

## IMPLEMENTATION OF EXPERT SYSTEMS IN MAPPING THE LEARNING STYLES OF HIGH SCHOOL STUDENTS

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### ABSTRAK

Penelitian ini bertujuan untuk memetakan gaya belajar siswa SMA Negeri 2 Lasalimu Selatan menggunakan sistem pakar. Metode yang digunakan dalam penelitian ini adalah pendekatan kuantitatif, dengan pengumpulan data melalui kuesioner gaya belajar yang diisi oleh siswa. Sampel penelitian berjumlah 160 siswa dari kelas X dan XI, dengan analisis data menggunakan rumus persentase untuk menganalisis distribusi gaya belajar berdasarkan jenjang kelas, kelas, dan usia. Hasil penelitian menunjukkan bahwa pada kelas X, gaya belajar visual mendominasi (42%), sedangkan pada kelas XI, gaya belajar auditori lebih dominan (45%). Gaya belajar kinestetik masih berada pada persentase yang rendah pada kedua kelas tersebut. Berdasarkan hasil penelitian tersebut, disarankan kepada guru untuk merancang pendekatan pembelajaran yang mengakomodasi gaya belajar visual dan auditori, dengan tetap memperhatikan siswa dengan gaya belajar kinestetik, meskipun persentasenya rendah. Pembelajaran yang lebih personal berdasarkan gaya belajar siswa diharapkan dapat meningkatkan efektivitas proses pembelajaran dan prestasi akademik siswa.

Kata Kunci: *Auditori, Sistem Pakar, Kinestetik, Gaya Belajar, Visual.*

### ABSTRACT

This study aims to map the learning styles of students at SMA Negeri 2 Lasalimu Selatan using an expert system. The method used in this research is a quantitative approach, with data collected through a learning style questionnaire filled out by the students. The sample consists of 160 students from grades X and XI, with data analysis using percentage formulas to analyze the distribution of learning styles based on grade level, classroom, and age. The results show that in grade X, the visual learning style dominates (42%), while in grade XI, the auditory learning style is more dominant (45%). The kinesthetic learning style remains at a low percentage in both grades. Based on these results, it is recommended that teachers design learning approaches that accommodate visual and auditory learning styles, while also paying attention to students with kinesthetic learning styles, even though their percentage is low. More personalized learning based on students' learning styles is expected to improve the effectiveness of the learning process and students' academic achievements.

**Kata Kunci:** *Auditory, Expert Systems, Kinesthetic, Learning Style, Visual.*

### INTRODUCTION

Each student has unique characteristics in the way they learn, known as learning styles. These learning styles significantly influence the process of delivering and receiving information, as well as the outcomes achieved in the learning activities (Razali et al., 2023; Riad et al., 2023). For example, some students find it easier to understand material through visualization, while others absorb information better through hearing or physical activity. The variation in learning styles often presents a challenge for educators, especially when designing effective lessons that cater to all students in the classroom (Fernando & Premadasa, 2024; Rashad Sayed et al., 2024).

In SMA Negeri 2 Lasalimu Selatan, this challenge is increasingly felt due to the diversity of student characteristics. Additionally, many teachers still use conventional teaching methods, which tend to be uniform and do not take into account the differences in learning styles among students. As a result, even though the lesson material is delivered effectively, not all students can absorb the information in the same way, which in turn can affect their understanding and learning outcomes. Therefore, it is crucial to better understand the students' learning styles in greater depth so that the learning process can be designed to meet each student's individual needs (Manipuspika, 2020; Marosan et al., 2022).

One approach that can help address this issue is by utilizing information technology, particularly in the form of expert systems. An expert system is an artificial intelligence-based tool that can be used to analyze and provide recommendations based on existing data (Inusah et al., 2023; Syed Naseer Ahmed et al., 2023; Velez et al., 2023). In the context of education, expert systems can be used to map students' learning styles in a more objective and structured manner (Bradáč et al., 2022; Supriyanto et al., 2018). Based on the results of this mapping, teachers can design lessons that are more aligned with students' learning styles, which in turn can enhance the effectiveness of the learning process and improve students' academic performance.

