developed, particularly in non-

formal education settings. This gap limits students' opportunities to engage critically with historical evidence and to construct meaningful historical understanding.

Students are often not involved in a learning process that systematically encourages them to think critically about historical narratives and relate them to the socio-cultural context of the present; classroom conditions that tend to be one-way (teacher-centered) and lecture-dominant have consequences for low interactivity and limited improvement of students' skills (Alfarez et al., 2025). Meanwhile, the dominance of lectures is also reported to limit student engagement and the development of analytical skills in history learning (Firmansyah et al., 2025). Within this framework, the indication that historical thinking skills have not yet become the main focus can be understood as part of a broader pattern where learning is still oriented towards memorizing the chronology of events, figures, and places without in-depth analysis or association of events with the broader context (Hutauruk et al., 2024).

The potential of Old Semarang as a historical laboratory can be leveraged by developing digitally based history learning media (Hu et al., 2023). One relevant innovation is Image Cloud Recognition (ICR). This cloud-based digital service enables recognition of target images and links them to historical information stored in a digital database. Through this technology, historical objects and their contextual meanings can be brought into classroom learning by scanning images or representations of historical sites and artifacts. With its ability to combine fact-based visualization and communicative narration, ICR has the potential to support students' imagination, engagement, and critical discussion of past events. Nevertheless, a significant gap remains in existing literature and practice. While digital learning media have been widely discussed, few studies have developed media that integrate local public history with cloud-based image recognition technology, particularly to strengthen historical thinking skills. As a result, the potential of local historical environments such as Old Semarang has not been fully leveraged to create interactive learning media that enable students to analyze evidence, interpret historical context, and construct historical meaning. Therefore, the development of public history-based ICR media becomes necessary as an innovative strategy to address this gap.

ICR media has been shown to help students understand the context of time and space from historical images (Lee, 2023). It is a key element in historical thinking, in which understanding the chronology and geographical relationships of historical events has an important role (López-García et al., 2024). Through the integration of ICR, students are invited to think historically by evaluating interpretations, questioning perspectives, and reflecting on the historical implications of each image. The use of technology has proven effective in creating a more interactive, visual, and contextual learning environment, elevating history learning (Holzmann-Littig et al., 2023). With ICR media support, historically significant buildings in the Old Semarang area can be managed digitally and presented virtually with adequate information. This will create flexibility and ease of learning. Even when learning must be conducted remotely, this medium remains highly relevant (Radianti et al., 2020).

The inherent flexibility of ICR as an alternative medium enables educators to encourage students to become good observers (Yaacob et al., 2020). Teachers can design learning that allows students to think reflectively. Through this reflective thinking ability, students have the opportunity to learn, reflect, and re-explain analytically about historical objects encountered through these media. Based on the description above, this study seeks to develop ICR media as an alternative to the use of media in teaching history in schools. The development of this media is based on several considerations, namely the great potential of public history as an authentic learning resource, the relevance of colonial history materials to the curriculum, and technological developments that allow the creation of more interactive and interesting learning experiences. Through this research, it is hoped that innovative and effective learning media can be produced and contribute to the development of the history of non-formal education in Indonesia.

METHOD

Research Design

This study employed a mixed-method research and development (R&D) approach to develop and examine the effectiveness of public history–based Image Cloud Recognition (ICR) learning media. The development process followed the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. In the analysis stage, qualitative data were collected to identify learning needs, student characteristics, and contextual problems in history learning. These findings served as the basis for designing and developing the ICR media. After the product had been validated and revised through the ADDIE stages, its effectiveness was tested using a quasi-experimental pretest–posttest control group design. At this stage, quantitative data were collected to measure the extent to which the developed media improved students' historical thinking skills compared to conventional learning. Thus, the mixed-method approach enabled the integration of qualitative insights during the development phase and quantitative evidence during the effectiveness-testing phase, allowing this study not only to produce an instructional product but also to provide empirical evidence of its educational impact.

