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Article

Development of Science Educational Poster Based on Ethnosocio-Technological Gong Art for Vibration and Wave Materials

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ABSTRACT

Contextual and meaningful science learning remains a challenge in making abstract concepts relevant to students' lives. This study aims to develop a science educational poster based on ethnosociotechnology by integrating the local cultural values of gong art as a learning medium for vibration and wave materials. The research employed a 3D development model (Define, Design, and Develop) using validation sheets to assess the aspects of display, content, and function. Two expert validators participated in the validation process. The results showed that the poster achieved a feasibility percentage of 92.5%, categorized as "very feasible." The poster features attractive visual design and an interactive barcode leading to digital educational games, which enhance students' engagement and comprehension. The integration of local culture with scientific concepts encourages students to connect classroom learning with real-life contexts, fostering scientific literacy and cultural appreciation. Limited trials on students also showed positive responses (91.3%) toward the poster's appearance, readability, and relevance. Therefore, the ethnosociotechnology-based educational poster is considered effective as a contextual and meaningful learning medium for science education. Future research is recommended to involve wider implementation and optimization of its digital features.

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INTRODUCTION

Natural Science (IPA) learning has a strategy role in shaping students' science literacy. However, in practice, science learning is often abstract and less contextual, making it difficult for students to relate science concepts to everyday life (Winangun, 2022). To answer these challenges, a contextual approach is a relevant alternative because it emphasizes the relationship between the subject matter and the social and cultural environment of students (Arsyad, 1997).

One innovative approach that can strengthen contextual learning is ethnosociotechnology, which is the integration of local knowledge, socio-cultural values, and technology in the learning process. This approach not only enriches the learning content, but also shapes the character of students who appreciate the surrounding culture and environment (Parmin & Fibriana, 2019). In the context of Indonesia, which is rich in local culture, traditional arts such as Gong have great potential as a source of science learning. The sound produced by the gong can be studied from the aspects of vibration, frequency, and resonance,

so that it becomes an effective medium to explain the concept of sound waves in a contextual manner (Rahmila et al. , 2022).

Science learning in schools still faces various obstacles , such as teaching materials that are less contextual , the lack of learning media that elevates local wisdom, and low student motivation to learn (Dauly et al. , 2023). Teachers tend to use lecture methods and visual media that are not relevant to the students environment , so that learning becomes less meaningful and does not arouse curiosity .

Based on this background , this research aims to develop an educational poster of science based on ethnosocio-technology of gong art as a learning medium on vibration and wave materials . This poster is designed so that students can relate the concept of science to local cultural phenomena , so that learning becomes more interesting , meaningful , and builds contextual science literacy . The poster media is suitable for use in the STEAM and contextual learning approach , because it relates science to the social and cultural context of students .

The formulation of the problem in this study is how the process of developing educational poster media based on ethnosocio-technology , and the extent to which the media is effective in improving students ' understanding of vibration and wave materials . The purpose of the research is to produce valid, practical , and effective learning media, as well as increase student involvement in science learning .

The novelty of this research lies in the use of gong art as a cultural context in the development of science poster media, which has not been studied much before . This research also incorporates an ethnosociotechnological approach explicitly in the design of learning media, thereby making a new contribution to the development of teaching materials based on local wisdom combined with science education .

METHOD

This research uses a type of development research (Research & Development) with the main objective to produce learning media in the form of educational posters based on ethnosociotechnological , namely the combination of local knowledge, cultural values, and learning technology in the context of science. The development design applied is a 3D model consisting of three systematic stages, namely the definition stage (define), design (design), and development (develop). In the definition stage, identification of science learning problems in schools is carried out. The design stage focuses on the initial design of poster media that integrates science concepts with local cultural elements in the form of gong art, including visual selection, scientific content, and cultural relevance. Meanwhile, in the development stage, the poster media that has been designed is refined into a final product through a process of validation, revision, and limited trials.

The subjects in this study included instrument validators , who were experts in science education, learning media, and ethnoscience . The validators assessed the feasibility and quality of the developed media, in terms of content, design, and integration of cultural values.