Previous studies have highlighted the importance of mapping learning styles in the context of education. For example, a study by (Arimbi et al., 2021) stated that using methods aligned with students' learning styles can improve their academic performance. Similarly, a study by (Rahman et al., 2019) revealed how technology can support the analysis of students' learning styles, including through the use of expert systems that enable personalized learning. However, the implementation of such technology in schools in resource-limited areas, such as SMA Negeri 2 Lasalimu Selatan, remains minimal.

This study aims to implement an expert system to map the learning styles of students at SMA Negeri 2 Lasalimu Selatan. By utilizing data obtained from learning style tests, this expert system can provide a more accurate and detailed mapping of students' learning styles. The results of this mapping will provide useful information for teachers in designing more effective and personalized teaching approaches, which can be tailored to each student's learning style. This is expected to create a more inclusive learning experience and help students learn in the way that suits them best. This research is also closely related to the achievement of the Sustainable Development Goals (SDGs), particularly Goal 4, which is "Quality Education." The implementation of an expert system in mapping students' learning styles in high schools can support the achievement of inclusive, equitable, and quality education.

## **METHOD**

This study applies a quantitative approach to achieve its objectives. The quantitative approach was specifically chosen with the intention of mapping the percentage of students' learning styles at SMA Negeri 2 Lasalimu Selatan. This mapping will be classified based on several variables, namely class level, specific classroom, and the age of each student involved. The use of this method allows for systematic collection and analysis of numerical data related to learning style preferences.

The participants involved in this study were 160 students, all of whom came from SMA Negeri 2 Lasalimu Selatan. The sample was taken from students in grade X and grade XI, in order to obtain a representative picture of the two levels. The involvement of students from these two grade levels is expected to provide adequate data variation for analysis. This participant selection was carried out to ensure that the data collected is relevant to the focus of the study.

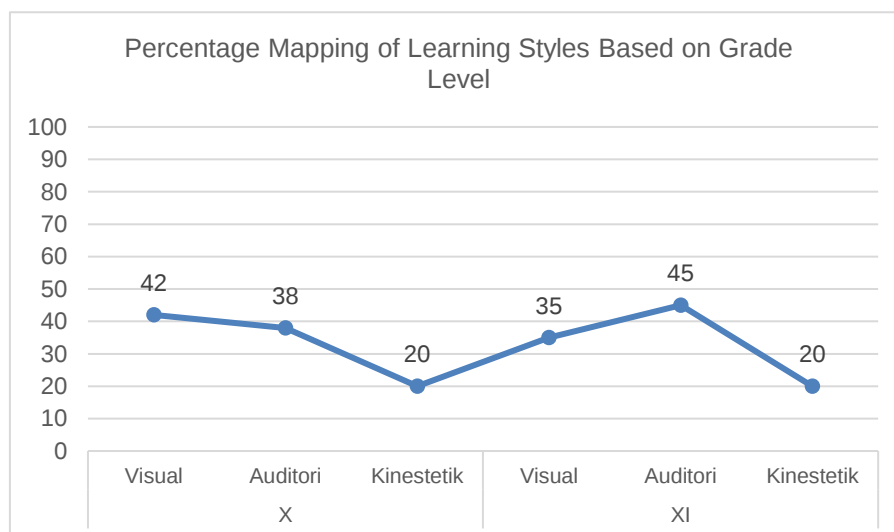
The main instrument used for the data collection process is a learning style identification expert system. This expert system is designed to be accessed online by students through the website address sipagabel.com. Each student is directed to use the system to find out and confirm their individual learning style type. Numerical data resulting from the identification of learning styles from each student is then collected through the platform as a basis for percentage analysis.

## RESULTS AND DISCUSSION

Results Based on the implementation results of the system at SMA Negeri 2 Lasalimu Selatan, the data on students' learning style mapping is presented as follows:

### 1. Mapping of Learning Styles According to Grade Level

This section outlines the mapping of students' learning styles based on grade level, with a sample from grades X and XI at SMA Negeri 2 Lasalimu Selatan, totaling 160 students. The data on learning style mapping is presented in Figure 1:



**Figure 1. Mapping of Learning Styles Based on Grade Level**

Based on Figure 1, there is a difference in the distribution of learning styles between students in grades X and XI. In grade X, the visual learning style is the most dominant, with 42%, followed by the auditory learning style at 38%, and the kinesthetic learning style, which is the lowest at 20%. This data indicates that the majority of grade X students rely more on visual-based materials such as images, diagrams, and text in their learning process. These findings align with other research that suggests the dominant learning style for grade X students is visual (Bernal et al., 2024; Kartina & Afriansyah, 2024).

