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A Literature Review on the Integration of Ethno-STEAM in Science Learning through Local Potential: The Case of 'Mi Lethek Bantul'

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Abstract: This study is a literature study which is conducted to explore the incorporation of the Ethno-STEAM-based approach to learning science using local potential of 'Mi Lethek Bantul'. Ethno-STEAM is a learning approach that integrates Science, Technology, Engineering, Arts, and Mathematics, by integrating local cultural values as a learning environment. Mi Lethek as a traditional dish made of cassava flour embodies various simple concepts of science and technology that can be used in the learning process, e.g., physical and chemical changes, traditional biotechnology procedures, use of energy, and concepts of traditional tool engineering It is demonstrated in the study that science learning based on the incorporation of the Ethno-STEAM approach using 'Mi Lethek Bantul' is fostering improved conceptual understanding of the students, in addition to fostering cultural awareness, creativity, critical and problem solving skills. Through this incorporation, there is the potential to develop contextualized, pertinent learning, and enhance the development of the character of the students and character literacy in the sciences. Hence, the application of Etno-STEAM drawn from local potential is a powerful strategy in holistic, sustainable learning in the sciences.

Keywords: Literature Review, Ethno-STEAM, Science Learning, Local Potential 'Mi Lethek Bantul'

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1. Introduction

Science learning encompasses processes, outcomes, and scientific attitudes, regardless of the materials, methods, or media applied (Jumini, 2022). Its implementation is inherently dynamic, aligning with curriculum evolution and contemporary educational trends (Sahrir, 2023). Despite this, science instruction in classrooms often remains limited to abstract theories and mathematical computations, detaching students from real-world relevance. For scientific knowledge to be meaningful, it must be linked to practical applications, allowing students to grasp its value beyond textbooks.

Science education should function as both a medium for data collection and a dissemination platform for knowledge, especially in higher education settings (Alkhabra et al., 2023; Arpaci et al., 2023). To achieve this, learning must be meaningful—engaging students mentally and physically, and allowing them to connect scientific concepts with their everyday experiences (Sugiarto, 2023). One way to foster such engagement is through the use of local environmental resources, which provide students with direct, experiential learning and help embed knowledge into long-term memory.

The integration of local potential into science learning can be achieved through the Ethno-STEAM approach, as exemplified by the traditional food product "Mi Lethek Bantul." While the STEM (Science, Technology, Engineering, and Mathematics) approach has gained global traction, its implementation in ASEAN countries still faces challenges—particularly concerning teacher preparedness. Many educators lack specialized certification to effectively teach interdisciplinary STEM content, regardless of their subject area (Sorenson, 2010). Moreover, in developing countries, STEM practices have yet to significantly inspire students to pursue careers in science and technology fields (Kalolo, 2016).

To address these challenges, the STEAM approach—which integrates the Arts into STEM—has been further enriched with ethnoscience, forming what is now known as the Ethno-STEAM approach. Ethnoscience refers to indigenous knowledge rooted in language, customs, culture, morality, and traditional technologies, embodying scientific principles developed by local communities (Sudarmin, 2015). According to Yuliana (2017), this cultural-scientific integration encourages educators to design learning experiences that reflect both scientific concepts and local wisdom.

Ethnoscience-based learning is crucial for uncovering culturally embedded knowledge, offering a gateway to formal scientific understanding in educational contexts (Parmin, 2017). This aligns with the views of Nurkhalisa and Ummayah (2015), who assert that learning should extend beyond the classroom students must also learn from their environment and society. Ethnoscience-based learning aligns not only with the evolution of contemporary education and Indonesia's current

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curriculum standards, but also serves as a means to cultivate cultural appreciation and national identity among students. It enhances their understanding of regional culture and local potential, offering an accessible entry point into scientific concepts—especially for students who struggle with abstract material. By embedding learning in real-life contexts, this approach allows students to relate more personally to the subject matter.

Ethnoscience-based learning aligns not only with the evolution of contemporary education and Indonesia's current curriculum standards, but also serves as a means to cultivate cultural appreciation and national identity among students. It enhances their understanding of regional culture and local potential, offering an accessible entry point into scientific concepts—especially for students who struggle with abstract material. By embedding learning in real-life contexts, this approach allows students to relate more personally to the subject matter.

A contextual learning model is particularly suitable within the Ethno-STEAM framework. Community activities and local industries that are relevant to educational content represent valuable local resources that can be integrated into the learning process (Firda, 2023). The integration of Science, Technology, Engineering, Arts, and Mathematics (STEAM) is a crucial response to the demands of 21st-century education. This interdisciplinary approach fosters the development of students' critical thinking, problem-solving abilities, creativity, innovation, and technological literacy. According to Reeve (2013), the STEAM model must also be designed to emphasize various dimensions of the learning process, ensuring that it goes beyond mere content delivery.

Given this context, a literature review on the integration of Ethno-STEAM science learning with the local potential of 'Mi Lethek Bantul' becomes highly relevant. This review aims to analyze how the traditional industry of 'Mi Lethek Bantul' a long-standing local enterprise in Bantul, Yogyakarta, established since 1940 can serve as a cultural and scientific anchor in the science learning process. The production of Mi Lethek involves various scientific principles that can be meaningfully connected to classroom instruction.

While numerous studies have explored the application of STEAM education and the use of local culture in science learning, there remains a lack of integrated models that specifically employ ethno-scientific contexts rooted in local industries such as Mi Lethek. Most Ethno-STEAM research tends to focus on traditional tools, folklore, or crafts, but seldom connects these elements directly to industrial food production processes that are both culturally rich and scientifically relevant.

This literature review proposes the novel integration of a living local industry—Mi Lethek Bantul—as a learning medium for Ethno-STEAM. It offers a unique case where cultural heritage, traditional food processing, and interdisciplinary

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scientific concepts can be synthesized into an authentic, contextualized learning experience. By mapping scientific content onto real-world cultural practices, this approach promotes deeper learning, student engagement, and local identity reinforcement.

The research objectives are to explore the scientific principles embedded in the traditional Mi Lethek production process; to analyze existing models and approaches in Ethno-STEAM-based science education and identify their strengths and limitations; to propose a conceptual framework for integrating Mi Lethek as a contextual learning resource within science curricula through the Ethno-STEAM approach; and to inspire the development of learning tools and modules that align with both national curriculum standards and local wisdom.

