

# Diffusion of artificial intelligence-based learning innovation; A case study in MTs Muhammadiyah Tawanghari Sukoharjo

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## Abstract

Madrasah Tsanawiyah Muhammadiyah Tawanghari is a junior high school level educational institution that bases its curriculum on Islamic principles and progressively applies information technology (IT) on the foundation of Muhammadiyah values. This study aims to determine the process of diffusion of innovation in technology-based learning, focusing on the role of teachers as agents of change in applying artificial intelligence in the context of learning. The research method used was qualitative descriptive, involving in-depth interviews with four teachers who had key roles in introducing the innovation. The results showed that most teachers have received information about the use of artificial intelligence through various socialization activities, workshops, and training. The diffusion of learning innovations in MTs Tawanghari involves various communication channels, including interpersonal communication such as lectures, dialogues, and demonstrations of effective practices; communication through mass media, such as the publication of writings on school websites; and communication through social media, such as Youtube, Instagram, and Facebook. In addition, teachers consider that innovation in post-pandemic learning has significant urgency, with success indicators in the form of increased active student participation in the learning process. In addition, teachers also voiced the need for community platforms and continuous training on artificial intelligence-based learning.

**Keywords:** *learning innovation, artificial intelligence, communication technology*

## INTRODUCTION

More than two years have passed since the Covid-19 pandemic swept across the globe, resulting in tremendous paradigm shifts in various aspects of life, both at the individual level and society as a whole. The impact of this pandemic includes various significant changes, including in the world of education. Governments in various countries, including Indonesia, have responded by implementing various policies aimed at reducing the rate of Covid-19 transmission, such as lockdowns, large-scale social restrictions (PSBB), and the implementation of restrictions on community activities (PPKM).

One of the sectors that has been significantly affected is education. School closures and restrictions on activities in places of education have changed the way people learn. In an effort to maintain the continuity of the learning process, various learning innovations have emerged such as blended learning systems, learning application development, curriculum adjustments, and the use of new learning methods (Sofianto & Zuhri, 2021). Innovation in this context is an idea, action, or item that is considered new by someone, and the novelty of this innovation is often measured subjectively, according to the views of the individual who accepts the idea (Rusmiarti, 2015).

However, this paradigm shift also has a significant impact on the learning process. In the Indonesian context, the government introduced the Learning From Home (BDR) program as an effort to ensure the continuity of the education process in the midst of a pandemic (Indonesia. Ministry of Education and Culture, 2020). With these restrictions, schools, including Madrasah Tsanawiyah Muhammadiyah Tawang Sari (MTs Tawang Sari), are faced with major challenges to ensure smooth learning.

Artificial intelligence (AI) has an important role in facilitating the discovery or search process, learning applications, and decision making (Xu, et al, 2021). In 2022, the introduction of ChatGPT is an important breakthrough in the field of AI as it simplifies human-machine interaction and opens up new potential for AI applications in everyday life, education, research, and various other sectors (Dwivedi, et al, 2023). Significant increased interest from researchers, academics, and higher education institutions towards ChatGPT's contributions and implications in teaching, learning, and research pedagogy methods. Experts in this field recognize the potential that ChatGPT has to support data analysis, answer student questions, and assist in literature review, without requiring technical or programming skills to use it (Fuchs, 2023; Burger, et al, 2023).

Education has an important role in the development of a quality and highly competitive society. MTs Tawang Sari is one of the junior secondary education institutions that has built a strong foundation in basing its curriculum on Islamic principles. However, this school is also faced with the demands of an era that continues to change and develop, especially in the era of increasingly advanced information technology. One innovative response that can be a solution in the face of this drastic change is the use of information technology (IT) and artificial intelligence (AI) in learning. MTs Tawang Sari has implemented progressive steps by utilizing information technology and Muhammadiyah values as a foundation in its curriculum. This leads to a discussion in this study about how the process of diffusion of innovation in technology-based learning, focusing on the role of teachers as agents of change in the use of artificial intelligence in learning.

However, it should be noted that the adoption rate of technology-based learning innovations can vary between teachers, students, and the community. Subandi (2011) emphasizes that the level of resistance to innovative technology-based learning ideas can vary greatly. Rogers (in Littlejohn, 2017) also notes that there are always individuals who are more likely to adopt an innovation earlier than others, before the majority of people consider following it. These people are often pioneers in introducing and adopting such innovations, and they have a significant influence on others.

