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The Title of the Research Paper Malomang as a Bridge to Science Literacy: Analysis of the Needs of Science Students and Teachers

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Abstract:

Scientific literacy requires students to connect familiar phenomena with evidence-based explanations, yet local culture is rarely used as a recurring context for reasoning. This study mapped student and teacher needs as a basis for designing an ethnoscience-based science module integrating the Malomang tradition within the topic of matter and its changes. A descriptive-exploratory needs analysis was conducted in June 2026 at MTsN 1 Kampar, Indonesia, involving 30 Grade VII students and three science teachers. Data were collected through a 21-item needs questionnaire, a 20-item preliminary scientific-literacy test, 12-question semi-structured teacher interviews, and document review. Quantitative data were summarized using frequency, percentage, mean, sample standard deviation, and range; teacher responses were analyzed thematically and triangulated across sources. Results showed that 90.0% of students were interested in learning science through Malomang and 93.3% perceived local culture as helpful for understanding science; however, only 6.7% reported frequent culture–science integration. All students reported difficulty interpreting scientific texts, tables, graphs, or data, and initial scores varied widely ($M = 52.17$; $SD = 20.12$; range = 15–90). Teacher interviews indicated that students performed better on recall tasks than on evidence-based reasoning and that existing materials lacked structured scientific-literacy activities. The findings support a print-based module with optional QR-linked resources, authentic visuals, simple investigations, progressive data scaffolds, and tasks moving from observation to claims supported by evidence. This study provides traceable design requirements but does not establish product validity, practicality, or effectiveness.

Keywords: Ethnoscience; Malomang; Needs Analysis; Science Literacy; Science Module

Introduction

Scientific literacy is necessary so that students don't just master terminology but are able to explain phenomena, assess how evidence is generated, interpret data, and use scientific information when making decisions. The 2022 PISA results show Indonesia's average science score was 383, below the OECD average of 485. (OECD, 2023) . This international data is not used to label specific classes, but rather emphasizes the need for learning experiences that regularly require students to work with phenomena and evidence. The PISA 2025 framework also expands attention to the ability to search for, evaluate, and use scientific information in decision-making contexts. (Deta et al ., 2024; OECD, 2026) .

In science classes, these demands become challenging when students must move from macroscopic phenomena to particle models and cause-and-effect relationships that are not immediately apparent. The topic of matter and its changes, for example, requires students to distinguish between pure substances and mixtures, interpret changes in temperature and state, relate heat transfer to cooking processes, and assess evidence of physical or chemical changes. If learning only emphasizes definitions and routine exercises, everyday contexts can easily become detached from scientific reasoning.

Ethnoscience provides a gateway to bridge this gap because cultural practices are treated as sources of scientific inquiry. Research on Weaving Troso, T openg Singo Barong, and the Pacu Jalur Tradition shows that local contexts can support knowledge reconstruction, scientific literacy, and cultural awareness when students are asked to compare community knowledge with scientific evidence and concepts. (Jihannita et al ., 2024; Khusniati et al ., 2023; Zulirfan et al ., 2023) . However, cultural familiarity is not evidence that students understand the science behind it. Students may witness a tradition every year but still have difficulty explaining it scientifically. (Zulirfan et al ., 2023) . Therefore, culture is not simply present as a decorative illustration; it must stimulate observation, inquiry, representation, and argumentation.

Malomang is a Malay tradition still known in the Kampar community. Sticky rice and coconut milk are placed in a bamboo tube lined with banana leaves and heated near a fire source. The selection of ingredients, mixing, heat transfer, water loss, aroma distribution, and changes in texture and color provide an authentic connection to matter and its transformations. Initial studies have identified Malomang as a resource for science learning. (Ardana et al., 2023) . The unanswered pedagogical question is not simply whether Malomang contains scientific concepts, but rather what needs must be met for the context to truly help students reason.

Needs analysis is a fundamental stage in the development of teaching materials because it functions to identify gaps between current learning conditions and expected conditions. Through this stage, decisions regarding content, activities, formats, and learning support can be formulated based on empirically identified user characteristics and problems, rather than solely relying on developer assumptions. Several studies on Pacu Jalur-based science textbooks, ethnoscience vlogs, e-modules, and technology-assisted modules have shown that needs analysis can reveal limitations in the contextualization of teaching materials, format preferences, characteristics of learning activities, and skills that need to be facilitated. (Anggreini & Permadi, 2021; Dina et al., 2024; Febrian et al., 2023; Lestari et al., 2021; Malina et al., 2021; Vitrianingsih et al.,

2021). These findings emphasize the importance of a consistent link between identified problems and product design decisions to be developed.