Through this literature review, it is hoped that educators and curriculum developers can find new inspiration for implementing Ethno-STEAM learning strategies. By leveraging local wisdom, such as that embodied in the Mi Lethek industry, science education can become more contextual, engaging, and effective.

2. Method

This study is grounded in prior bibliometric investigations (Yang et al., 2017; Kulakli & Osmanaj, 2020), which underscore the utility of bibliometric reviews for both scholars and general audiences. These reviews facilitate the transformation of publication metadata into interpretable visualizations and maps, thereby offering meaningful insights. For instance, keyword mapping can help identify dominant research themes, disciplinary clusters, author affiliations, the geographical distribution of journal publications, and patterns of institutional or international collaboration—elements that are instrumental in recognizing emerging technologies (Tanudjaja & Kow, 2018). Moreover, bibliometric techniques are vital in tracking research trends and formulating informed research strategies.

To optimize the accuracy and efficiency of bibliometric data collection in this research, we employed digital tools such as search engines and academic databases. Scopus was selected as the primary database due to its extensive coverage and alignment with the study's objectives.

The research procedure follows a methodological flowchart adapted from Widowati and Tyas (2024), as illustrated in Figure 1.

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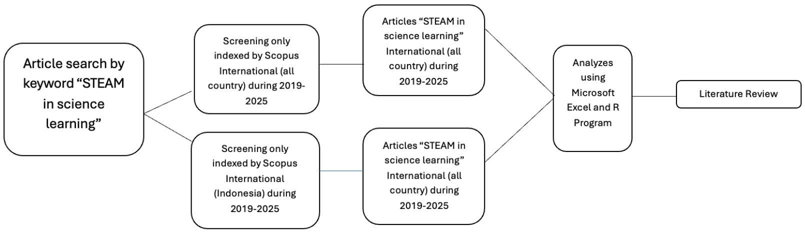

Figure 1. Research Flowchart
Source: Widowati & Tyas, 2024

The literature search was conducted using the Scopus database (https://www.scopus.com) with the following search parameters:

a. For keyword "STEAM AND LEARNING AND SCIENCE" then the results are 1197 documents

b. Fornkeywords STEAM AND "ethno", then the results are 15 articles
Relevant documents were subsequently selected and exported in BibTeX format, ensuring that all key metadata—such as citation counts, bibliographic details, abstracts, and keywords—were included (Lim et al., 2024).

Bibliometric analysis was carried out using *bibliometrix*, an R-package specifically developed for comprehensive bibliometric and scientometric analysis. As an open-source tool, *bibliometrix* leverages R's advanced statistical algorithms, numerical processing capabilities, and integrated data visualization functions to support robust and detailed analyses (Aria & Cuccurullo, 2017).

3. Result and Discussion

The literature review in this article uses bibliometric analysis with the help of the R program. Bibliometric analysis is a popular and rigorous method for analysing large amounts of scientific data in a particular context. According to Choudhri et al. (2015), bibliometric metrics have become an important component in evaluating academic productivity today. According to Derviş (2020), bibliographic data is processed through the following workflow: study design, data collection, data analysis, data visualization, and interpretation. Bibliometric analysis is used to determine trends, historical reviews, forecasts, and contributions to Industry 4.0 literature (Ahmi, 2019).

Literature search was conducted by visiting the Scopus journal data at https://www.scopus.com/ then continued by searching for articles with the keyword "STEAM AND LEARNING AND SCIENCE" then the results of 1197 documents appeared, then the analysis was continued by exporting data in BibTeX format by checking all indicators including citation information, bibliographical information, and abstract and keywords. After the analysis was carried out using the R program, the data shown in Figure 2 below will appear.

Completeness of metadata -- **1179** docs from **Scopus**

Metadata	Description	Missing Counts	Missing %	Status
AU	Author	0	0.00	Excellent
DT	Document Type	0	0.00	Excellent
LA	Language	0	0.00	Excellent
PY	Publication Year	0	0.00	Excellent
TI	Title	0	0.00	Excellent
TC	Total Citation	0	0.00	Excellent
SO	Journal	1	0.08	Good
AB	Abstract	2	0.17	Good
C1	Affiliation	51	4.33	Good
DI	DOI	203	17.22	Acceptable
DE	Keywords	289	24.51	Poor
RP	Corresponding Author	474	40.20	Poor
ID	Keywords Plus	689	58.44	Critical
CR	Cited References	1179	100.00	Completely missing
WC	Science Categories	1179	100.00	Completely missing

Advice | Report | Save | Close

Figure 2. Metadata Summary from STEAM Journals

A total of 1179 documents relevant to STEAM and education were identified. The metadata analysis indicates that information regarding authorship, document types, language, publication years, journals, and total citations is generally available. However, there are notable gaps: journal data is missing in 0.08% of records, abstract data in 0.17%, affiliation data in 4.33%, DOI in 17.22%, keywords in 24.51%, corresponding author information in 40.20%, and Keywords Plus in 58.44%. Most strikingly, 100% of the articles have not been cited, and none are classified under the science category, suggesting a significant disconnect between STEAM research and its uptake or application in the domain of science education.

This underrepresentation in citation and disciplinary classification raises critical concerns regarding the integration and impact of STEAM within science learning. According to Yakman & Lee (2012), STEAM an evolution from STEM by incorporating the arts aims to foster holistic, interdisciplinary learning experiences that promote creativity, critical thinking, and problem-solving. However, its theoretical and empirical applications in formal science education remain limited, as echoed in various reviews (Henriksen, 2014; Quigley & Herro, 2016).

The lack of citation could be indicative of several issues: either the STEAM-related articles are not yet well integrated into the mainstream educational discourse, or there is insufficient alignment with core science curricula and pedagogical frameworks. Moreover, the absence of classification under "science" in major indexing systems points to a potential gap in the recognition of STEAM as a legitimate or central paradigm in science education scholarship (Beers, 2011). This emphasizes

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the pressing need for deeper analytical and empirical studies that bridge STEAM approaches with established science education objectives, curricula, and learning outcomes.

Thus, a more targeted STEAM analysis in science education is urgently needed to uncover how interdisciplinary approaches can truly enrich scientific literacy and inquiry-based learning. Such analysis can support the development of curriculum models and teaching strategies that effectively blend scientific rigor with creativity and innovation—core tenets of 21st-century education (Honey, Pearson, & Schweingruber, 2014).