In the context of innovation diffusion, there are four key elements that help explain how to increase the speed and effectiveness of innovation deployment and adoption. These four elements, which will be the main focus in this study, are as follows: 1) Time; 2) The characteristics of the innovation itself; 3) Communication channels; and 4) Social systems. First of all, time becomes a central element in the process of diffusion of innovation. Every innovation takes time to spread and affects adoption rates. The adoption rate, as one of the indicators of success, is strongly influenced by perceptions of innovation characteristics. In this case, these characteristics include the advantages of new innovations compared to existing alternatives, the degree of compatibility of innovations with existing values and experiences, the complexity of innovation, trialability (possibility to try) for potential adopters, and also the ability to be observed by other potential adopters. This is important because many potential adopters tend to want to see how innovations are implemented by others before they are willing to adopt them (Littlejohn, 2017).

Based on the above problems, researchers focused the formulation of research problems on how the adoption process of AI technology-based learning innovations carried out by teachers at Madrasah Tsanawiyah

Muhammadiyah Tawang Sari (MTs Tawang Sari). The purpose of this study is to determine the diffusion of AI technology-based learning innovations carried out by these teachers as agents of change in an effort to improve the quality of continuous learning at MTs Tawang Sari.

## LITERATURE REVIEW

### The Development of AI in Indonesia

The development of AI in Indonesia is highly correlated with internet users where in 2023 there are 213 million or more than 77% of Indonesia's population already internet users and also the growth of startups that utilize this technology in supporting business activities. The government hopes that with the development of AI, business sectors that have utilized AI can pay attention to user security without limiting innovation, and also the community to continue to improve digital literacy and skills in the use of AI (Agustini, 2023).

The development of Artificial Intelligence (AI) or artificial intelligence in Indonesia has been the main highlight in the last ten years. AI refers to the ability of a system to accurately interpret external data and manage it for specific purposes. This is a concept that is increasingly gaining attention from researchers and professionals in various sectors. AI has great potential in changing the way we interact with technology (Sousa, et al, 2019; Goralski & Tan, 2020).

Indonesia is not standing still in adopting AI. Many initiatives and projects have been launched to harness artificial intelligence in various fields, including government, industry, health, and education. The implementation of AI in Indonesia is also linked to the Industrial Revolution 4.0, which marks a fundamental change in the way we process data and make decisions. One sector that has seen great benefits from AI is the manufacturing industry, where AI is used to improve efficiency in production lines. In addition, the education sector has also adopted AI rapidly (Nasution, 2012). Schools in Indonesia utilize an AI-based learning outcomes assessment system, which helps teachers and students optimize the learning process. However, while taking steps forward in AI development, Indonesia also needs to pay attention to existing challenges, such as adequate regulation, workforce skills, and data privacy issues. This development is in line with the efforts of the Indonesian government which has encouraged the growth of artificial intelligence since 2018. A number of initiatives and investments have been taken to advance AI technology in the country. Along with global developments, Indonesia also strives not to be left behind in adopting and developing AI technology. Thus, Indonesia continues to move forward in the use of artificial intelligence to support economic growth, better public services, and improvements in various sectors of life.

The use of artificial intelligence technology (AI) in Indonesia has experienced rapid development. Government agencies in the country have been actively adopting AI as an important tool in carrying out their functions as government regulators. This is reflected in various initiatives and programs supported by the Ministry of Communication and Information Technology, which encourage the use of artificial intelligence in government services (Indonesia. Ministry of Communication and Information, 2019).

One of the positive impacts that can be seen from the implementation of AI is the reduction of waiting times in various administrative processes and public services. Artificial intelligence enables automation of routine tasks, increases efficiency, and reduces the workload of government employees. In addition, AI also contributes to improving the quality of the results of processes or services provided to society. This creates a more responsive, efficient, and high-quality public service environment, in accordance with the government's vision to improve services to the people (Wahono, 2023).