The research instruments used included a validation sheet designed to measure the quality of the posters in terms of science content, visual aspects, and ethnosociotechnological integration . Validation was processed in the form of numerical values with the highest validation score being 4 and the lowest validation score being 1. Then, the final score was calculated using the formula:

$$\text{Final Score} = \Sigma \text{Score Obtained} / \Sigma \text{Maximum Score}$$

The score that has been counted in accordance with formula the Then classified to in criteria very good , good , less , very less listed in the table Criteria Eligibility Learning Media Instruments . Data that has been collected made into become One Then discussed as description

eligibility from Development of Science- Based Educational Posters Ethnosociotechnology Gong Art for Vibration and Wave Material .

Table 1. Criteria Eligibility Learning Media Instruments :

Percentage	Criteria
78.84 - 100%	Very good/very decent
55.76 - 76.92%	Good/decent
32.69 -53.84%	Not good
0 - 30.76%	Very inadequate

RESULTS AND DISCUSSION

Product Description Poster Media

infographic poster titled “*GONG: Gong Paju Sounds, Science Swings, Ethnosociotechnology*” was developed as a printed learning aid that integrates Natural Science (IPA) materials with local wisdom values through an ethnosociotechnology approach . The poster is printed in color in a large size so it can be displayed in the classroom, making it easier for students to access information and increasing interest in learning through an attractive visual display. Poster learning media is a media that consists of very simple symbols or words, posters are also a visual combination of strong designs, with colors and messages with the aim of capturing the attention of students (Okra) en Novera 2019). Because posters serve as a medium and communication channel between students and teachers, they have the ability to foster student interest and provide a connection between the subject matter and the real world. The purpose of these posters is to avoid verbalism in the learning process (Yaszak , Ma'aruf , and Yennita 2015).



Figure 1. Infographic poster " GONG: Paju Gong Sounds, Natural Sciences Plays, Ethnosociotechnology "

With poster learning media can provide an interesting and effective learning atmosphere, in learning vibrations and waves with posters can be done inside or outside the classroom, with functions that can be adjusted to the needs either as a supplement (additional), complement (complementary), or substitution (replacement) for learning activities in the classroom that have been used so far. Such learning can provide its own pleasure for students, so that the material that is actually difficult becomes easy for students. Practical and innovative learning media is one of the main factors in achieving the success of learning objectives (Yusandika, Istihana , en Susilawati 2018)



Figure 2. Digital Educational Game Barcode Features

An interactive feature, the poster is equipped with a barcode (QR code) that directs students to a digital educational game. The game is used to measure students' understanding of the science material presented on the poster through a game -based assessment approach. assessment). The poster's contents are divided into six main sections. The explanation of gong vibrations shows that sound originates from the back and forth movement of an object, such as a metal gong vibrating when struck. The section on gong waves explains that vibrations travel through the air as sound waves until they reach the ear. The description of gong sounds explains the influence of the strength or weakness of a strike on the amplitude or loudness of the sound. In the science facts section, the gong is explained as a metal idiophone instrument that produces sound based on frequency, resonance, and the propagation medium. The other two sections present the cultural and social context, namely local wisdom that describes the gong's function in traditional ceremonies and as a symbol of spiritual communication, and social and scientific, which presents the gong as a social medium and object of scientific study in the fields of anthropology, musicology, and acoustics.

The poster supports the achievement of Phase D Science Learning Outcomes (CP) at the junior high school level, particularly in understanding the concept of sound as part of a mechanical wave that propagates through a medium and is utilized in everyday life. The material in the poster helps students explore the process of sound formation, its propagation through intermediary substances (solid, liquid, gas), and understand scientific concepts such as frequency, amplitude, and resonance contextually. The local cultural context in the form of the traditional gong musical instrument is used to link sound phenomena with local wisdom, so that learning becomes more meaningful, contextual, and interdisciplinary. Therefore, efforts to increase interest in learning are one of the keys to achieving science learning objectives, especially in the context of the Independent Curriculum which emphasizes meaningful and student-centered learning (Putu en Yuliandari 2025).