Articles Relevant to STEAM and Education

The data shows that the research trend in the field of STEAM is large because as many as 1179 data were found through bibliometric analysis. The research trend in the field of STEAM must be followed by its application with ethnoscience, because there are not many articles that examine the integration of STEAM with ethnoscience, this is indicated by the search results on Scopus data with the keywords STEAM AND "ethno", only 15 articles were found.

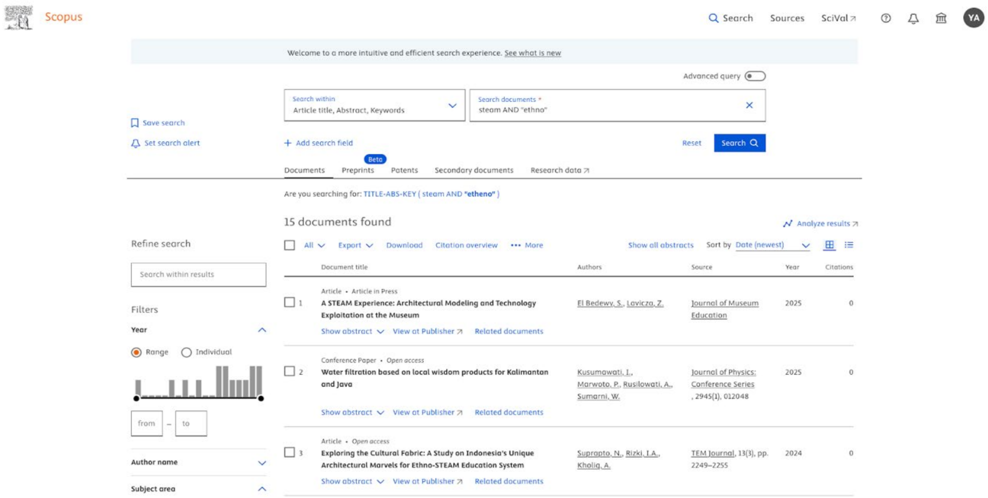

Figure 3. Search Results for STEAM and Ethnoscience Articles

The results obtained provide an opportunity for researchers to study more deeply related to the potential of ethno-STEAM in this case based on the local potential of the process of making ‘Mi Lethek Bantul’ which has not been widely studied. The selection of ‘Mi Lethek Bantul’ as material in the ethno-STEAM journal is due to the uniqueness of ‘Mi Lethek Bantul’. ‘Mi Lethek Bantul’ is one of the culinary products typical of Bantul Regency, Special Region of Yogyakarta which has a uniqueness.

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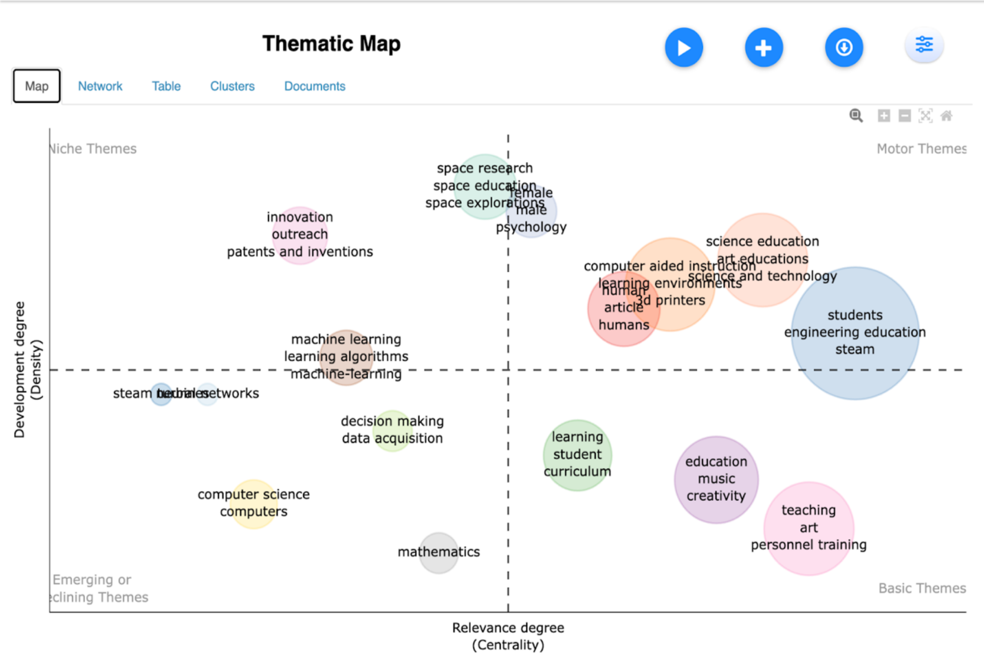

Figure 4. Thematic Map of STEAM and ethnoscience Research

Figure 4 displays a thematic map that groups various topics based on two main dimensions, namely the degree of development (density) which shows how mature a theme is in research, and the degree of relevance (centrality) which describes the level of connection between the theme and other fields.

In the upper right quadrant (Motor Themes), there are themes that are growing rapidly and are highly relevant, such as students, engineering education, and STEAM. These themes are the main focus of research and development. In addition, science education, art education, and science and technology are also included in this category, indicating that interdisciplinary and innovative approaches to education are receiving strong attention.

Meanwhile, the upper left quadrant (Niche Themes) includes themes that have depth but are not yet widely connected to other fields, such as innovation, outreach, and patents and inventions. This shows that research in the field of innovation and patents is growing in a specific community but has not been widely integrated with other broader themes. In addition, space research, space education, and space explorations are also included in this category, indicating a specific focus on space exploration.

In the lower right quadrant (Basic Themes), there are themes that are highly relevant but still have low research density, such as education, music, creativity, and teaching, art, and personnel training. These themes are an important foundation in research and can be developed further with deeper exploration.

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In contrast, the lower left quadrant (Emerging or Declining Themes) shows themes that are either developing or are actually declining in research interest, such as computer science, computers, decision making, data acquisition, and mathematics. Despite having great potential, these fields do not seem to be the main focus in current research trends.

Based on data analysis on the thematic map, research in the fields of STEAM and engineering education can be the main drivers of the development of science and education. On the other hand, innovation and space exploration are developing on a more specific scale, while fields related to computer science and mathematics still need more attention to increase their relevance in broader research.