Multinational companies such as Google, Alphabet, and Facebook have invested heavily in the development of AI technology in Indonesia. They bring global resources and knowledge to support local AI projects. Indonesian startups such as Snapcart, Kata.ai, BJtech, Sonar, Nodeflux, Bahasa.ai, AiSensum, and Deligence.ai are innovators in the development of diverse AI solutions. They often create AI applications that focus on data analytics, natural language processing, and other sectors. The Indonesian government is also

actively supporting the development of AI through various initiatives, including institutions such as Inkubator. Government support is important in driving the growth of the AI ecosystem, as well as adequate regulation. With the involvement of these various actors, the development of artificial intelligence technology in Indonesia continues, with the potential to have a positive impact in various sectors, including the economy and services to society.

With the continued development of AI technology in Indonesia, it is expected that its application will continue to increase and provide greater benefits to the government and society as a whole.

### **Application of AI in education**

The application of artificial intelligence (AI) in education in Indonesia has great potential to bring positive development. In Indonesia, education is one of the growing sectors, and the use of AI technology can be a catalyst for improving the quality and accessibility of education. To drive wider adoption of AI technologies in education, it is important to emphasize their tangible benefits and excellence in teaching, with a view to promoting broader utilization of AI in digitized instruction (Ma & Lei, 2024).

The application of artificial intelligence (AI) in education in Indonesia brings significant personalized learning benefits. In the context of education in Indonesia, AI allows students to have a learning experience that is more tailored to their needs. AI can analyze data about each student, including their learning abilities and preferences. Based on this information, AI can devise appropriate lesson plans, provide the right material, appropriate level of difficulty, and even the most effective teaching method for each student.

Application in the context of vocational education, AI is used to personalize learning for each learner. AI systems help in creating custom learning profiles such as practicums for each learner, which allows learning materials to be tailored to the learners' individual abilities, learning styles, and experiences (Wahyudi & Hidayat, 2023).

This is very important considering the diversity of students' levels of understanding in Indonesia. Students with different backgrounds and potentials can feel more comfortable and motivated in a personalized learning environment. In addition, personalized learning through AI can also help overcome challenges in remote teaching, which is increasingly becoming the norm in pandemic situations. AI can help teachers and schools provide a more interactive and relevant approach to learning, so students stay engaged and excited about learning, even from home.

The application of artificial intelligence (AI) technology in Indonesia has great potential in improving the quality of teachers. AI can reduce administrative tasks that typically take up teachers' time, such as reporting and grading, so they can focus more on substantial teaching. In addition, AI also allows teachers to monitor student progress more efficiently. With sophisticated data analysis, AI can provide insights into students' individual development, identify areas of special concern, and even provide better teaching recommendations. This not only helps teachers provide a better education, but also provides better support to each student, improving their learning outcomes.

In addition, AI is also used to create educational content that is more interactive and interesting for students. This includes the creation of learning materials tailored to individual needs, the creation of adaptive exams, and the development of innovative online learning platforms. With the help of AI, learning materials can be tailored to each student's level of understanding and learning style, making their learning experience more effective. AI-generated exams can more accurately assess students' progress, provide useful feedback, and design challenges that fit their skill level.

### **Diffusion of AI Technology Innovation**

In the context of the diffusion of AI technology innovation, there are four key factors that play an important role in understanding how this technology can be spread and adopted more effectively. The four factors include: time, communication channels and social systems (Littlejohn, 2017). Time is a key element in the diffusion of AI technology. The process of deploying and adopting this technology takes a certain amount

of time. The rate of adoption will depend on the extent to which the AI technology has been accepted by the community or organization. AI technology characteristics such as advantages compared to other technologies, compatibility with existing infrastructure and processes, and the level of complexity of the technology will affect the adoption rate. AI technologies that are easier to understand and integrate will be more quickly adopted. Effective communication channels are essential in the diffusion of AI technology. Clear and easily accessible information about this technology can speed up the process of its deployment. Good communication can help educate potential adopters about the benefits and potential of AI technology. Social systems in the context of the diffusion of AI technology include factors such as social, cultural, and community norms that influence the acceptance of this technology. When AI technology is well integrated in existing social systems, adoption will be smoother.

In adopting AI technology, individuals or organizations will consider the characteristics of the technology, the extent to which this technology fits their needs, how information about this technology is conveyed, and how this technology will interact with their social environment. All of these factors will affect the rate and speed of adoption of AI technology in a variety of contexts.