Based on these foundations, this study aims to: (1) identify the gap between students' learning experiences and science learning practices implemented by teachers; (2) map the needs of students and teachers related to strengthening science literacy, the availability of learning resources, and the integration of local culture in learning; and (3) formulate module design requirements based on the convergence of student questionnaire and initial test data, the results of interviews with three science teachers, and a review of learning documents. The contribution of this study lies in formulating an explicit and traceable relationship between the findings of the needs analysis and module design requirements. This research is limited to the needs analysis stage so that the results obtained are not intended as evidence of the validity, practicality, or effectiveness of the product.

Methods

This study uses a descriptive design at the needs analysis stage within a development research framework that refers to the Dick and Carey model. This article specifically reports the initial stages of development, namely the identification of learning gaps, mapping student and teacher needs, and formulating design requirements for the *Malomang* ethnoscience integrated science module. The research was not directed at testing hypotheses, causal relationships, or product effectiveness, but rather to obtain an empirical basis for developing modules that are appropriate to student characteristics, teacher needs, scientific literacy demands, and the learning context in schools.

The research was conducted in June 2026 at MTsN 1 Kampar, Riau. Participants consisted of 30 students from one grade VII and three science teachers. The research schools and classes were selected purposively because they were in accordance with the product development targets, namely science learning for grade VII on the material of substances and their changes. All students in the selected classes were involved as participants. Thus, student involvement represents total participation in the study classes and not a probability sampling of the entire population of seventh-grade students. Three science teachers were purposively selected based on their involvement or experience in teaching seventh-grade science and their understanding of the material on matter and its changes. The scope of participants is contextual so that the research results are used to direct product development in the context of the research school and are not intended to be statistically generalized to the general population of students or science teachers of grade VII.

The research data were obtained through four techniques: a student needs questionnaire, a science literacy baseline test, semi-structured interviews with teachers, and a document review. The student needs questionnaire consisted of 21 items covering four aspects: seven items on student experiences with ethnoscience-based learning, five items on module needs, five items on scientific literacy strengthening needs, and four items on learning interests. The questionnaire was used to map student learning experiences, perceived difficulties, needs for learning resources, and student acceptance of the use of the *Malomang* tradition as a science learning context.

The initial science literacy test consists of 20 questions with dichotomous scoring, with a score of 1 for correct answers and a score of 0 for incorrect answers. The questions are structured based on three science literacy competencies. Eight items measure the ability to explain phenomena scientifically; six items measure the ability to construct and

evaluate scientific investigations and critically interpret data and evidence; and six items measure the ability to trace, evaluate, and use scientific information in decision-making. This test is used to obtain an overview of students' initial achievements and variations in abilities and to determine the form of scientific literacy support that needs to be accommodated in the module.

Semi-structured interviews were conducted with three science teachers using a 12-question questionnaire. The interviews were used to obtain information on learning strategies, availability of learning resources, student difficulties in understanding the material, scientific literacy assessment practices, experiences integrating local culture, the relevance of *Malomang traditions* to the topic of matter and its changes, and the features of required teaching materials. A document review was conducted of the curriculum documents and learning tools used in the school. The review aims to examine the suitability of the material, competency requirements, forms of learning activities, assessment practices, and opportunities for implementing modules in science learning for grade VII.

The questionnaire data was analyzed descriptively using frequencies and percentages for each item and aspect of needs. The initial science literacy test score was calculated based on the number of correct answers and converted to a scale of 0–100. The test data were then summarized using the mean, sample standard deviation with a divisor of $n-1$, minimum score, maximum score, and range. The interpretation of the scores refers to the criteria (Muljono, 2021), namely very good (86–100), good (72–85), sufficient (58–71), low (43–57), and very low (0–42). Similar interpretation criteria have been used in research on scientific literacy skills by (Erniwati et al., 2020).