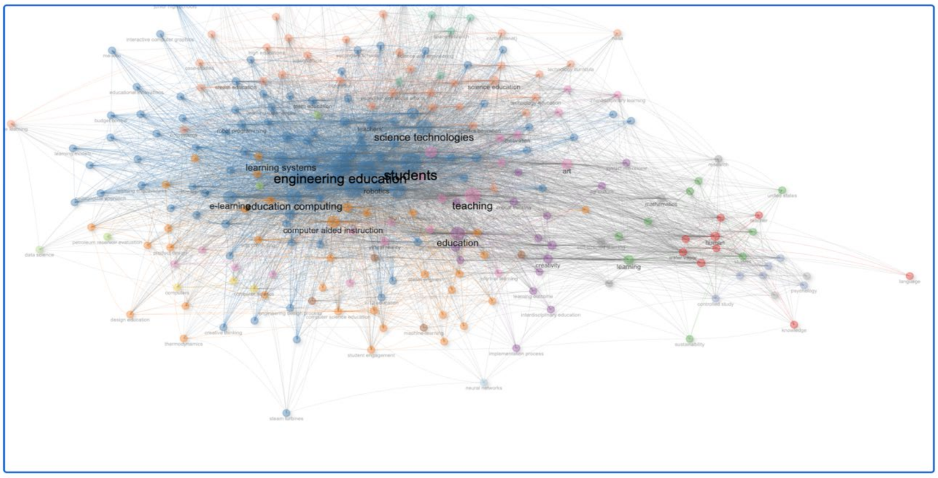

Figure 5. Visualization of the Network of Relationships between Various Concepts or Topics in the Field of Education and Technology

Figure 5 is a visualization of the network of interconnectedness of various concepts or topics in the field of education and technology, where the text size reflects the level of importance or connectedness of a topic in the network. The larger the text size, the more significant the topic is in the overall ecosystem of research or discussion that is visualized.

It can be observed that "students", "engineering education", and "science technologies" are the main themes with the broadest interconnections and often appear in relation to various other sub-themes. This shows that research and discussion in the field of engineering education and science technology have a central position and are widely associated with other concepts. In addition, terms such as "learning systems", "e-learning", and "computing" also appear quite large, indicating that digital learning technology and computer-based learning systems have an important role in the development of engineering education.

The network also shows a strong relationship between "computer-aided instruction", "virtual reality", and "robotics", indicating that technology-based innovation in education is growing. In addition, the presence of the terms "teaching", "education", and "creativity" in the network confirms that pedagogical aspects and creative approaches to learning remain an important part of research in engineering and science education.

Interestingly, there are several groups of themes that seem to form certain clusters. For example, the dominant blue cluster on the left side illustrates the close relationship between engineering education, digital learning systems, and computer-based technologies. The red cluster on the right side includes themes such as "human", "psychology", and "knowledge", indicating the relationship between human factors and psychological aspects in the learning process. Meanwhile, the green cluster at the bottom seems to focus on more specific topics, such as "sustainability" and "controlled study", which leads to more experimental or sustainability-based research.

In addition, several smaller themes scattered on the periphery of the network, such as "language", "mathematics", and "research", show that although these themes have a role in the network, their relevance is not as strong as the main themes such as engineering education and science technology.

Overall, this visualization confirms that the main focus of current research is on engineering education, the use of technology in learning, and its impact on students and learning systems. As technological innovation continues to develop, it can be predicted that the role of e-learning, artificial intelligence, and computer-based technologies will continue to increase in shaping the future of education.

Mi Lethek is one of the traditional culinary specialties from Bantul Regency, Special Region of Yogyakarta, which has become part of the local culinary heritage and is popular for its uniqueness. The name "lethek" in Javanese means "dull" or "dirty", referring to the grayish brown color of these noodles which does not look as bright as modern instant noodles - but that is precisely what makes them attractive. Mi Lethek is made traditionally without preservatives or colorings, using cassava flour and cassava chips as the main ingredients, resulting in a distinctive and authentic taste. The manufacturing process still maintains traditional methods, even in some places still using cow power in the process of grinding the noodle dough, such as that which can be found at the Mi Lethek Cap Garuda Factory, located in Bendo Hamlet, Trimurti Village, Srandakan District, Bantul Regency, Yogyakarta. This place is also an educational tourism destination for visitors who want to see firsthand the traditional noodle making process. In addition to being able to be bought raw, Mi Lethek is also widely sold in processed forms such as fried noodles or boiled noodles in various food stalls in Bantul and its surroundings. One of the famous places to enjoy Mi Lethek is at Warung Makan Mbah Mendes or at Warung Mi Lethek Srandakan, which serves noodles with a blend of typical Javanese spices and is often served with additional

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duck eggs or shredded kampung chicken. The combination of savory flavors, chewy textures, and strong aromas of spices make this culinary not only a food, but also a cultural experience worth trying when visiting Bantul. The following is a visualization of Mi Lethek Cap Garuda.

Figure 6. Old Packaged of "Mi Lethek Bantul"
(Source: Cahyo, 2019)

Figure 7. New Packaging of "Mi Lethek Bantul"
(Source: Cahyo, 2019)

The analysis of science material and scientific questions based on the stages of making 'Mi Lethek Bantul' is as follows:

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Tabel 1. The analysis of science material and scientific questions based on the stages of making 'Mi Lethek Bantul'

Stages of Making Mi Lethek	Scientific Questions that Arise	Science Material
Raw material	1. Why is the color of Mi different from lethek noodles? 2. Why use cassava flour? 3. How does cassava flour compare to wheat flour?	Nutrition in food, substances and their changes
Fermentation of "Gaplek" Flour	1. Why does "gaplek" have to be fermented?	Biotechnology
Chips Milling	1. Why should cows be used for grinding? 2. Why use a large pounder of 12 quintals? 3. How fast are cows grinding? Is it stable or not? Does it affect the quality of the dough? 4. How is the use of the organ system in cows in the process of grinding "Mi Lethek"? 5. What is the relationship between the organ system in humans and animals in the process of making "Mi Lethek"?	Using cows to reduce environmental pollution due to machines, noise pollution. Because according to the manager, neighbors are happy if they are not disturbed. A large pounder will increase the pressure so that the mill runs optimally. Cow speed can be measured using a video analysis tracker, 3 hours per day per cow. There are 3 cows, enough for 12 hours of production. Respiratory and circulatory systems in humans and animals.
Airing process	1. Why should it be aired? 2. What is the best temperature until the cooling process is complete?	The process of temperature change and energy change

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Drying using oven or sunlight?	1. What is the difference between drying with an oven and the sun? 2. What are the results of drying using an oven and the sun? 3. What is the difference in time when drying with an oven and the sun? 4. What is the temperature used in the drying process? 5. What is the good water content for dried lethek noodles? 6. What are the characteristics of lethek noodles that are fit for consumption?	Changes in the form of substances, evaporation, good water content so that it does not cause bacteria and the noodles will last longer and last longer.
First Printing	1. Why are the noodles nice and unbroken?	Because the pressing process uses great pressure.
Packaging of Mie Lethek	1. How to pack well? 2. What kind of packaging should be used to ensure the noodles last?	Use thick plastic so that no wind can get in, so the noodles don't get damp and last longer.