Participants

The participants consisted of 2 history teachers and 60 students from two non-formal education institutions: the Semarang City Learning Activity Studio and the Ungaran Learning Activity Studio in Semarang Regency. The teachers were involved in the needs analysis and product evaluation stages, providing expert input on the feasibility and practicality of the developed media. The students participated in the effectiveness testing stage, with 30 students in the experimental group and 30 students in the control group. Since this study employed a quasi-experimental design, random assignment was not feasible; instead, intact groups from existing institutional settings were used. The Semarang City Learning Activity Studio was assigned as the experimental group, whereas the Ungaran Learning Activity Studio was assigned as the control group. The selection was conducted purposively based on similarities in students' educational levels, learning characteristics, and instructional objectives. To strengthen internal validity, both groups were drawn from institutions with comparable roles in non-formal education, and pretest data were used to examine baseline equivalence prior to the intervention. Thus, although the groups were located in different settings, the design incorporated procedural controls to minimize contextual bias and to support a more valid comparison of treatment effects.

Instruments

The research instruments included a needs-analysis questionnaire, a media-practicality questionnaire, interview guidelines, a historical-thinking skills test, and expert-validation sheets. The needs analysis and practicality questionnaires were administered to teachers and students to collect data on the relevance, usability, and practicality of the history learning media. The interview guidelines were used to gather in-depth information about teachers' and students' experiences in history learning and their perceptions of the ICR media. The historical thinking skills test was administered as a pretest and a posttest to measure students' historical thinking skills before and after the intervention. The test was developed based on four indicators: chronological understanding, contextual analysis, source interpretation, and historical reflection. Expert validation sheets were also used to assess the media's feasibility in terms of content, instructional design, and technical functionality. To ensure instrument quality, content validity was established through expert judgment by three validators with expertise in history education, instructional media, and educational evaluation. The reliability of the questionnaire

and test instruments was tested through a pilot study using Cronbach's alpha. Instruments with satisfactory validity and reliability coefficients were retained for use in the main study.

Data Analysis

Qualitative data obtained from open-ended questionnaires and interviews were analyzed using qualitative descriptive techniques to identify learning needs, media practicality, and user responses to the ICR media. Quantitative data, in the form of pretest and posttest scores on historical thinking ability, were analyzed using inferential statistics in SPSS version 26. The analysis begins with normality and homogeneity tests to ensure that the prerequisites are met. Furthermore, the media effectiveness test was conducted using an independent-samples t-test to determine the difference in improvement in historical thinking ability between the experimental and control classes. The significance level used in this study was 0.05.

RESULTS AND DISCUSSION

Results

Field Test Results of *Image Cloud Recognition Application*

The development of Image Cloud Recognition (ICR) media, based on public history, began with the design of a learning media prototype comprising three main components: an Android application, a cloud-based storage system, and an image-scanning feature. This medium is designed to allow students to access public historical information directly through scanning images of historic objects. The developed media have been adjusted to meet the feasibility criteria for learning media, based on theoretical studies and input from potential users, namely teachers and students. These adjustments include visual clarity, narrative comprehension, and ease of navigation within the application, so that the media can be used effectively for learning history.

The ICR application is available and can be installed on Android smartphones, allowing students to use their devices independently during learning. The developed learning content raises the public history of Semarang Old City, with the main objects being the Blenduk Church, the Marba Building, and Spiegel. Historical materials are systematically compiled using various local and academic sources, resulting in relevant and contextual content.

Figure 1. Example of a Created Application View

Figure 2. Example of a Created Application View

Figure 3. Example of a Created Application View

The Marba Building, as one of the public historical objects in Semarang's Old City, can be scanned using the ICR application. Media refinement is carried out on the narrative aspect, making it more concise and easier to understand, as well as on the selection of images that are more relevant to the text's content. This improvement aims to increase the ease of use of media by teachers and students in learning history.