## **METHODS**

This research uses a qualitative descriptive approach, which allows researchers to understand in depth the qualitative aspects of the diffusion of *Artificial Intelligence* (AI)-based learning innovations at MTS Muhammadiyah Tawang Sari. Researchers combine quantitative data with in-depth interviews to gain a more comprehensive understanding. Quantitative data is obtained through surveys, which are used to measure the level of acceptance and utilization of AI technology in the learning process.

In the first stage, researchers used an online questionnaire distributed to 20 active teachers at MTS Tawang Sari to get an overview of the use of AI in learning. Then, researchers conducted in-depth online interviews with 4 guardian teachers, which helped researchers understand the diffusion process of innovation they had implemented. The description and analysis were conducted after observing the diffusion of these innovations at the individual level, so that researchers could provide a detailed understanding of how teachers adopt and utilize AI in learning at MTS Muhammadiyah Tawang Sari.

## **RESULTS AND DISCUSSION**

### **Diffusion of AI Technology-Based Learning Innovation**

The discussion on the application of innovation in AI-based learning will begin with the exploration of four key elements of innovation diffusion, as described in Innovation Diffusion theory by Everett Rogers and colleagues. This theory deeply examines various aspects related to change related to new ideas, technologies, and adaptation processes, as mentioned in research by Littlejohn (2017). Rogers linked the process of spreading innovation to social change, which involves stages of discovery, dissemination, and impact or consequence. In the context of this study, the social change being described is a shift from the usual learning methods and models carried out by teachers in normal times to technology-based learning. This kind of change can arise internally within the teacher's group, or arise in response to interactions with outside change agents. This interaction may occur suddenly or unplanned, or it may also be the result of planning carried out by outside parties such as educational institutions.

Before the presence of AI technology in learning, teachers at MTs Muhammadiyah Tawang Sari had made adjustments to online learning, both in full and hybrid forms, during the pandemic. They have made efforts to learn about various online learning platforms, apps, and technology tools to deliver course materials virtually. Teachers have also developed learning strategies that are appropriate to the online format, including the creation of digital learning content, the design of online assignments, and the adjustment of evaluation methods. Once they discover new methods in the teaching process, these teachers actively share their knowledge

and experience with their fellow teachers. This knowledge dissemination is carried out through various channels, such as discussions in online education forums, social media groups, virtual meetings, or trainings organized by governments or educational institutions. Teachers enthusiastically share advice, strategies, and learning resources to help their peers navigate the challenges of online learning.

Based on the classification of innovation adoption rates, teachers at MTs Tawang Sari can be classified as innovators or early adopters in facing change. The discussion on the diffusion of learning innovations based on AI technology will be analyzed through four main elements in the theory of innovation diffusion. This theory describes strategies to accelerate and increase effectiveness in disseminating and adopting innovations in the context of learning. These key elements include: 1) the time aspect; 2) the characteristics of the innovation itself; 3) the communication channels used; and 4) social dynamics in learning systems.

a. Time

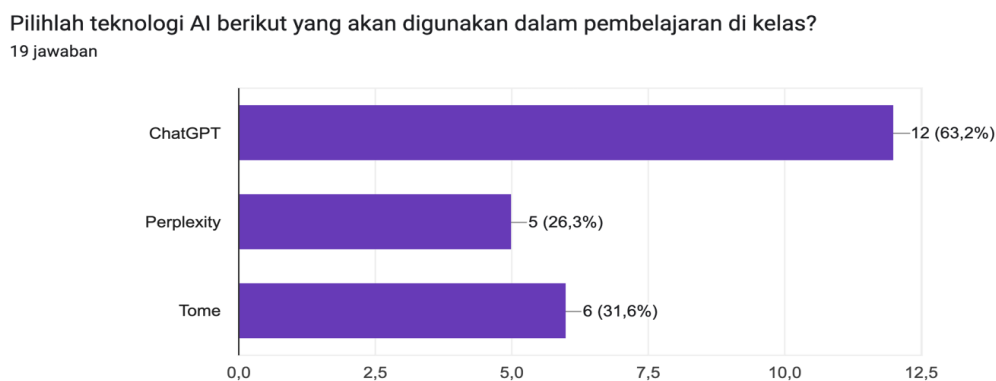
The time factor has a major role in the concept of diffusion of innovation. As emphasized by Rogers, the introduction of innovations takes a certain amount of time to spread, and the ultimate goal is to accelerate the adoption rate of those innovations (Littlejohn, 2017). In the context of learning, time becomes a critical element that has an impact on changes in learning habits. Changes in human behavior take time, and after two years of these changes taking place, significant social shifts occur, especially in the communication patterns involved in the learning process. One of the class VII teachers at MTs Muhammadiyah Tawang Sari underlined the importance of adopting innovation in learning. He stated, "The current different situation makes students feel bored with online learning that only focuses on delivering material to understand and assigning assignments. They become deprived of interest and enthusiasm for learning. Therefore, I have adapted to a variety of learning methods and models that focus more on students, not just curriculum fulfillment."