Bibliometric analysis reveals a growing trend in Ethno-STEAM science learning, indicating increased scholarly interest and educational relevance. This trend is further reinforced by the potential integration of local cultural resources, such as the traditional food product Mi Lethek Bantul, into science instruction. Mi Lethek is a distinctive culinary product from Bantul, Yogyakarta Special Region, made from cassava processed into flour and shaped into noodles. While modest in appearance, Mi Lethek holds significant promise not only as a competitive culinary product but also as a rich contextual medium for science education. Produced using conventional, non-mechanized methods, Mi Lethek is often perceived as a healthier and more organic alternative to factory-made noodles (Cahyo, 2019).

The integration of science learning with the Mi Lethek production process exemplifies a contextual, meaningful, and local wisdom-based learning approach. Direct observation of the noodle-making process provides students with hands-on opportunities to explore a variety of scientific concepts in a real-world setting. For instance, in nutrition-related science topics, students can analyze the caloric differences between cassava and wheat flour. Cassava, used in Mi Lethek, contains approximately 146 calories per 100 grams—significantly lower than wheat flour, which contains around 365 calories per 100 grams (Risa, 2016). This comparison offers students a tangible understanding of nutritional science.

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This process exemplifies conventional biotechnology: the use of naturally occurring enzymes and microorganisms in food preparation without genetic modification. During dough formation, biological reactions involving native enzymes break down starches into simpler sugars, affecting the noodle’s taste and texture. These traditional techniques demonstrate how biotechnology is not limited to modern laboratories but also encompasses ancestral practices rooted in local wisdom.

In an educational context, this provides a powerful framework for students to appreciate that biotechnology exists on a spectrum—from high-tech innovations to time-honored, eco-friendly methods practiced by local communities for generations. Ethno-STEAM learning, therefore, not only enriches conceptual understanding but also promotes environmental awareness, cultural appreciation, and scientific curiosity.

During the steaming or drying stages of Mi Lethek dough, observable changes in temperature and physical form occur—offering a direct illustration of energy and heat transformation. The traditional sun-drying process, for instance, serves as an example of solar energy being converted into thermal energy, a concept that can be meaningfully linked to lessons on energy transformation in science curricula.

Additionally, the grinding of cassava flour involves mechanical pressure, making it a suitable entry point for exploring the concept of force and pressure in physics. The manual pressing process, which often involves the use of a heavy pestle, demonstrates how physical effort and pressure are applied to transform raw ingredients into dough.

Another interdisciplinary link can be made with biology, particularly within topics related to the human and animal circulatory and respiratory systems. In traditional Mi Lethek factories, cow power is still used to rotate large grinders. This practice provides a unique opportunity for students to observe how animals contribute to traditional industries. Teachers can guide students to examine the anatomical functions of the cow's body—such as the respiratory and muscular systems—that enable this physical labor. This contextual example reinforces biological concepts while also promoting empathy and understanding of human-animal relationships in everyday life.

From the lens of environmental education, the Mi Lethek production process strongly reflects principles of sustainability. Its reliance on natural resources—particularly sunlight for drying—and the minimal use of chemical additives exemplify an environmentally friendly alternative to modern, industrialized food production. This traditional method not only preserves local cultural heritage but also offers a low-impact approach that aligns with current sustainability goals.

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Incorporating this production model into classroom discussions allows educators to introduce key concepts in environmental conservation and green technology. Students are encouraged to critically analyze and compare the ecological footprints of traditional versus industrial food systems. Such comparisons foster environmental awareness and stimulate reflection on how ancestral knowledge can contribute to modern sustainability practices. Through this contextual integration, science learning becomes more relevant, inspiring students to consider both technological advancement and ecological responsibility in their everyday lives.

Figure 8. Material mixing process

Figure 9. The process of drying lethek noodles under direct sunlight.

Integrating science content with local cultural contexts, such as the traditional production of *Mi Lethek*, allows students not only to grasp scientific concepts theoretically but also to relate them directly to real-life experiences. This contextualization enhances the relevance and enjoyment of learning while simultaneously fostering a deeper appreciation for cultural heritage and environmental stewardship.

The STEAM (Science, Technology, Engineering, Art, and Mathematics) learning approach is particularly well-suited for application within the *Mi Lethek Bantul* production process. This traditional practice naturally intersects with all five STEAM domains, offering a rich, holistic, and contextual learning experience. Each component can be explored as follows:

a. Science

The traditional production of *Mi Lethek* offers a valuable context for exploring various scientific concepts, particularly in the fields of physics, chemistry, and biology. At the core of the process are observable physical and chemical changes. When cassava flour is mixed with water to form dough, students can investigate physical transformations, such as changes in texture and viscosity. Furthermore, the subsequent drying process—whether by sunlight or heat—introduces the concept of changes in states of matter, evaporation, and energy transfer (Gillespie & van Heuvelen, 2004). These processes allow students to apply thermodynamic principles, such as the relationship between temperature, energy, and molecular behavior (Martínez et al., 2011).

From a chemistry perspective, the gelatinization of starch during heating provides an entry point to understanding chemical bonding, thermal degradation, and non-reversible reactions, particularly when examining how heat changes the molecular structure of food components (deMan, 1999). These concepts are highly relevant to real-world applications, particularly in the food industry and environmental sustainability.

Biological principles also emerge in this context. For instance, the role of cows in powering the traditional milling process offers an opportunity to study animal physiology, particularly systems related to digestion, respiration, and muscular function (Guyton & Hall, 2006). Students can examine how cows convert chemical energy from food into mechanical energy, a direct application of bioenergetics and metabolic pathways (Campbell & Reece, 2008). This opens up discussion about the human-animal interaction in agriculture, the ecological implications of animal labor, and sustainable energy alternatives topics that align with both environmental science and ethics in biology education.