Expert Validation and Media Feasibility Test

Before being implemented in the field, the public history-based Image Cloud Recognition (ICR) media was reviewed by experts to assess its feasibility in terms of content, instructional design, language clarity, and technical functionality. The validation results indicated that the developed media met the feasibility criteria and were suitable for use in history learning after several revisions. The revisions mainly concerned the clarity of the visual display, the conciseness of the historical narratives, the relevance of the selected images, and the ease of navigation within the application. Thus, the validation process confirmed that the media was not only technically functional but also pedagogically appropriate for supporting students' historical thinking skills.

Image Cloud Recognition Testing Stage

Assumption Test

Normality Test

The normality of the pretest scores of students' historical thinking ability in the experimental class (Semarang City Learning Activity Studio) and the control class (Semarang Regency Ungaran Learning Activity Studio) was assessed using the Kolmogorov–Smirnov test. The results of the normality test are presented in Table 1.

Table 1. Normality Test Results

	Pretest	**Kolmogorov-Smirnova Statistic**	**df**	**Sig.**
Historical Thinking Studio Learning Activities in Semarang City	Pretest Experiment	0.113	30	.200*
	Control Pretest	0.145	30	.111
Berpikir Historis Sanggar Kegiatan Belajar Ungaran Kabupaten Semarang	Pretest Experiment	0.151	30	.080
	Control Pretest	0.145	30	.200

Based on the results of the Kolmogorov-Smirnov test, both the experimental and control groups have a normal distribution. This is evidenced by the significance values for each class being greater than 0.05. It can be concluded that the data in this study are normally distributed.

Homogeneity Test

The homogeneity test aims to ensure that both groups have equal variance. The results of the homogeneity test are as follows

Table 2. Homogeneity Test Results

Historical Thinking Students (Pretest)	**Living Statistic**	**df1**	**df2**	**Sig.**
Historical Thinking Studio Learning Activities in Semarang City	3.280	1	58	.075
SMAN 12 Semarang	4.918	1	58	.131

Based on the results of the statistical test using SPSS 26, the significance values for both the experimental and control classes were greater than 0.05. Therefore, it can be concluded that the experimental and control class data have the same (homogeneous) variance.

Independent Sample t-Test

Table 3. Independent Sample T-Test

	Historical Thinking Pretest						
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Historical Thinking Studio Learning Activities in Semarang City	-.234	58	.816	-.467	1.996	-4.462	3.528
	-.234	52.133	.816	-.467	1.996	-4.471	3.538
Historical Thinking Studio Learning Activities in Semarang City	.290	58	.772	.533	1.836	-3.142	4.208
	.290	53.154	.773	.533	1.836	-3.149	4.216

Based on the results of the statistical analysis in SPSS 26, the p-values for both the experimental and control groups were greater than 0.05. This indicates that there is no statistically significant difference in students' historical thinking abilities between the two groups.

Test the Effectiveness of Media *Image Cloud Recognition*

Table 4. Test the effectiveness of *Image Cloud Recognition media*

	Historical Thinking Pretest						
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Historical Thinking Studio Learning Activities in Semarang City	8.778	58	.000	12.267	1.397	9.469	15.064
	8.778	38.468	.000	12.267	1.397	9.439	15.094
Historical Thinking Studio Learning Activities in Semarang City	10.239	58	.000	11.033	1.078	8.876	13.190
	10.239	47.759	.000	11.033	1.078	8.866	13.200

Statistical analysis shows that the use of Image Cloud Recognition (ICR) media has a very significant impact on students' historical thinking skills compared to conventional learning media. This is evidenced by the t-value of the calculation for the Semarang City Learning Activity Studio (8,778) and the Semarang Regency Ungaran Learning Activity Studio (10,239), which is greater than the table t-value (1,672) with a significance value of 0.000<0.05, so it can be concluded that Image Cloud Recognition media shows potential effectiveness in improving the historical thinking skills of non-formal education students.