Interview data was analyzed thematically through several stages, namely re-reading interview notes, identifying relevant units of information, condensing data, coding, and grouping information based on similarities in meaning. The three teachers' responses were not converted into percentages but were directed towards obtaining depth and diversity of information. Interview findings were organized into five analytical focuses: pedagogical support, reconstruction of cultural knowledge into scientific concepts, assessment of scientific literacy, access to learning resources, and feasibility of module implementation.

Triangulation was conducted by comparing the results of questionnaires, pre-tests, teacher interviews, and document reviews. This process was used to identify findings that supported, complemented, explained, or limited each other. Findings that demonstrated cross-source alignment were then translated into module design requirements, including context selection, material organization, learning activity formats, visual supports, scientific literacy practice stages, step-by-step learning support, and alternative uses of digital resources.

The needs questionnaire and baseline test were used as diagnostic tools in the pilot study, not as psychometric instruments for individual decision-making. Results were interpreted descriptively at the group level and cross-checked with interview data and learning documentation. Score categories were used as an interpretive framework to map trends in students' initial achievement and were not intended to represent standardized levels of scientific literacy proficiency. The research results are used as the basis for formulating the initial design and cannot yet be seen as evidence of the validity, practicality, or effectiveness of the module.

Results and Discussion

The Gap between Cultural Proximity and Learning Experience

Student data indicates strong affective capital, but they have not yet received commensurate pedagogical channels. A total of 27 students (90.0%) are interested in learning science through Malomang ; 28 students (93.3%) consider science easier to understand when connected to local culture; and 28 students (93.3%) are interested or very interested in learning Malomang from a scientific perspective. In contrast, only two students (6.7 %) stated that teachers often connect science with culture. This difference does not mean that teachers ignore culture, but rather indicates that the association that occurs is not yet perceived as a routine and structured learning pattern by students.

Table 1. Diagnostic Indicators of Student Needs (n = 30)

Dimensions	Indicator	Results
Cultural relevance	Interested in learning science through Malomang	27 students (90.0 %)
Cultural relevance	Science is easier when it is related to local culture	28 students (93.3 %)
Class practice	Teachers often link science and culture	2 students (6.7 %)
Learning Resources	Need/really need additional modules	28 students (93.3 %)
Format	Choosing a combination of print and QR/video materials	20 students (66.7 %)
Scientific literacy	Difficult/very difficult to read data, tables, graphs, or text	30 students (100%)
Literacy practices	Learning rarely trains data interpretation	22 students (73.3 %)
Interest	Monotonous learning resources reduce interest	16 students (53.3 %)

Source: Preliminary study data processed by the author (2026).

These findings are in line with the study of the need for science books based on Pacu Jalur which found limitations in the local context of teaching materials and the need for more meaningful learning resources. (Febrian et al ., 2023) . This finding also explains why close traditions do not automatically result in ethnoscience literacy. (Zulirfan et al ., 2023) . The design implications are stark: Malomang should be a recurring scientific problem, not a one-page introduction. Students need to observe the function of materials, predict changes, record data, and defend explanations using evidence.

In the material on Substances and Their Changes, the sequence of activities can begin with the identification of sticky rice, coconut milk, banana leaves, bamboo, water, and smoke ; followed by the classification of mixtures, observation of changes in texture and water content, modeling particle motion and aroma diffusion, and evaluation of evidence of physical or chemical changes. This sequence maintains respect for community knowledge while distinguishing between descriptions of practices, local conjectures, and scientific explanations. Ethnoscience studies emphasize that the power of cultural context lies in the process of reconstruction, not simply the naming of traditions. (Khusniati et al ., 2023; Wahyuni et al ., 2026) .

Teacher Needs: Not Just More Methods

A synthesis of interviews with three teachers indicates that learning has utilized lectures, discussions, Q&A sessions, assignments, presentations, videos, demonstrations, and lab work. Thus, the main problem is not a lack of method variety. The gap lies in the orchestration of learning: these activities do not always form a complete sequence from observing phenomena, gathering evidence, representing data, to evaluating claims. All three teachers found it easier for students to answer memory questions than tasks requiring the reading of tables, graphs, data, or scientific information. Specific assessments of scientific literacy have also not been conducted; assessments focus more on material mastery and cognitive achievement.