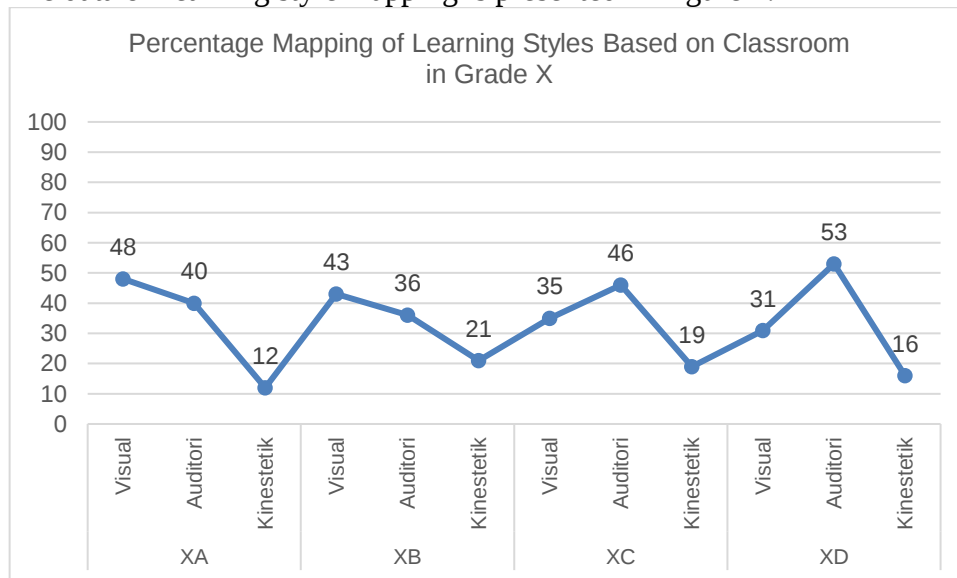
Meanwhile, in grade XI, there is a slight change in the pattern. The auditory learning style increased to 45%, surpassing the visual learning style, which dropped to 35%. The kinesthetic learning style remained at 20%, showing no change compared to grade X. This shift indicates that grade XI students tend to feel more comfortable learning through listening methods, such as discussions, lectures, or audio recordings, compared to grade X students (Himmah & Nugraheni, 2023; Kadir et al., 2020).

In general, there is a shift in learning style preferences from visual to auditory as the grade level increases, although the difference is not very significant. Meanwhile, the kinesthetic learning style remains the lowest in both grade levels, indicating that learning methods based on physical activity or hands-on practice are less preferred by students. These findings can serve as a guide for teachers in designing lesson plans. In grade X, a visual-based approach may be more effective, while in grade XI, methods involving auditory aspects, such as interactive

lectures and group discussions, can be further optimized. Additionally, since the kinesthetic learning style remains low, it is important to find ways to accommodate students with this preference in the learning process.

## 2. Mapping of Learning Styles According to Classroom in Grade X

The grade X classrooms are divided into XA, XB, XC, dan XD with a total of 96 students. The data on learning style mapping is presented in Figure 2:



**Figure 2. Mapping of Learning Styles Based on Classroom in Grade X**

Based on the data displayed in Figure 2, there is a variation in learning styles in each classroom, reflecting students' preferences in absorbing information. In class XA, the majority of students have a visual learning style, with 48%, followed by the auditory learning style at 40%, while the kinesthetic learning style reaches only 12%. This indicates that most students in this class find it easier to understand the material through images, diagrams, or written text rather than listening or engaging in physical activities.

Next, in class XB, a similar pattern is observed, with the visual learning style still dominant at 43%, followed by auditory at 36%, and kinesthetic at 21%. However, there is a slight increase in the percentage of kinesthetic learning style compared to class XA, indicating that more students in this class rely on hands-on experience or physical activities in their learning process.

In class XC, a shift occurs where the auditory learning style becomes more dominant, with 46%, surpassing the visual learning style at only 35%. Meanwhile, the kinesthetic learning style remains low at 19%. This indicates that students in class XC are more accustomed to learning through listening, such as by listening to the teacher's explanations or participating in group discussions.

