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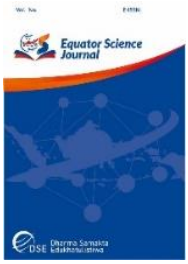

Integrating Dadiah as a Theme in Science Education to Promote Sustainable Development Goals (SDGs) for Junior High School Students

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ABSTRACT
Dadiah is a traditional food from the Minangkabau ethnic group of West Sumatra. Dadiah is made from buffalo milk which is fermented in bamboo and left for several days to form a yogurt-like structure. In addition, it is not uncommon for traditional foods that exist in various regions to have high nutritional value and are very good for health as well as through natural manufacturing and processing processes. Some of the sustainability goals are goals to build awareness of healthy living, healthy food sources, and responsible production processes. Thus, this traditional food has a very high potential to implement ESD. This traditional food can be used as a contextual learning resource that can support ESD values. In this study, the content analysis method was used to explore the potential of scientific concepts and ESD values based on kinds of literature. The criteria for content analysis are the relevance to scientific concepts, alignment with ESD values, and the coverage of Sustainable Development Goals (SDGs). There are the curriculum, textbooks, and sources from UNESCO about SDGs. This study showed that there are four basic competencies in science learning that are related to Dadiah as the theme. In addition, Dadiah can cover the five goals of the SDGs (goals number 2, 3, 8, 12, and 15) and can stimulate the achievement of sustainable key competencies in learning. Based on the results of this study, Dadiah which is a

traditional food has the potential to be implemented in science learning to achieve Sustainable Development Goals.

INTRODUCTION

In recent years, all sectors of life have collaborated to support various activities that support the achievement of sustainability goals. This sustainable activity is expected to make the world in the future better and avoid various problems such as hunger, reduced energy, habitat loss, climate change, and others. One of the important sectors that can support this sustainability is the education sector through learning activities that lead to the awareness or actions of students that support sustainability.

Education for Sustainable Development (ESD) is an effort to encourage students to be able to act constructively and creatively in facing global challenges and create a resilient and sustainable society. The World Conference on Education for Sustainable Development (Ermenc & Niemczyk, 2022) defined ESD as an approach to teaching and learning based on the ideals and principles that underlie sustainability including key issues. Once the aims of ESD are established, another challenge is to devise the most efficient and strategic method of achieving these objectives (Kopnina & Meijers, 2014). ESD enables every human being to acquire the knowledge, skills, attitudes, and values needed to shape a sustainable future. ESD incorporates key issues of sustainable development into teaching and learning; for example, climate change, disaster risk reduction, biodiversity, poverty reduction, and sustainable consumption.

Education for sustainable development equips students with knowledge, skills, and values for the social, environmental, and economic challenges of the 21st century. In the education sector, the part that plays an important role in implementing ESD is the role of educators and students, which directly instills sustainability values into students who later as adults will have an important role in society (Fredriksen & Rhodes, 2004). Students are taught to master the competencies needed for future challenges and problems that require students to have sustainable competencies. The learning process that implements ESD values to students will be able to help students to prepare themselves and take an active role in achieving the goals of sustainability (Hopkinson & James, 2010). ESD programs are supposed to focus on the triple bottom line, finding a balance between social/economic/environmental aspects of sustainable development (Stevenson, 2006).

Educational transformation for sustainable development is expected to use innovative learning methods, student-centered teaching, and use various learning styles. Education for sustainable development uses innovative learning methods, student-centered teaching, and various learning styles. Empowering students and making them agents in the educational process, from early childhood to old age. It can enhance learning beyond the boundaries of education. One of the innovations that can be used to transform education that leads to sustainable development is the use of traditional food which is a form of local wisdom as a source of learning, namely Dadiah. Dadiah is one of the traditional foods in the province of West Sumatra, Indonesia. Dadiah is a fermented product of buffalo milk (I. S. Surono, 2020). The purpose of this research is to explore the potential of traditional food, Dadiah, from West Sumatra, Indonesia, as a contextual learning resource to support Education for Sustainable Development (ESD). The study aims to show how Dadiah can be used to teach scientific concepts, promote sustainable practices, and instill values related to sustainability among students.

Local Wisdom "Traditional Food" as The Source of Education for Sustainable Development

One of the characteristics of local wisdom is having a high sense of solidarity and concern for environmental sustainability (Aqilah & Lathifah, 2023). Local wisdom in society can be a culture that is influenced by values, norms, laws, beliefs, ethics, customs, and special rules. This local wisdom is a hereditary inheritance from the ancestors and makes the community more bound (Rambu Atahau et al., 2020). One form of local wisdom is traditional food. The process of developing traditional food is influenced by the values and beliefs that develop in society. Indonesia is very rich with local wisdom in various regions. The vast territory of Indonesia also produces a heterogeneous society in terms of culture, social, way of dressing, the type of food. Especially for food, the territory of Indonesia has

various types of traditional food whose processing prioritizes the values that are brought in their respective regions.

The process of making traditional food that pays attention to solidarity and concern for environmental sustainability can be said to have values that are also aimed at sustainable development. Traditional regional food is usually processed and processed using available resources around (Ivana et al., 2021). In addition, it is not uncommon for traditional foods that exist in various regions to have high nutritional value and are very good for health as well as through natural manufacturing and processing processes. Some of the sustainability goals are goals to build awareness of healthy living, healthy food sources, and responsible production processes (Secretariat, 2017). Thus, this traditional food has a very high potential to support ESD. This traditional food can be used as a contextual learning resource that can support ESD values.