Table 2. Thematic Synthesis of Needs Analysis of Three Science Teachers

Lens of need	Interview findings	Meaning for design
Pedagogical support	The methods are quite diverse, but students still find it difficult to connect concepts with everyday phenomena.	Modules need to provide an observation-question-investigation-data-claim flow, not just add activities.
Content reconstruction	Local cultures are sometimes used as examples, but no specific materials are available; Malomang is considered suitable for substances, mixtures, heat, and changes.	Provide a map of community practices to science concepts, inquiry questions, and the limits of scientific explanation.
Literacy assessment	Students are stronger in memory; specific assessments of scientific literacy have not been conducted.	Distribute the tasks of reading data, evaluating evidence, and making decisions across each activity.
Sources and access	Textbooks, student worksheets, teacher modules, the internet, PPT, and videos are used; the materials are still general and lack context.	Use the complete printed core with QR as an enrichment, not a learning prerequisite.
Feasibility of implementation	Teachers want authentic images, simple practicals, student worksheets, literacy questions, cultural information, and videos.	Features were chosen for their learning function, concise structure, and usability in real classroom settings.

Source: Synthesis of 12-question interviews with three science teachers (2026).

Table 2 identifies five needs that are often confused. First, teachers require pedagogical support to maintain continuity of activities. Second, teachers need to reconstruct content so that community knowledge is not directly equated with school science. Third, teachers need examples of literacy assessments that are integrated with learning. Fourth, learning resources must be sensitive to access. Fifth, implementation must be concise and realistic. This separation is important because solutions in the form of images and videos only address the appearance, while the main issue concerns the quality of students' intellectual tasks.

These teacher needs reinforced student findings. Teachers observed weaknesses in data analysis; all students reported difficulties with data and scientific representation,

and 73.3 % rated data interpretation exercises as infrequent. Teachers cited new cultural contexts as examples; only 6.7 % of students felt integration was frequent. Teachers requested images, lab work, student worksheets, literacy problems, and videos; students preferred contextual images (40.0 %), simple experiments (33.3%), and a combination of print and digital (66.7%). This convergence across sources made design decisions more robust than single percentages.

Initial Achievements in Scientific Literacy and Their Implications for Module Design

Questionnaire data showed that the scientific literacy gap primarily relates to the ability to interpret scientific information and evidence. Twenty-one students (70.0 %) reported difficulty, and nine students (30.0%) reported very difficulty, when understanding data, tables, graphs, or scientific texts. Thus, all students involved in the study reported difficulties in this area. All students also stated that they needed or really needed strengthening of scientific literacy. This finding is reinforced by the results of teacher interviews which showed that students tend to be better able to complete tasks that emphasize memory than tasks that require data interpretation, explanation construction, and the use of scientific evidence.

Table 3. Descriptive Statistics of the Initial Science Literacy Test

Statistics	Results
Number of students	30
Number of questions	20
Average	52.17
Sample standard deviation	20.12
Minimum–maximum score	15–90
Range	75
Average category	Low

Source: Score categories refer to Djaali and Muljono (2008);

As shown in Table 3, the initial science literacy test yielded a mean score of 52.17 with a standard deviation of 20.12. Based on Djaali and Muljono's (2008) interpretation criteria, this mean is in the low category because it falls within the 43–57 range. The use of similar criteria in measuring scientific literacy was also found in Erniwati et al.'s (2020) research. These results indicate that in general, students' initial scientific literacy achievements still require strengthening, especially in activities that require the interpretation of information and the use of scientific data and evidence.

In addition to the low mean, the minimum score of 15 and the maximum score of 90 yield a range of 75 points. The standard deviation of 20.12 also indicates that student scores are quite widely distributed around the mean. Thus, the low mean reflects a trend in group achievement and does not indicate that all students have the same initial abilities. The combination of the low mean and the wide variation in scores indicates that the module needs to be designed to accommodate differences in student initial readiness. Because the test was used as a diagnostic tool in the preliminary study, the categories are interpreted as descriptive mapping and not as standardized levels of scientific literacy proficiency.

The convergence of the results of the questionnaire, pre-test, and teacher interviews provided a consistent basis for formulating the module design. Strengthening scientific literacy needs to be integrated into a series of learning activities and not simply placed as an evaluation question at the end of the lesson. In the *Malomang* context,

students can be directed to observe phenomena, identify variables, and analyze data regarding temperature, heating time, mass changes, water content, or texture of materials. Observational data and data provided in the module can be represented in tables or graphs. Next, students are directed to formulate claims, select relevant evidence, and explain the relationship between the evidence and the scientific concepts being studied.