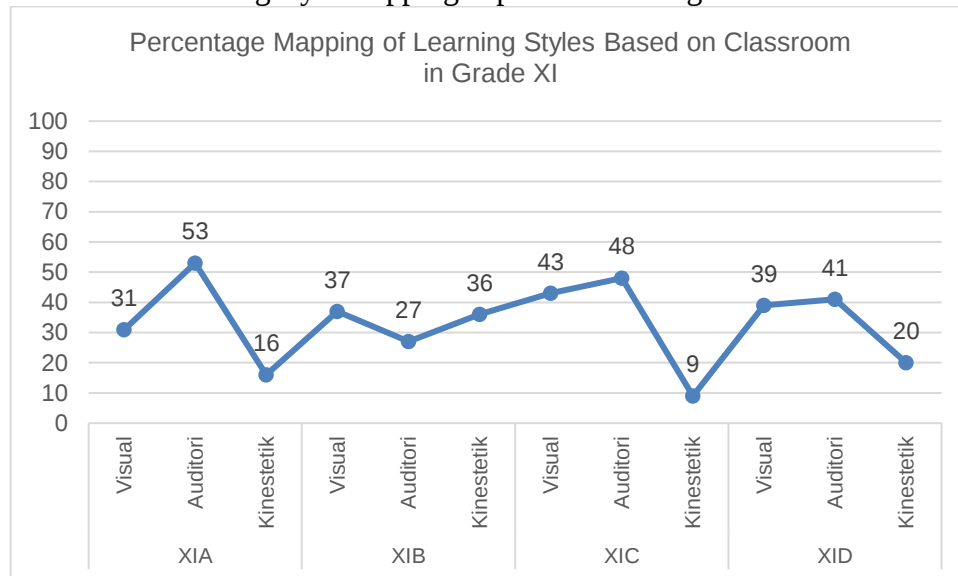
A more significant difference is observed in class XD, where the auditory learning style becomes the most dominant among all classes, with 53%, followed by the visual learning style at 31%, and the kinesthetic learning style, the lowest in this class, at 16%. From this data, it can be concluded that students in class XD rely more on sound and verbal explanations to understand the lesson material.

Overall, the data shows that visual and auditory learning styles are more dominant in each class, while kinesthetic learning style tends to be lower. Classes XA and XB have more students with a visual learning style, while classes XC and XD tend to be more dominant in the auditory learning style. This can be a consideration for educators when designing lessons, for example, by balancing the use of visual media and auditory techniques such as lectures or

discussions. Meanwhile, students with kinesthetic learning styles should also be facilitated with more interactive activities to help them understand the material better.

### 3. Mapping of Learning Styles According to Classroom in Grade XI

The grade XI classrooms are divided into XIA, XIB, XIC, and XID, with a total of 64 students. The data on learning style mapping is presented in Figure 3:



**Figure 3. Mapping Learning Styles Based on Class XI Classroom**

Based on the data presented in Figure 3, there is a variation in learning style patterns across each grade XI class, namely XIA, XIB, XIC, and XID. In class XIA, the most dominant learning style is auditory, with a percentage of 53%, indicating that the majority of students are more comfortable receiving information through listening methods, such as lectures or discussions. Meanwhile, the visual learning style has a percentage of 31%, which shows that a considerable number of students prefer understanding the material through images, diagrams, or written text. In contrast, the kinesthetic learning style in this class is the lowest, at 16%, meaning that only a few students are more comfortable learning through physical activities or hands-on practice.

In contrast to class XIA, class XIB shows a more balanced distribution of learning styles. The visual learning style is at 37%, followed by auditory at 27%, and kinesthetic at 36%. The higher percentage of kinesthetic learning style in this class indicates that more students are active in learning through hands-on practice, compared to class XIA.

In class XIC, the dominant learning style shifts again, with auditory becoming the most prominent at 48%, followed by visual at 43%. However, unlike the other classes, the kinesthetic learning style in this class has the lowest percentage among all grade XI classes, at only 9%. This indicates that only a few students are comfortable with learning methods based on hands-on activities, while the majority prefer learning through listening or viewing.