Embedding these processes in science education encourages contextual learning that connects classroom theory with local, culturally significant practices (Aikenhead

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& Jegede, 1999). According to Duit et al. (2007), such integration fosters deeper conceptual understanding by making learning more relevant and meaningful. This approach also aligns with the Next Generation Science Standards (NGSS), which emphasize crosscutting concepts, scientific practices, and disciplinary core ideas in real-world contexts (NGSS Lead States, 2013).

b. Technology

Although the *Mi Lethek* production process remains largely traditional, it provides a rich context for comparative analysis of technological development. The continued use of manual milling powered by cows serves as a tangible illustration of pre-industrial technology. When juxtaposed with modern grinding machinery, students are exposed to concrete differences in energy use, efficiency, labor intensity, and environmental impact. This contrast allows learners to explore the trajectory of technological innovation—from labor-intensive, low-carbon methods to high-speed mechanized processes that, while efficient, may have greater ecological footprints.

Analyzing this evolution invites critical reflection on sustainable development and appropriate technology. According to Eilks and Hofstein (2015), integrating technology in science education through real-world contexts enables students to grasp the broader socio-technical systems behind everyday objects. In line with the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006), such an approach ensures that technology is not merely showcased but meaningfully embedded in pedagogical strategies. Furthermore, examining the *Mi Lethek* process through a technological lens fosters an appreciation for locally rooted innovation and indigenous knowledge systems (Sillitoe, 2007), encouraging culturally responsive teaching (Gay, 2010).

c. Engineering

Engineering aspects of *Mi Lethek* production are present in the practical design and mechanical functioning of tools used for tasks such as milling, sun-drying, and manual packaging. These tools exemplify vernacular engineering—locally developed systems optimized for available materials and community needs. Introducing students to these tools through a problem-solving lens encourages them to identify limitations and propose improvements grounded in engineering principles. For instance, they could redesign traditional drying racks into solar-powered or hybrid dryers using upcycled materials, integrating renewable energy concepts and sustainability practices (Bybee, 2013).

This hands-on process aligns with the principles of Project-Based Learning (PjBL) and Engineering Design Processes (EDP), where students engage in iterative designing, prototyping, and testing (Wang et al., 2011). It also aligns with calls for incorporating *ethno-engineering* practices that respect and extend local knowledge

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rather than replace it (Ogunniyi & Ogawa, 2008). In doing so, learners become more than passive recipients of knowledge—they transform into active agents who co-create appropriate, community-based solutions.

d. Art

The art component in the study of *Mi Lethek* production opens diverse pathways for students to express creativity while deepening their engagement with cultural and scientific knowledge. Through designing packaging concepts or developing product branding strategies, students integrate principles of visual communication, aesthetics, and consumer psychology skills essential in both the creative industry and entrepreneurial education (Eisner, 2002). These activities help students understand how visual elements influence perception, cultural identity, and marketing effectiveness, particularly for traditional or local products.

Beyond branding, students can also create educational posters, infographics, or illustrated storybooks that depict the stages of *Mi Lethek* production. These projects serve not only as artistic expressions but also as pedagogical tools that enhance science communication and interdisciplinary learning (Marshall, 2014). Additionally, the production of documentary-style videos, short films, or stop-motion animations about *Mi Lethek* can foster digital storytelling skills, promote collaborative learning, and support multimodal literacy (Bull & Kajder, 2004).

Incorporating art in this way aligns with Multiple Intelligences Theory (Gardner, 1999), recognizing that students learn in varied ways—some visually, others spatially, or through narrative. It also supports Universal Design for Learning (UDL) by providing multiple means of representation and expression (Meyer, Rose, & Gordon, 2014). Moreover, such creative work honors and preserves intangible cultural heritage, giving students a role in documenting and revitalizing local traditions through modern media (UNESCO, 2003).

Ultimately, art in STEAM does more than decorate scientific concepts—it humanizes and contextualizes them, enabling students to connect emotionally and culturally with what they learn. As Hetland et al. (2007) argue, arts-integrated learning cultivates habits of mind such as observation, reflection, imagination, and persistence—skills that are as crucial in science and engineering as they are in the arts.

e. Mathematics

Mathematical concepts are seamlessly embedded within the production of *Mi Lethek*, offering meaningful and context-rich opportunities to strengthen students' numeracy and analytical thinking. Students can engage in real world mathematical applications by calculating ingredient quantities based on the desired yield, determining ratios and proportions in flour-to-water mixtures, and estimating optimal drying times under different weather conditions. These activities not only

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reinforce arithmetic and measurement skills but also build awareness of mathematical relevance in everyday life (Boaler, 2016).

Moreover, students can explore cost analysis by comparing production expenses (raw materials, labor, energy) with selling prices to determine profit margins. This introduces them to basic financial literacy, a critical life skill for economic decision-making (OECD, 2017). As a data literacy extension, learners may collect and analyze production-related data—for instance, tracking the number of batches produced weekly, recording environmental variables affecting drying, or surveying customer preferences.

Such datasets enable the practice of statistical analysis, including organizing data into frequency tables, calculating means or percentages, and visualizing trends using graphs and charts. These experiences develop students' abilities to interpret and represent data—competencies central to 21st-century STEM education (English, 2016; National Council of Teachers of Mathematics, 2000).

By contextualizing mathematics through *Mi Lethek* production, students experience problem-solving, modeling, and quantitative reasoning in a culturally grounded setting, which aligns with the principles of ethnomathematics (D'Ambrosio, 2001; Rosa & Orey, 2011). This approach not only improves learning outcomes but also fosters appreciation of local wisdom and cultural practices through the lens of mathematical thinking.

4. Conclusion

Based on the literature review, it can be concluded that integrating science learning with the Ethno-STEAM approach—rooted in local potential such as Mi Lethek Bantul—holds significant promise for fostering contextual, meaningful, and holistic education. This interdisciplinary approach enables students to grasp scientific concepts such as physical and chemical changes, energy transformation, the role of microorganisms, and conventional biotechnology in a tangible and relevant manner.

Moreover, students are actively engaged in exploring traditional technologies, understanding the engineering of simple tools, appreciating artistic and cultural expressions, and applying essential mathematical competencies. Beyond academic content, this integration also nurtures students' awareness of local wisdom, promotes cultural preservation, and encourages problem-solving grounded in real-world environmental contexts.

Ultimately, Ethno-STEAM-based science learning not only strengthens students' scientific literacy but also cultivates character development and essential

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21st-century skills—preparing them to become thoughtful, innovative, and culturally conscious citizens.