This series of activities is in line with scientific literacy competencies which include the ability to explain phenomena scientifically, construct and evaluate investigations, interpret data and evidence critically, and use scientific information in decision making. (Istyadji, 2023; OECD, 2026). Thus, the cultural context not only serves as an illustration of the material, but also becomes a source of phenomena and evidence that students use to develop scientific reasoning.

The variation in students' initial abilities also emphasizes the need for gradual learning support. In the early stages, the module can provide partially completed tables, labeled graph axes, sample answer structures, and sentence starters to help students formulate claims and demonstrate evidence. This support is then gradually reduced through tasks that ask students to define variables, select relevant evidence, compare multiple explanations, and interpret data that does not fully support the initial conjecture.

The development of transfer skills needs to be facilitated by presenting contexts other than *Malomang*, such as melting ice, condensation, perfume diffusion, combustion, and the water cycle. This activity structure positions local culture as the initial bridge connecting students' experiences with scientific concepts, while mastery of scientific literacy is developed through the application of scientific reasoning to various phenomena. With this design, the module is expected to not only help students understand the concept of matter and its changes, but also to accustom them to using information, data, and evidence to build explanations and make scientific decisions.

From Data Convergence to Design Requirements

The questionnaire results indicated a strong need for supplementary learning materials. Twenty-eight students (93.3 %) stated they needed or strongly needed additional modules with engaging presentations. Textbooks remained the primary learning resource for 17 students (56.7 %), while only three students (10.0%) reported using dedicated modules. This indicates that students have not yet received supplementary learning materials specifically designed for their learning needs.

Student preferences for module features also provided information about the type of learning experience they needed. Contextual images were chosen by 12 students (40.0 %), simple experiments by 10 students (33.3%), contextual stories by five students (16.7%), and exercises or quizzes by three students (10.0%). Furthermore, 14 students (46.7 %) chose experiments as the most motivating learning activity. These preferences not only indicate the presentation format that appeals to students but also serve as a basis for determining activities that can encourage engagement, observation, data collection, and evidence-based reasoning.

Twenty students (66.7 %) chose printed learning materials supplemented with digital resources via QR codes or videos. This finding supports the use of printed formats as the primary component that can be used independently, while digital resources are positioned as a complement to present dynamic processes, particle motion visualizations, simulations, or additional data. The use of digital resources needs to be linked to clear cognitive activities. Videos, for example, are accompanied by guides and observation tables; animations are followed by tasks to compare models before and after changes; and information links are followed by activities to evaluate sources and make decisions

based on evidence. Thus, technology is used to expand students' access to scientific phenomena and evidence, not just as a visual element in modules.

Table 4. Traceability Matrix of Findings and Module Design Requirements

Convergence of findings	Design risks if not accommodated	Module design requirements
A total of 90.0% of students were interested in learning science through <i>Malomang</i> and 93.3% considered local culture to be helpful in understanding, but only 6.7% reported that integration of culture and science was done frequently.	<i>Malomang</i> context is only used as an introductory illustration and is not integrated with the knowledge formation process.	Using <i>Malomang</i> as an emerging context to generate scientific questions, observations, data, models, explanations, and claims.
All students reported difficulty understanding data, tables, graphs, or science texts; teachers also identified a predominance of tasks that emphasized memorization.	Science literacy activities only appear as evaluation questions at the end of learning.	Arrange a series of observation activities, investigations, data representation, claim formulation, and evidence evaluation in each learning unit.
The initial test mean was in the low category ($M = 52.17$; $SD = 20.12$), with a score of 15–90.	Using a uniform level of difficulty does not accommodate differences in students' initial abilities.	Providing work examples, gradual instructions, remedial, enrichment, and progressive reduction in learning assistance.
A total of 66.7 % of students chose printed materials enriched with QR or video; teachers also used the internet and video as additional resources.	Reliance on devices, internet connections, or QR codes can limit students' access to key materials.	Making printed materials the primary learning resource that can be used independently and positioning QR as a complement for dynamic processes, enrichment, and additional data.
Contextual images and simple experiments were the most popular features; teachers also wanted materials with visuals and investigative activities.	Attractive features only increase visual appeal without generating reasoning activity.	Connect each image, video, and experiment with the tasks of observing, recording, comparing, interpreting, and using evidence.
<i>Malomang</i> tradition is close to students' experiences, but the relationship between local knowledge and scientific explanations has not been systematically established.	Public knowledge can be directly equated with scientific concepts without going through a process of scientific testing and reconstruction.	Distinguish between descriptions of societal knowledge, questions that can be investigated, empirical evidence, scientific models, and the limits of