Along with the views expressed by his colleagues, a teacher who teaches class VIII gave the following response, "Today, both teachers and students have become more skilled in using technology. Adaptation and adjustment in learning includes integrating technology in the educational process. We cannot return to conventional learning patterns that were implemented before the pandemic because there has been significant progress in mastering technology, both by students and their parents. For example, students tend to be more interested in completing their assignments through online platforms than the traditional way with pen and paper books."

Overall, the spread of innovation in learning has experienced a significant acceleration, and the main factor influencing that acceleration is the emergencies faced. The decision to adopt learning innovations from the moment teachers become aware of them to finally deciding to implement them in their classrooms is in line with the demands resulting from widespread school closures and the implementation of learning from home programs. In other words, the pandemic situation has had a positive impact on the diffusion of learning innovation.

b. AI Technology-Based Learning Innovation

The level of acceptance or adoption of an innovation is strongly influenced by how individuals interpret the characteristics of the innovation. AI-based learning innovations, for example, can be adapted and changed according to students' conditions, potentials, and special needs. In an effort to integrate AI technology into learning, an approach that combines online and face-to-face learning may be a wise alternative, especially for teachers who face limited access and devices. In addition, in implementing these innovations, teachers have the flexibility to adapt them to the specific needs and dynamics in their learning environment.



**Figure 1: Ai technology that teachers use in the classroom**

According to research respondents, the innovations they made in AI-based learning included using chatgpt (63.2%), Perplexity (26.3%) and Tome (31.6%). Advances in learning innovation bring us to a point where we can dig deeper into the various options available. One approach that stands out is to think of ChatGPT as a learning tool that can help teachers move students' focus away from competition and assessment toward deeper collaboration and understanding. For example, a teacher in a programming subject may instruct students to cooperate with ChatGPT in the process of designing odd and even number algorithms. In this context, students can engage in discussions with ChatGPT about number calculation requirements, share ideas regarding the steps of creating algorithms, and critically consider the advantages and disadvantages of the various algorithms they design. ChatGPT, with its personalized and interactive features, enhances pedagogical innovation, academic integrity, and experiential engagement in the teaching-learning-assessment process (Kumar, et al, 2024).

Teachers can adopt various innovations in AI-based learning by adjusting existing innovative learning models according to the needs and challenges they face in the school environment. In a survey involving 20 teachers as respondents, as many as 60.87% of them stated that they were able to develop their creativity in the innovation process to overcome problems in schools. Furthermore, another 30.63% of teachers describe their innovation methods by seeking inspiration and best practices from existing innovative learning models and implementing them. Meanwhile, around 9.50% of teachers choose to innovate based on the guidance or training results they have participated in.

When talking about innovation, it is important to remember that perceptions of the novelty of innovation are subjective and can differ between individuals. For example, for a grade VII teacher, introducing interactive learning modules might be considered an interesting innovation in their teaching process. On the other hand, for other teachers, the use of such modules could be considered a routine step, and the novelty for them might lie in the use of tools such as Tome to improve the effectiveness of subject matter delivery. In the context of spreading innovations, the practice of sharing good practices from various innovative learning models through various communication channels is one of the ways used by innovator teachers to introduce these innovations to other fellow teachers who may also be interested in adopting similar innovations.