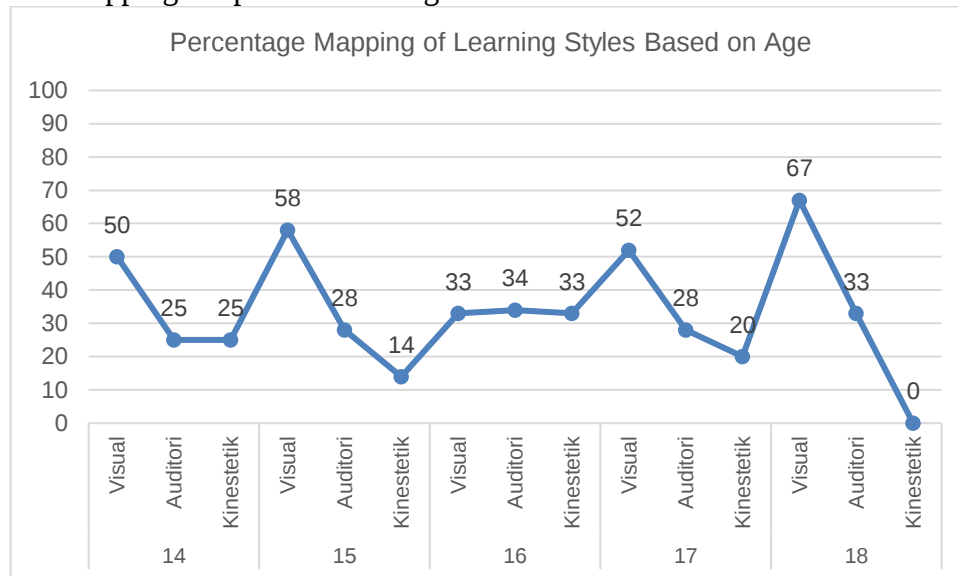
Finally, in class XID, there is a balance between the visual and auditory learning styles, with percentages of 39% and 41%, respectively. This shows that there is no significant dominance between the two learning styles, so the most effective teaching methods for this class should ideally combine both visual and auditory elements proportionally. Meanwhile, the kinesthetic learning style in this class is at 20%, which is higher compared to class XIC but still lower than in class XIB.

Overall, these findings indicate that the auditory learning style tends to be more dominant in grade XI, especially in classes XIA and XIC. Meanwhile, the visual learning style

remains relatively high across all classes, while the kinesthetic learning style shows considerable variation, with the highest percentage in class XIB and the lowest in class XIC.

#### 4. Mapping of Learning Styles Based on Age

The mapping of learning styles based on students' age is reviewed for ages 14-18. The results of this mapping are presented in Figure 4.



**Figure 4. Mapping of Learning Styles Based on Age**

This figure shows the distribution of learning style percentages based on age, categorized into visual, auditory, and kinesthetic styles. At age 14, the visual learning style dominates with 50%, while auditory and kinesthetic styles are at lower percentages, 25% each. As age increases, the percentage of visual learning style rises, reaching 58% at age 15. However, it then decreases at age 16 to 33%, before rising again at age 17 to 52%. The peak occurs at age 18, where the visual learning style reaches 67%, indicating that as individuals grow older, more tend to prefer visual learning methods.

Meanwhile, the auditory learning style remains relatively stable, ranging from 25% to 34%. At ages 14 and 15, the percentages are almost identical, 25% and 28%, respectively. Then, at age 16, there is a slight increase to 34%, which remains until age 17 at 33%. At age 18, the auditory learning style percentage slightly decreases to 33%. This shows that auditory learning methods do not undergo significant changes as age increases and remain a preference for some individuals in this age range.

On the other hand, the kinesthetic learning style shows significant fluctuations. At age 14, its percentage is the same as auditory, at 25%, but it drastically drops to 14% at age 15. It then increases again at ages 16 and 17 to 33%, indicating a larger preference for movement-based or hands-on learning at this age. However, at age 18, there is a sharp decline to 0%, signaling that individuals at this age tend to move away from hands-on learning methods and switch to more visual or auditory approaches.

Overall, this graph shows that the visual learning style becomes increasingly dominant as age increases, while the auditory learning style remains relatively stable with no significant changes. In contrast, the kinesthetic learning style experiences a drastic decline towards age 18, which may indicate a shift in preferences in how individuals acquire and understand information as they transition into adulthood.