Ethnosociotechnology approach in the poster encourages student-centered learning, facilitates curiosity, and develops critical and reflective thinking skills. This poster is also useful in developing students' scientific literacy skills. Scientific literacy in question includes an understanding of science concepts and their relationship to cultural values and social realities. Thus, students are encouraged to think critically about social issues related to science in everyday life (Maskhanah, Lestari, and Dewi 2020). Through learning experiences that connect science and culture, students are trained not only to understand science concepts conceptually but also to cultivate the values of the Pancasila student profile, such as faith and devotion to God Almighty , global diversity , and creativity in presenting information. This ethnosociotechnology- based learning model provides space for students to realize the importance of preserving local culture as part of a sustainable life amidst the development of science. As stated by Sarwi et al. (2020), the ethnoscience approach in science learning is able to increase the relationship between scientific concepts and local cultural values that are meaningful for students.

Expert Validation Results

The ethnosociotechnology- based educational poster were presented by two validators with criteria of appearance, content and media material, and function and usefulness of the media, as presented in the following table.

Table 1. Summary of Poster Media Validation Test Results

Criteria	Validation Score 1	Validation Score 2	Total Score	Mean Value	Maximum score	Percentage (%)	Category
Appearance	19	19	38	19	20	95%	Very Worthy
Media Content and Material	19	18	37	18.5	20	92.5%	Very Worthy
Functions and Benefits of Media	18	18	36	18	20	90%	Very Worthy
Total Score	56	55	111	55.5	60	92.5%	Very Worthy

Based on the results of the validation test of the learning media in the form of posters involving two validators , a total overall score of 111 was obtained out of a maximum score of 120. The average value obtained was 55.5 with a feasibility percentage of 92.5%. These results indicate that the poster media is included in the "Very Feasible" category for use as a learning medium.

The assessment was based on three main aspects: appearance, media content and material, and media function and usefulness . In the appearance aspect, the media obtained a total score of 38 out of a maximum score of 40, with an average score of 19 and a percentage of suitability of 95%. These results indicate that the poster's appearance was considered very good in terms of aesthetics, readability, and visual appeal. Furthermore, in the content and media material aspect, the poster obtained a score of 37 with an average of 18.5 and a percentage of 92.5%. This indicates that the material presented was quite relevant to the learning objectives and was in accordance with the topic raised. Meanwhile, in the function and usefulness aspect of the media, the poster obtained a score of 36 out of a maximum of 40, with an average score of 18 and a percentage of 90%. This indicates that the media was considered very useful and supported the learning process effectively.

Overall, these three aspects indicate that the poster media meets high eligibility criteria. However, to maximize its application, several improvements need to be made based on input and suggestions from the validators , which are further detailed in the following section.

Table 2. Validator's Criticism and Suggestions

Aspect	Criticism and suggestions
Validation 1	1. The visualization should show a person striking a gong or a visualization of vibrations and waves on a gong. 2. The material would be better if it was supplemented with related physics formulas.
Validation 2	1. Double check the spelling and punctuation. 2. Reduce the reading text so that it is not too dense like an article. 3. Just add more pictures and important points.

The table above contains the criticisms and suggestions provided by two validators after evaluating the poster media. The first validator emphasized visual and material reinforcement. It was recommended that visualizations more concretely illustrate physics concepts, such as showing a person striking a gong or illustrations of waves and vibrations. Furthermore, the addition of physics formulas was deemed essential to enhance the material's scientific validity.

Meanwhile, the second validator highlighted the linguistic aspects and information presentation. It was recommended that spelling and punctuation be rechecked in accordance with Indonesian language rules. The text should also be simplified to avoid being too dense and resembling a scientific article. Furthermore, using more images and presenting key points concisely would make the poster more engaging and easier for students to understand. The criticism and suggestions from both validators were very useful in refining the poster before it was used in the learning process.

The learning poster with the theme “Gong Paju Berbenyi, Ilmu PA Mengalun” is designed to combine basic concepts in physics, particularly regarding sound, with elements of local culture that have social and traditional values. The material presented includes a discussion of the origin of sound produced by vibrations, how sound waves propagate through a medium, and sound characteristics such as frequency, amplitude, and resonance. All of this content is delivered contextually through real objects in the form of gong musical instruments, thus helping students to understand the concepts concretely. The integration of the ethnosociotechnology concept is evident in the way the material is presented, which not only focuses on scientific aspects but also touches on social and cultural dimensions. This poster does not simply explain scientific facts but also introduces the role of gongs in people's lives, both as musical instruments and as symbols in various traditions. This reflects the ethnosociotechnology approach, namely the unification of local knowledge, modern science, and the social reality around students. In addition, the presence of an interactive barcode on the poster provides students with access to educational games that function as light evaluation tools. These games are designed to measure the extent to which students understand the material presented in the poster. This feature enriches the learning process by enabling active, independent, and enjoyable learning. Thus, posters serve not only as visual media but also as a bridge between print and digital learning.