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References

Ahmi, A., Elbardan, H., & Raja Mohd Ali, R. H. (2019). Bibliometric Analysis of Published Literature on Industry 4.0. 2019 International Conference on Electronics, Information, and Communication (ICEIC), 1–6. https://doi.org/10.23919/ELINFOCOM.2019.8706445

Aikenhead, G. S., & Jegede, O. J. (1999). Cross-cultural science education: A cognitive explanation of a cultural phenomenon. *Journal of Research in Science Teaching*, 36(3), 269–287.

Alkhabra, Y.A., Ibrahem, U.M., & Alkhabra, S.A. 2023. Augmented reality technology in enhancing learning retention and critical thinking according to STEAM program. Humanities and Social Sciences Communications, 10(1). https://doi.org/10.1057/s41599-023-01650-w

Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, *11*(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

Arpaci, I., Dogru, M.S., Kanj, H., Ali, N., & Bahari, M. 2023. An Experimental study on the implementation of a STEAM-based learning module in science education. Sustainability, 15(8):6807. https://doi.org/10.3390/su15086807

Barak, M. (2012). From 'doing' to 'doing with learning': Reflection on an innovative model for technology-based learning. *The Science Education Review*, 11(2), 45–57.

Beers, S. Z. (2011). *21st Century Skills: Preparing Students for THEIR Future*. Kappa Delta Pi Record, 47(2), 76–83.

Bishop, A. J. (1988). *Mathematical Enculturation: A Cultural Perspective on Mathematics Education*. Springer.

Boaler, J. (2016). *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching*. Jossey-Bass.

Bull, G., & Kajder, S. (2004). Digital storytelling in the language arts classroom. *Learning & Leading with Technology*, 32(4), 46–49.

Bybee, R. W. (2013). *The Case for STEM Education: Challenges and Opportunities*. NSTA Press.

Cahyo Setiadi Ramadhan, Imam Suprabowo, Wulan Noviani. 2019. Pengembangan Mi Lethek Sebagai Kuliner Unggulan Bantul. Jurnal BERDIKARI. Vol.7 No.2. https://doi.org/10.18196/bdr.7263.

Campbell, N. A., & Reece, J. B. (2008). *Biology* (8th ed.). Pearson Benjamin Cummings.

Choudhri, A. F., Siddiqui, A., Khan, N. R., & Cohen, H. L. (2015). Understanding Bibliometric Parameters and Analysis. Radio Graphics, 35 (3), 736–746.

Online ISSN 2655-2450 | Print ISSN 2655-2388

https://doi.org/10.1148/rg.2015140036
D'Ambrosio, U. (2001). *Ethnomathematics: Link Between Traditions and Modernity*. Sense Publishers.
deMan, J. M. (1999). *Principles of Food Chemistry*. Springer.
Derviş, H. (2020). Bibliometric Analysis using Bibliometrix an R Package. Journal of Scientometric Research, 8 (3), 156–160. https://doi.org/10.5530/jscires.8.3.32.
Duit, R., Treagust, D. F., & Widodo, A. (2007). Science education research internationally: Conceptions, research methods and knowledge production. *International Journal of Science Education*, 30(15), 2091–2114.
E.M. Reeve. (2013). Implementing Science, Technology, Mathematics and Enginerring (STEM) Education in Thailand and in Asean, Bangkok: Institute For The Promotion and Teaching Science and Technology (IPST).
Eilks, I., & Hofstein, A. (2015). *Relevant Chemistry Education: From Theory to Practice*. Sense Publishers.
Eisner, E. W. (2002). *The Arts and the Creation of Mind*. Yale University Press.
English, L. D. (2016). Advancing Elementary and Middle School STEM Education. *International Journal of Science and Mathematics Education*, 14(1), 5–24.
Firda, Habibi Habibi. (2023). Pembelajaran Kontekstual IPA Berbasis Potensi Lokal bagi Siswa Kepulauan Sumenep. Prosiding Seminar Nasional Penelitian dan Pengabdian kepada Masyarakat 2 Tahun 2023 dengan tema "Inovasi Penelitian dan Pengabdian kepada Masyarakat menuju Indonesia Emas 2045.
Gardner, H. (1999). *Intelligence Reframed: Multiple Intelligences for the 21st Century*. Basic Books.
Gay, G. (2010). *Culturally Responsive Teaching: Theory, Research, and Practice*. Teachers College Press.
Gillespie, R. J., & van Heuvelen, A. (2004). *Chemical Principles in Context*. Houghton Mifflin.
Guyton, A. C., & Hall, J. E. (2006). *Textbook of Medical Physiology* (11th ed.). Elsevier Saunders.
Henriksen, D. (2014). Full STEAM ahead: Creativity in excellent STEM teaching practices. *The STEAM Journal*, 1(2), 15.
Hetland, L., Winner, E., Veenema, S., & Sheridan, K. M. (2007). *Studio Thinking: The Real Benefits of Visual Arts Education*. Teachers College Press.
Honey, M., Pearson, G., & Schweingruber, H. (2014). *STEM Integration in K–12 Education: Status, Prospects, and an Agenda for Research*. National Academies Press.
Jumini, S., Madnasri, S., Cahyono, E., & Parmin, P. (2022). Article review: integration of science, technology, entrepreneurship in learning science through

bibliometric analysis. Journal of Turkish Science Education, 19(4), 1237-1253.

Kalolo, J. F. (2016). Re-Aligning Approaches for Successful Implementation of STEM Education in Today's Elementary Schools in Developing Countries: Policy Commitments and Practices. Journal of Education and Literature, 4(2), 61–76. http://www.rassweb.com.

Kulakli, A., & Osmanaj, V. (2020). Global research on big data in relation with artificial intelligence (A bibliometric study: 2008-2019). *International Journal of Online and Biomedical Engineering*, 16(2), 31–46. https://doi.org/10.3991/ijoe.v16i02.12617

Lim, W. M., Kumar, S., & Donthu, N. (2024). How to combine and clean bibliometric data and use bibliometric tools synergistically: Guidelines using metaverse research. *Journal of Business Research, 182*. https://doi.org/10.1016/j.jbusres.2024.114760

Marshall, J. (2014). Transdisciplinarity and art integration: Toward a new understanding of art-based learning across the curriculum. *Studies in Art Education*, 55(2), 104–127.

Martínez, E., Domínguez, C., & López, J. (2011). Teaching thermodynamics through food science experiments. *Journal of Chemical Education*, 88(2), 215–219.