In addition, the positive mean difference between the two groups indicated an increase in students' historical thinking skills following the use of ICR media. Thus, it can be concluded that public history-based Image Cloud Recognition media have proven to be effective in improving the historical thinking ability of non-formal education students compared to conventional learning media. In addition, the positive mean difference between the two groups indicated an increase in students' historical thinking skills following the use of ICR media. Thus, it can be concluded that public history-based Image Cloud Recognition media have proven to be effective in improving the historical thinking ability of non-formal education students compared to conventional learning media.

Discussion

Development of Public History Based on Public History Image Cloud Recognition

The development of public history–based Image Cloud Recognition (ICR) media responds to the dominance of textual and memorization-oriented approaches in history learning. By integrating cloud-based image recognition technology with public history content, students can scan historical images or objects and immediately access contextual explanations linked to local historical sites. This feature provides opportunities for students to engage directly with visual

historical evidence rather than merely receiving information in verbal form. Pedagogically, such interaction supports the development of historical thinking skills by encouraging students to identify sources, analyze historical context, interpret meaning, and reflect on the relevance of historical events to contemporary public life. Thus, the contribution of ICR lies not only in making learning more visual and engaging but also in facilitating students' active inquiry into historical evidence and interpretation. In line with multimedia learning theory, combining visual representations with contextual narratives can improve conceptual understanding and information retention compared to text-based material alone (Chang et al., 2022; Fonseca et al., 2025). Therefore, ICR media offers strong potential to enhance the quality of history learning through a more meaningful and analytically oriented learning design.

Media Image Cloud Recognition (ICR) was developed based on a contemporary constructivist approach that places learners as active subjects in building knowledge through interaction with objects, contexts, and digital learning environments. Image scanning and public historical information exploration activities allow students to be directly involved in the contextual observation and interpretation of historical sources. Recent research confirms that students' active involvement in analyzing evidence, understanding context, and constructing historical meaning contributes significantly to strengthening historical reasoning (Retz & Yeager, 2023; van Boxtel & Grever, 2021). Thus, ICR media supports the paradigm shift in history learning from a teacher-centered approach to a student-centered, inquiry-based approach grounded in meaningful learning experiences.

Cognitive Mechanisms and the Role of Visuals in Historical Thinking

The effectiveness of Image Cloud Recognition (ICR) media in improving historical thinking skills can be explained through the cognitive mechanisms that work during the learning process. Visualizing public historical objects helps students build a more concrete understanding of the spatial and temporal context, an important prerequisite for historical reasoning and interpretation. Research shows that students' engagement with visual representations and authentic contexts fosters the ability to relate historical events to the social and cultural contexts in which they occurred, thereby strengthening historical meaning-making (Endacott et al., 2022; Gestsdóttir et al., 2021). Thus, history learning no longer focuses on memorizing facts but on developing the ability to reflectively and in context interpret the meaning and relevance of history.

In addition, the use of real, object-based visuals encourages students' cognitive and emotional engagement in learning history. This involvement plays an important role in enabling higher-level thinking processes, such as analysis, reflection, and historical meaning. Recent research shows that contextual visualization based on real objects and cultural heritage can increase cognitive engagement, strengthen knowledge construction, and deepen students' conceptual understanding through more authentic and meaningful learning experiences (Dordio et al., 2024; Fontal et al., 2024). Thus, Image Cloud Recognition (ICR) media serve not only as a visual aid but also as a trigger for deeper historical thinking by integrating visual, cognitive, and emotional experiences into learning.