Source: Preliminary study data processed by the author (2026).

The matrix in Table 4 shows a traceable relationship between empirical findings, the risks that might arise if those needs are not accommodated, and the module design requirements. This approach positions student preferences not as the ultimate goal of development, but as the basis for determining the pedagogical function of each feature. Authentic images, for example, are not only used to attract attention, but also to support the activity of observing and comparing. Simple experiments are not only intended to increase engagement, but also to generate data that can be analyzed. Likewise, cultural stories do not stop as contextual introductions, but are directed to raise questions whose answers require scientific observation and evidence.

These findings are in line with previous needs analysis research which emphasized the importance of matching learning formats, media, and activities to user characteristics. (Anggreini & Permadi, 2021; Dina et al., 2024; Lestari et al., 2021). The added value of the analysis in this study lies in the formulation of an explicit relationship between each finding and the resulting design decisions. Thus, module features are not determined solely on the basis of user appeal or preference, but also on the cognitive and pedagogical functions they need to facilitate.

These design requirements also position teachers as facilitators of the transition from cultural knowledge to scientific explanation. Teachers not only convey information about the Malomang tradition but also help students identify claims developing within the community, determine areas that can be scientifically investigated, select relevant evidence, construct models, and define the boundaries of an explanation. Culturally responsive learning becomes meaningful when contextual proximity is accompanied by a systematic process of comparing, investigating, and evaluating knowledge.

Thus, the preservation of cultural knowledge and the development of scientific rigor are not positioned as conflicting goals. The Malomang tradition functions as an authentic context that provides meaning to learning, while investigation procedures and the use of evidence maintain the accuracy of scientific explanations. The requirements formulated through this needs analysis are still initial design specifications and need to be further examined through validation stages, practicality testing, and module effectiveness testing.

Conclusion

The needs analysis identified three major gaps in science learning. First, there is a gap between the potential of local culture and its application in learning. Although 90.0% of students are interested in learning science through *Malomang* and 93.3% believe local culture can contribute to understanding, only 6.7% of students reported that culture and science are frequently integrated into learning. Second, there is a need to strengthen scientific literacy. All students reported difficulty understanding data, tables, graphs, or science texts, while interviews with three teachers indicated that students were more accustomed to completing tasks that emphasized memorization rather than evidence-based reasoning. The mean initial science literacy score of 52.17 was in the low category, with a standard deviation of 20.12 and a score range of 15–90, indicating a wide variation in initial abilities. Third, there were gaps in the availability of learning resources. 93.3%

of students needed or strongly needed additional modules, and 66.7% preferred printed materials over digital resources via QR codes or videos.

The convergence of data from the questionnaire, pre-test, teacher interviews, and document review resulted in five module design requirements. The module needed to: (1) use *Malomang* as a recurring context that connects cultural knowledge to scientifically investigable questions ; (2) provide a sequence of activities that move from observation and inquiry to data representation, claim formulation, and evidence evaluation; (3) provide gradual learning support, including worked examples, remedial, and enrichment, to accommodate variations in students' initial abilities; (4) make printed materials the primary learning resource that can be used independently, with digital resources as a complement; and (5) connect each image, experiment, video, and QR code with a cognitive task that explicitly trains observation, data interpretation, and evidence-based reasoning.

The results of this study provide an empirical basis and traceable design requirements for the development of the *Malomang ethnoscience integrated science module* . However, the findings are contextual to the participants and research schools and are still limited to the needs analysis stage. Therefore, the research results cannot be used as evidence of the validity, practicality, or effectiveness of the module. The resulting design requirements need to be followed up through the development stage, expert validation, practicality testing, and product effectiveness testing.

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