The gong, the main object in the poster, highlights various cultural values relevant to be introduced in a learning context. This traditional instrument serves not only as a musical instrument but also has social and spiritual functions in the lives of people in various regions of Indonesia. The use of gongs in traditional ceremonies, welcoming guests, and as a traditional communication medium demonstrates cultural values such as honor, solemnity, and social solidarity. The practice of playing the gong collectively also reflects the values of mutual cooperation and cooperation, which are essential parts of community life. Furthermore, gongs represent efforts to preserve cultural heritage, as their existence is preserved across generations as part of local cultural identity. The diversity of gong forms and functions across regions reinforces the value of respect for the nation's cultural diversity. The integration of cultural values through the gong symbol in learning media serves as a means to build students' awareness that science, particularly science, is inseparable from social and cultural contexts. Therefore, it is necessary to provide the younger generation with an understanding and love for local wisdom itself (Yosefa Lemianti and Gisela Nuwa 2020). Understanding the needs of science learning is crucial because its effectiveness depends on adapting to the characteristics of students, teachers, and educational institutions. Therefore, contextual learning media, such as ethnosociotechnology-based posters, are a strategic solution for creating relevant and meaningful learning. This approach supports the implementation of contextual learning that aligns with the principles of the Independent Curriculum and strengthens the profile of Pancasila students, particularly in the dimensions of faith and devotion to God Almighty,

critical reasoning, global diversity , and independence in understanding and preserving local culture (Umi Purnama 2024).

The ethnosociotechnology- based learning media of the Gong Paju Ponorogo musical instrument has several advantages that make it a strategic choice in science education, particularly physics. The gong is not just a traditional musical instrument, but also a representation of a combination of local knowledge, socio-cultural values, and complex scientific concepts. As a learning medium, the gong provides contextual, meaningful, and enjoyable learning by combining cultural aspects with physics concepts such as vibration, sound waves, resonance, frequency, and amplitude. This encourages students to not only understand science theoretically but also to see its application in real life through community cultural practices and understand the connection between culture or local wisdom related to science (DWI, 2022).

This culture-based learning has proven to enable students to not only receive the information presented, but also to create meaning, understanding, and developing the knowledge they have acquired. Furthermore, this learning process not only transfers culture in its manifestation, but also empowers students to create meaning, transcend the limits of their imagination to achieve deeper understanding, and, in fact, enables students to become more creative in the subjects they study (Wulansari and Admoko 2021).

The use of this media also builds students' pride and cultural identity, strengthens character through an understanding of local heritage, and fosters an appreciation for Indonesia's cultural diversity. From a pedagogical perspective, gong-based learning supports a scientific approach , collaborative learning, and integration across subjects such as physics, history, and art. Furthermore, this approach aligns with the spirit of the independent curriculum, which emphasizes strengthening the profile of Pancasila students, particularly in the dimensions of mutual cooperation, independence, and global diversity . Thus, gong media not only helps students master scientific concepts but also fosters 21st-century skills and a strong cultural awareness. By integrating various disciplines, developing 21st-century skills, leveraging technology, increasing student motivation, and preparing them for future challenges, innovative integrated science education can make a significant contribution to creating a better generation. Therefore, it is important for educators, policymakers, and all stakeholders in the education sector to continue encouraging and implementing innovations in ethnosociotechnology- based integrated science education (Anwar, 2025).

Implementation on Students

The implementation phase was carried out after the ethnosociotechnology- based educational poster learning media was declared highly suitable by experts. The main objective of this phase was to determine how the media was applied in the field and to assess its effectiveness and student response to its use in science learning on vibrations and waves.

The implementation was carried out on a limited basis at a junior high school (SMP) in Ponorogo Regency, involving 30 eighth-grade students as trial subjects. This activity was conducted over two face-to-face classroom sessions.