#### c. Communication Channel

Communication is a key aspect in the third element in the diffusion model of innovation proposed by Everett Rogers. In the context of diffusion, it is important to understand that the exchange of information between individuals is the primary means of conveying and promoting new ideas with the aim that others are interested or willing to adopt the innovation. The selection of the type of communication channel used can have a significant impact on the effectiveness of information exchange, therefore, the selection and

use of such channels needs to be done carefully (Rusmiarti, 2015). Rogers stated that this communication channel includes interaction between personas and mass media, but along with development, social media is also recognized as one of the effective tools in the process of diffusion of innovation (Littlejohn, 2017). In addition, a proven effective strategy is to combine the use of formal communication channels with informal communication channels in an organizational context, as this can increase the dissemination of information and stimulate other groups to accept innovation (Rusmiarti, 2015).

Teachers are adopting various channels of interpersonal communication as they seek to introduce innovation in learning. They involve a variety of methods, such as giving talks, holding dialogues, and demonstrating the good practices of learning they have applied. The process of delivering innovations occurs during formal meetings during socialization, but is not limited to there, some of which also continue to more in-depth discussions outside the event through informal face-to-face meetings, messages on private WhatsApp, or even through telephone conversations. Overall, teachers are adopting various types of communication channels that include both formal activities and informal interactions to disseminate best practices in the use of AI technology in the classroom learning process.

d. Social System

The application and adaptation of AI in learning in schools requires a mutually supportive social system between principals, teachers, and students. It is based on the understanding that technological innovation, including AI, is not only a technical challenge but also a social and organizational challenge.

1. *The Principal's Role as a Change Leader*: The principal plays a key role as a change leader in creating a vision of AI-powered learning innovation. According to Fullan (2015) in "*The New Meaning of Educational Change*", effective principals are those who can inspire, motivate, and support teachers and staff in implementing change. They are instrumental in creating a school culture that encourages the exploration and adoption of innovation.
2. *Teacher Capacity Building*: Teachers are the main implementers of learning innovations in the classroom. Capacity building through ongoing professional training and support in the use of AI is essential. Ertmer and Ottenbreit-Leftwich (2010) emphasize that teachers need technical, pedagogical, and content knowledge as well as confidence in using technology for effective integration in learning.
3. *Engaging Students as Beneficiaries*: Students are key beneficiaries of AI-powered learning innovations. Active participation of students in the learning process, including providing feedback on the use of technology, is very important. Thus, a student-centered approach should be an integral part of implementing AI, as explained by Duffy et al. (1992) in "*Constructivism and the Technology of Instruction: A Conversation*".
4. *Cooperation and Collaboration*: The application of AI in schools requires collaboration among all stakeholders. This includes not only principals, teachers, and students, but also parents, communities, and outsiders such as technology developers and research institutes. This collaboration can strengthen social support and ensure that AI adoption meets actual learning needs and is effectively integrated into the curriculum.
5. *Policy Development and Infrastructure Support*: The application of AI requires supportive school policies and adequate technology infrastructure. This includes access to devices and resources, data security, and privacy. This support enables teachers and students to use AI in a safe and responsible way.

Fundamentally, the successful integration of AI in education depends on social and organizational factors, not just on the technology itself. Creating an environment conducive to innovation, where all stakeholders are engaged and supportive, is key to maximizing the benefits of AI in education. Digital technology has a real impact on all aspects of higher education if supported by institutions. Organizations play a crucial role in the integration of digital technologies into teaching and learning (Lakshmi, et al, 2023). The potential for AI to improve learning, teaching, and assessment in education is very open, but it is also important to highlight thoughtful and principled approaches to adopting these technologies, as well as the social implications of their use in educational contexts (Koh & Doroudi, 2023)



## CONCLUSION

Most teachers have successfully adopted AI technology innovations in their learning context and utilized them effectively for various purposes. AI technologies, such as ChatGPT, Perplexity, and Tome, have helped teachers in implementing more effective learning processes. Teachers' innovation efforts involve adapting and modifying existing learning models as well as experimenting with new approaches to address learning challenges that arise in their classrooms. This adaptation and modification process needs to consider factors such as limited time, facilities, place, and habit changes induced by pandemic conditions.

In spreading their innovations, teachers have used various interpersonal communication channels, including being resource persons in socialization and training events both at the internal and external levels. Support from school principals has played an important role in facilitating the diffusion of learning innovations carried out by teachers. The success of this innovation can be seen from the level of student participation, their level of activity, creating a pleasant learning atmosphere, and achieving the expected level of learning completeness.

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