#### Discussion

Learning style mapping is an effort to identify and understand the ways in which students learn effectively (Shamsuddin & Kaur, 2020; Wardhani & Sartika, 2024). Each student has a tendency to learn in different ways, and learning style mapping aims to explore individual learning styles, which may include visual, auditory, or kinesthetic styles.

Learning style mapping becomes crucial because some students may find it easier to understand material by looking at images or diagrams, while others might feel more comfortable with verbal explanations or hands-on interaction (Susanti et al., 2024). By understanding students' learning styles, teachers can design more effective lessons, enhance student engagement, and accelerate the understanding process (Inayat & Ali, 2020). Learning style mapping helps create an inclusive and adaptive learning environment, where each student can develop according to their unique potential.

Referring to the findings of this study, visual learning style is the most dominant among students. Visual learning style refers to students' preference for learning material through sight. Students with this learning style find it easier to understand information presented in the form of images, graphs, diagrams, or videos. They tend to remember visual information more quickly than information presented only verbally. Teaching strategies that are suitable for visual learners can include the use of visual materials such as presentations, diagrams, or mind maps, which can help students organize information in a way that is easier to digest (Mahmood et al., 2024; Vadlamannati, 2023).

The auditory learning style tends to be stable among students at SMA Negeri 2 Lasalimu Selatan. Auditory learning style refers to students' preference for receiving information through hearing. Students with this learning style find it easier to understand material presented verbally, whether through lectures, discussions, or podcasts (Brilliant Albar & Sari, 2021; Kenna, 2023; Sati et al., 2024). They are also more skilled at remembering information presented in the form of sound or words. To support the auditory learning style, teachers can use methods such as lectures, group discussions, audio recordings, or music, which can help students focus and better understand the material (Masela & Subekti, 2021).

On the other hand, the findings of this study show that only a few students have a kinesthetic learning style. Nevertheless, teachers should still design lessons that can accommodate students with a kinesthetic learning style. Kinesthetic learning style refers to the way students learn through physical movement or activities that involve motor skills (Vadlamannati, 2023; Velez et al., 2023). Students with this style find it easier to understand concepts when they can engage directly with objects or participate in activities that involve their body (Ishartono et al., 2021). They typically prefer learning that involves experiments, role-playing, or outdoor activities (Dimastoro et al., 2022; Vokić & Aleksić, 2020).

Kinesthetic learning strategies involve engaging students through hands-on practice, simulations, and activities that require manipulating tools or materials, allowing learners to gain knowledge through direct physical experience. These approaches enable students to interact actively with the subject matter, which enhances their understanding and improves memory retention. Incorporating movement-based activities such as gallery walks or interactive demonstrations also addresses the natural need of kinesthetic learners for physical engagement. By doing so, students remain more focused and motivated throughout the learning process, making it easier for them to grasp complex ideas.

Additionally, providing opportunities for students to build models or conduct real-world investigations helps make abstract concepts more concrete and relatable. These tactile and experiential learning experiences encourage deeper cognitive processing and critical thinking skills. When educators diversify their teaching methods to include kinesthetic elements, they create a more inclusive classroom environment that supports varied learning styles. This

inclusive approach not only benefits kinesthetic learners but also enriches the overall educational experience for all students.

## CONCLUSION

This study aims to map the learning styles of students at SMA Negeri 2 Lasalimu Selatan using an expert system. Based on the results of the research, it was found that the visual learning style dominates among grade X students, while the auditory learning style is more dominant among grade XI students. Additionally, a shift in learning style preferences from visual to auditory was observed as the grade level increased, while the kinesthetic learning style remained low in both grades. These findings provide valuable insights for teachers in designing more effective and personalized teaching approaches according to each student's learning style. Based on the research findings, it is recommended that teachers at SMA Negeri 2 Lasalimu Selatan design more flexible and diverse lessons, adjusting teaching approaches based on students' learning styles. Teachers can use more visual media for students who tend to learn visually and more auditory techniques, such as lectures and discussions, for students who are dominant in the auditory learning style. Moreover, even though the kinesthetic learning style is not very dominant, it is important to still pay attention to students with this learning style by providing activities that involve physical movement or hands-on practice. Further research could be conducted by involving more variables and samples from various schools to gain deeper insights into the shift in learning styles across different education levels.

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