At the beginning of the lesson, the teacher provides a brief introduction to the basic concepts of vibration and waves and introduces gong art as a local cultural context that is the focus of the learning media. This activity aims to foster curiosity and connect scientific concepts to phenomena familiar to students' lives.

Next, students were divided into several small groups to observe and discuss the contents of the poster “GONG: Gong Paju Sounds, Science Swings, Ethnosociotechnology .” Students were asked to identify scientific information contained in the poster, such as the relationship between frequency, amplitude, and resonance with the sound produced by the gong. In this

process, the teacher acted as a facilitator who guided students in linking physics concepts with local cultural values.

The next activity is a digital exploration using the barcode (QR code) feature on the poster. By scanning the barcode , students can access a digital educational game containing an interactive quiz on vibrations and waves. This activity is a fun assessment tool because it incorporates game-based elements. assessment) with scientific learning.

During the implementation process, students demonstrated high enthusiasm. They actively participated in discussions, exchanged ideas, and were able to connect the concept of sound to their cultural experiences. Students also found it easier to grasp the concepts of vibration and waves because they were presented with concrete, contextual examples.

In general, observations during the activity indicated that learning using ethnosociotechnology- based posters increased student interest, strengthened student engagement, and fostered pride in local culture. This finding aligns with findings by Maziriri, Gapa, and Chuchu (2020) and Maskhanah, Lestari, and Dewi (2023), which suggest that integrating cultural values into science learning can improve students' scientific literacy and cultural awareness.

Thus, the application of this media not only provides a better conceptual understanding of vibrations and waves but also fosters students' character, fostering a love of regional culture and critical thinking about scientific phenomena around them. This type of learning supports the implementation of the Independent Curriculum and strengthens the Pancasila Student Profile, particularly in the dimensions of critical reasoning, independence, and global diversity (Wulansari and Admoko 2021) .

Survey Results Empirical

Tabel 3. Survey Result Data Small Empirical (10 Students)

Respondents	Gender	Class	Pretest Score	Posttest Score	Poster Responses (1–5)
S1	Man	VIII	55	80	4
S2	Woman	VIII	60	85	5
S3	Man	VIII	50	78	4
S4	Woman	VIII	58	82	5
S5	Man	VIII	52	79	4
S6	Woman	VIII	57	83	5
S7	Man	VIII	54	81	4
S8	Woman	VIII	59	84	5
S9	Man	VIII	56	80	4
S10	Woman	VIII	61	86	5

In the trial limited to ten student class VIII, carried out measurement effectiveness of educational posters based ethnosociotechnology gong art with compare pretest and posttest scores as well as evaluate response student to the media used . The pretest results show an average score of 56.2, which reflects understanding beginning student to material vibrations and waves before using poster media. After intervention learning using educational posters that

integrate element local in the form of gong art , score posttest increase significant to an average of 82.8. The increase by 26.6 points This show that the learning media developed capable give impact positive to understanding students' science concepts .

In addition to the increase cognitive aspects affective students are also measured through response against posters using Likert scale 1–5. Majority student give scores of 4 and 5, which indicate that the poster considered interesting , easy understood , and relevant with context culture they . Integration of elements ethnosociotechnology in posters, such as visualization tool gong music and explanation about the vibrations produced , provide experience learn more meaningful and contextual . This is in line with approach ethnopedagogy that emphasizes importance linking material learning with values culture local so that students more involved in a way emotional and intellectual .

In a way overall , empirical data This show that development of science- based learning media ethnosociotechnology gong art does not only increase results Study student in a way significant , but also strengthens relatedness between science and culture local . Findings This support idea that approach contextual based culture can be an effective strategy in increase quality science learning in schools medium .

Literature supporters to results empirical development of science- based educational posters ethnosociotechnology gong art shows that approach ethnopedagogy and ethnoscience own impact positive in science learning in schools . Integrating science learning values culture local capable create experience learn more contextual and meaningful for students (Sukistini et al., 2024). This in line with use gong art as a visual medium in posters, which is not only introduce draft vibrations and waves , but also link them with inheritance close culture with life students . Approach This Ethno -STEAM capable increase engagement and creativity student in understand scientific concepts , because they feel more connected in a way emotional with the material presented (Prabawati , 2023). In addition , learning media interactive based ethnoscience can increase scientific literacy and motivation Study in a way significant . Third literature This support findings empirical that educational poster based ethnosociotechnology gong art does not only increase results Study students , but also strengthens relevance science learning with context social and cultural local approach this is very appropriate with Spirit Independent Curriculum that encourages learning based wisdom local and strengthening character student through integration culture in education .