Local Context and Student Engagement in History Learning

The use of the public history of Semarang Old City as the main content of ICR media makes an important contribution to history education in Indonesia. The object of public history presents history as part of students' social reality, making learning more relevant and meaningful. Recent research shows that heritage education not only enhances the understanding of the past but also provides a meaningful context for learners in today's digital age, with heritage incorporated into both formal and informal learning processes (Dordio et al., 2024; Fontal et al., 2024). In addition, the younger generation's involvement in cultural heritage

through educational activities and heritage management increases awareness of cultural identity and students' emotional connection to local history (Zhang et al., 2024). This proximity of the local context helps students understand history as an ongoing social and cultural process, rather than just a past event. This is in line with the historical education approach that emphasizes the connection between the past and present life (Bartelds et al., 2020).

Students' involvement in history learning also increased through the use of Image Cloud Recognition (ICR) media. The process of image scanning and visual exploration encourages students to actively observe, question, and discuss the meaning of historical objects. This active engagement is important because participatory history learning, especially with the help of interactive digital media, is more effective in developing historical thinking skills than passive learning (López-Pérez & García-Peñalvo, 2024). Thus, ICR media contributes to improving the quality of learning interactions in history learning.

The Effectiveness of ICR Media and Its Implications for History Education

The results of the effectiveness test showed that public history–based Image Cloud Recognition (ICR) media significantly improved students' historical thinking skills compared with conventional learning media. This result can be theoretically explained by the way ICR facilitates students' cognitive engagement with historical content. By combining visual representations of historical objects with contextual narratives and interactive access to information, the media enables students to examine evidence, identify historical context, interpret meanings, and reflect on the relationship between past events and present realities. Such processes are closely aligned with the core dimensions of historical thinking. In terms of multimedia learning theory, integrating visual and verbal information helps learners process historical material through multiple cognitive channels, thereby enhancing conceptual understanding and retention (Chang et al., 2022; Sung & Liu, 2025). At the same time, the use of contextualized public history makes learning more meaningful, especially in non-formal education, where students often benefit from learning experiences closely connected to their surroundings. Therefore, the statistically significant results obtained in this study provide evidence that ICR media supports the development of historical thinking not only by making learning more engaging but also by creating conditions for deeper analysis, interpretation, and reflection on historical evidence.

However, the implementation of Image Cloud Recognition (ICR) media also faces various challenges, such as dependence on technological infrastructure and teachers' readiness to utilize digital-based learning media. Recent research shows that the success of technology integration in learning is greatly influenced by teachers' digital competence, their readiness to use digital tools, and adequate infrastructure support (Agyei & Voogt, 2024; Peterson & Punie, 2023; Suriadi et al., 2025). Therefore, the ICR media implementation strategy needs to consider improving teachers' pedagogical and technological competence as well as strengthening infrastructure support in the school environment. Therefore, the development of technology-based learning media needs to be accompanied by teacher training programs and institutional policy support. With this support, ICR media can become a sustainable learning innovation and have a wide impact on history education in Indonesia.

CONCLUSION

This study showed that public history–based Image Cloud Recognition (ICR) learning media was successfully developed through the ADDIE model and demonstrated positive results in supporting the historical thinking skills of non-formal education students. The effectiveness test indicated that students who learned using ICR media achieved better improvement in historical thinking skills than those who learned through conventional media. These findings suggest that integrating cloud-based image recognition technology with local public history

content can provide a more contextual, interactive, and meaningful learning experience. In this regard, ICR media appears to support students in analyzing, interpreting, and reflecting on historical events through visual and contextual engagement with historical sources.

However, these findings should be interpreted with caution. Since this study employed a quasi-experimental design involving groups from different institutional settings, the results do not fully establish a causal relationship. They may have been influenced by contextual factors that were not entirely controlled. In addition, the study was limited to two non-formal education institutions in Semarang City and Semarang Regency, so the findings cannot be generalized broadly to other educational contexts. Therefore, future studies are recommended to involve a larger, more diverse sample, employ more rigorous experimental procedures, and examine the long-term impact of ICR media on different dimensions of students' historical thinking skills. Further research may also explore the application of this media in other history learning contexts to strengthen its empirical and practical contribution

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