Meyer, A., Rose, D. H., & Gordon, D. (2014). *Universal Design for Learning: Theory and Practice*. CAST Professional Publishing.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.

Mukhopadhyay, S., & Greer, B. (2001). Modeling with a purpose: The role of context in mathematical modeling. *For the Learning of Mathematics*, 21(2), 20–25.

National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. NCTM.

NGSS Lead States. (2013). *Next Generation Science Standards: For States, By States*. The National Academies Press.

Novak, J. D., & Gowin, D. B. (1984). *Learning How to Learn*. Cambridge University Press.

Nurkhalisa and Ummayah (2015). Etse-Module "The Benefits of Acidic Bases in Life" Ethnoscience Based Demak Society in the Utilisation of Lime. International Journal of Science and Research (IJSR) 6, 1396–1400.

OECD. (2017). *PISA 2015 Assessment and Analytical Framework: Science, Reading, Mathematic and Financial Literacy*. OECD Publishing.

Ogunniyi, M. B., & Ogawa, M. (2008). The prospects and challenges of training South African science teachers in an argumentation-based course on science and indigenous knowledge. *Cultural Studies of Science Education*, 3(3), 703–722.

Parmin (2017). Ethnosains (Semarang: Swadaya Manunggal).

Patteson, A. (2002). If Truth Be Told: Learning from Women's Lived Experiences in

Online ISSN 2655-2450 | Print ISSN 2655-2388

Art Teaching. *Canadian Journal of Education*, 27(2/3), 291–305.

Pearson, G., & Young, A. T. (2002). *Technically Speaking: Why All Americans Need to Know More About Technology*. National Academy Press.

Quigley, C. F., & Herro, D. (2016). "Finding the Joy in the Unknown": Implementation of STEAM Teaching Practices in Middle School Science and Math Classrooms. *Journal of Science Education and Technology*, 25(3), 410–426.

Risa Panti Ariani , I.A.P Hemy Ekayani , Luh Masdarini. 2016. Pemanfaatan Tepung Singkong Sebagai Substitusi Terigu Untuk Variasi Cake. Jurnal Ilmu Sosial dan Humaniora. Vol. 5, No. 1.

Roehrig, G., & Garrow, C. (2007). Teaching science with technology: Case studies of science teachers' development of technology pedagogical content knowledge. *Contemporary Issues in Technology and Teacher Education*, 7(3), 231–255.

Rolling, J. H. (2010). A Paradigm Analysis of Arts-Based Research and Implications for Education. *Studies in Art Education*, 51(2), 102–114.

Rosa, M., & Orey, D. C. (2011). Ethnomathematics: The Cultural Aspects of Mathematics. *Revista Latinoamericana de Etnomatemática*, 4(2), 32–54.

Sahrir, D.C., Madnasari, S., Indriyanti, D.R.,& Sapitri, R. 2024. Research trends in ethno-steam-pjbl and religion integration oriented educational sustainable development in science learning through bibliometric analysis. Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education), 12(2):403-417.

Schliemann, A. D., Carraher, D. W., & Ceci, S. J. (1997). Everyday mathematics, mathematical thinking and school achievement. In L. P. Steffe et al. (Eds.), *Mathematics in Context*.

Sillitoe, P. (2007). Local science vs global science: Approaches to indigenous knowledge in international development. *Berghahn Books*.

Sorenson, B. (2010). Alaska STEM edocation and the economy: Report on the need for improved engineering and mathematics education in Alaska (Issue November). https://www.jedc.org/forms/STEMEducationJEDCFinal.pdf.

Sousa, D. A., & Pilecki, T. (2013). *From STEM to STEAM: Using Brain-Compatible Strategies to Integrate the Arts*. Corwin Press.

Sudarmin (2015). Pendidikan Karakter, Etnosains Dan Kearifan Lokal: KON-SEP Dan Penerapannya hearts Penelitian Dan Pembelajaran Sains [Pendidikan Karakter, etnosains dan Kearifan Lokal: Konsep dan Aplikasi dalam Penelitian dan Ilmu Pendidikan Karakter Pendidikan: Etnosains dan Kearifan Lokal], and others (ed.) (Semarang: CV. Swadaya Manunggal).

Sugiarto, Akhmad. 2023. Pembelajaran IPA Bermakna dan Menyenangkan Melalui Eduwisata. JSG: Jurnal Sang Guru Vol 2 No 3 Desember 2023, pp 1-7 E-ISSN: 2829-6567; P-ISSN: 2829-6583 https://ejournal.uinib.ac.id/jurnal/index.php/jsg/index.

Online ISSN 2655-2450 | Print ISSN 2655-2388

Tanudjaja, I., & Kow, G. Y. (2018). *Exploring Bibliometric Mapping in NUS using BibExcel and VOSviewer*.

Tobin, K. (1993). The practice of constructivism in science education. *Routledge*.

UNESCO. (2003). *Convention for the Safeguarding of the Intangible Cultural Heritage*. United Nations Educational, Scientific and Cultural Organization.

Wang, H., Moore, T. J., Roehrig, G. H., & Park, M. S. (2011). STEM Integration: Teacher Perceptions and Practice. *Journal of Pre-College Engineering Education Research (J-PEER)*, 1(2), 1.

Widowati, A., & Tyas, R. A. (2024). Mobile-based learning in science trends: a systematic review (2015–2023). In *Cogent Education* (Vol. 11, Issue 1). Taylor and Francis Ltd. https://doi.org/10.1080/2331186X.2024.2303563

Yakman, G., & Lee, H. (2012). Exploring the Exemplary STEAM Education in the U.S. as a Practical Educational Framework for Korea. *Journal of the Korean Association for Science Education*, 32(6), 1072–1086.

Yang, L., Sun, T., & Liu, Y. (2017). A bibliometric investigation of flipped classroom research during 2000-2015. *International Journal of Emerging Technologies in Learning*, 12(6), 178–186. https://doi.org/10.3991/ijet.v12i06.7095

Yuliana (2017). Pembelajaran Berbasis Etnosains dalam Mewujudkan Pendidikan Karakter Siswa Sekolah Dasar. ELSE (Elementary School Education Journal): Jurnal Pendidikan dan Pembelajaran Sekolah Dasar 1, 98–106.

Zaslavsky, C. (1996). *The Multicultural Math Classroom: Bringing in the World*. Heinemann.

Online ISSN 2655-2450 | Print ISSN 2655-2388