Student Response Results

Besides the results validation by experts , trials limited is also done to a number of student as users direct For obtain data regarding response and acceptance towards ethnosociotechnological poster media based gong art . Based on results questionnaire response students , obtained average percentage of 91.3% with very positive category . Students give response that the poster was developed easy understandable , interesting visually , and helpful they linking draft vibration as well as wave with life everyday , especially in context culture local Ponorogo .

Trials implemented in one of the unit education level School Intermediate First (Junior High School) in the Regency Ponorogo , with involving 10 students class VIII as participants . School This chosen Because own characteristics active and accustomed students follow activity art culture area . During the learning process , students show high enthusiasm when observe and discuss draft sound through example tool gong music . They look more focus , courage put forward opinion , and capable give another example of life daily related with draft vibrations and waves . These results show that the poster media that was developed capable grow interest learn , improve understanding concept , and foster a sense of pride to culture local among student .

Most of the student state that The illustrations and colors of the poster help increase focus learning , and feature *barcode* game educative considered “ fun ” and “ inducing curiosity ” know ”. Findings This show that visual media that combines element culture local capable increase motivation and engagement Study students , in line with results study Rahmila *et al* . (2022) which shows that the poster media contains ethnoscience can increase interest and understanding science concepts .

Aspect In cognitive terms , students demonstrated good ability in re-explaining basic sound concepts, particularly regarding the relationship between frequency, amplitude, and resonance in gongs. These results indicate that the use of ethnosociotechnology- based poster media helps students understand abstract concepts more concretely. They not only receive information but are also able to interpret physical phenomena through direct experiences close to everyday life. This condition is in line with the findings of Dantes *et al* . , (2023) which states that culture-oriented learning encourages strengthening *scientific literacy* Because students learn through contexts that are relevant and meaningful to them. Thus, integrating local cultural elements into learning media plays a crucial role in developing students' scientific thinking skills and conceptual understanding.

In the affective and social domains, student responses also showed positive results. They felt happy and proud when their regional culture was included in the science learning process. This sense of emotional involvement made students more enthusiastic and motivated to actively participate in learning activities. They discussed, respected each other's opinions, and were able to connect the concept of sound to cultural practices they were already familiar with. These results reinforced the findings of the study. studies Education & Hidayati, (2025) Learning that integrates cultural values can foster cultural awareness while improving cognitive learning outcomes. By linking science and culture, the learning process becomes more meaningful and supports the development of positive social character traits such as cooperation, a sense of responsibility, and pride in local heritage.

Overall, student responses confirmed the expert validation results that ethnosociotechnology- based poster media is highly suitable for use as a contextual science learning tool. This media not only enriches the learning experience but also fosters students' critical thinking skills, creativity, and cultural awareness. This type of learning aligns with the direction of the Independent Curriculum, which emphasizes the importance of reflective, student-centered learning, and oriented towards strengthening the Pancasila student profile. Thus, the application of local culture-based media such as ethnosociotechnology posters of gong art can be an effective alternative to create a more meaningful learning process, adapt to the local context, and support the preservation of national culture.

CONCLUSION

This development research produced a learning media in the form of an educational poster based on ethnosociotechnology of gong art that is valid, practical, and suitable for use in science learning on vibration and wave material. The validation results from experts showed a feasibility level of 92.5% with a *very suitable category* , both in terms of appearance, content, and media function. Limited trials on students gave a positive response with an average of 91.3%, indicating that this media is interesting, easy to understand, and able to increase motivation and learning engagement.

The developed posters not only help students understand scientific concepts concretely but also foster a sense of pride in local culture through the integration of social values and regional wisdom. The use of the gong cultural context makes learning more meaningful, contextual, and in line with the student-centered principles of the Independent Curriculum. Thus, this ethnosociotechnology-based poster media is effective for strengthening scientific literacy while supporting the preservation of local culture. This study recommends further

development on a broader scale, involving more students and different school levels, and optimizing digital interactive features to make the media more adaptable to the needs of 21st-century learning.

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