Description of Dadiah

Dadiah is a traditional food made from fermented buffalo milk and has a texture similar to yogurt. This traditional food is produced and consumed by the Minangkabau community in West Sumatra. Dadiah is a hereditary food and has a natural manufacturing and processing process. Dadiah production is mostly carried out in the areas of Bukittinggi, Padang Panjang, Solok, Fifty Cities, and Tanah Datar (I. Surono & Hosono, 1996). Minangkabau people usually produce and consume Dadiah for big events such as weddings or certain regional celebrations.

Currently, Dadiah is produced and processed naturally by the community. The fermentation process that occurs in the Dadiah is also done naturally. Dadiah uses material from buffalo milk which is an animal that is widely bred by the community because of its functional value which is very useful for the Minangkabau community for farming (Aritonang et al., 2021). Thus, the number of buffalo in the West Sumatra region is large. In the manufacturing process, buffalo's milk is naturally fermented in bamboo, then left overnight at room temperature (28 C – 30 C). During the night there will be a fermentation process so that the Dadiah will form a lumpy structure and become soft like yogurt. In addition, Dadiah is also proven to have a high nutritional content. The Dadiah made from buffalo milk has a higher fat and protein content than cow's milk (Putra et al., 2016). Meanwhile, the protein content in Dadiah reaches 4% (Sugitha, 1995). Dadiah also contains 16 types of amino acids and 10 of them are essential amino acids (Sugitha & Aidi, 1998).

Besides having high health potential, Dadiah also has the potential for economic development in the community because of its high nutritional value. However, currently, Dadiah tends to be consumed only by the elderly and lives in rural areas which are still thick with culture and tradition. Meanwhile, among young people and people living in urban areas, this fermented buffalo milk product is less popular and the amount of consumption by young people is still very low (Putra et al., 2016). Dadih not only has high nutritional value but can also be a source of economy and has a strong influence on society because it is a cultural food that must be preserved. Therefore, Dadiah is very suitable to be used as a theme in integrating ESD values in science learning at junior high school.

METHOD

This study used a content analysis method with the explicit-reflective approach to extract the relevant potential information from the literature. First, resources from various articles about Dadiah were collected and analyzed contextually for further research. The main documents that were used in this study are Permendikbud No. 37 2018 which contains the core competence and basic competence of science in junior high school in Indonesia. As supplementary to get the detailed result, this study also includes the official textbook from the government including all secondary textbooks (2013 curriculum 2017 revision) whether for the teacher guide or the students in the classroom (Mu'aziyah & Isnawati, 2023). Another source used is an article from UNESCO on SDGs and ESD to analyze the indicators of achievement of the SDGs that can be achieved through learning with the theme of Dadiah.

RESULTS AND DISCUSSION

Analysis of the core and the basic competencies related to Dadiah

Dadiah is a traditional food whose manufacturing process goes through certain stages, especially fermentation which also involves a process of changing substances. After analyzing the science e syllabus in grades 7, 8, and 9. It was found that four basic competencies can be achieved if it integrates Dadiah as a theme in learning. These four basic competencies are found in the seventh and ninth-grade lessons, while for the eighth grade there are no basic competencies that match the Dadiah theme. Therefore, based on the curriculum and textbooks, this is a basic competency that is following the Dadiah theme.

Table 1. Analysis of the core and the basic competencies related to Dadiah

Class	Basic Competence (Knowledge)	Basic Competencies (Skills)	Dadiah	Suitable material
VII	Explain the concepts of mixtures, substances and an example of the change in everyday life	Presenting the results of the investigation or works on the properties of solutions, changes physical and chemical changes, or mix separation	• Type of material or substance • Type of change of substance	• Material properties • Element • Compound • Mixture • Substance change • Properties of the solution
	3.4 Analyzing the concepts of temperature, expansion, heat, heat transfer, and its application in life day-to-day including mechanics maintain a stable body temperature humans and animals	4.4 Conducting an investigation of effect of heat on temperature and state of matter and heat transfer	• Effect of temperature on the product manufacturing process • Type of heat transfer • The effect of heat on the state of matter	• Temperature • Heat • Heat transfer • Substance form
IX	3.5 Analyzing the digestive system on human, a nuisance related to the system digestion, as well as efforts to maintain digestive system health	4.5 Presenting information search results about digestive system disorders or efforts to maintain the health of the system digestion	• Dadiah as healthy food	
	3.7 Applying the concept of biotechnology and its role in human life	4.7 Making one of the products conventional biotechnology in surrounding environment	• Conventional biotechnology products	• Biotechnology • Types of biotechnology • Benefits of biotechnology products

Based on the table 1 above, it can be seen that the material that is in accordance to the theme of Dadiah is related to the substance and its changes, conventional biotechnology in the form of fermentation, and the health of the digestive system. All of these materials are related to biology and some are also related to chemical processes. Technically, these materials can be applied with various approaches, models, or methods by educators. Several approaches that can be taken are projectbased learning. Project-based learning is a model that organize learning around projects (Thomas et al., 2015),

teacher can assign students a project that involves researching the scientific principles behind Dadiah fermentation, its nutrisional value, and its role in sustainable food systems. This approach encourages independent inquiry and critical thinking (Thomas et al., 2015).

Analysis of the sustainable development goals related to Dadiah

The Dadiah theme is related to several goals of the SDGs, particularly those related to consumption, production, food, and health. Therefore, here are some of the goals of SDGs that can be achieved through science learning with the theme of Dadiah.

Table 2. Analysis of the sustainable development goals related to Dadiah

Sustainable Development Goals	Description
Goal 2 – Zero Hunger	Students can understand that to overcome hunger is the availability of appropriate and nutritious food sources. Through this Dadiah traditional food product, students can find out about the availability of nutritious food products and what nutritional values are needed to prevent hunger. In addition, students can also be invited to appreciate food more and not waste food. This awareness can be raised if students are involved in the process of making Dadiah. Students will appreciate food more if they know the process and difficulties encountered when making it.
Goal 3 – Good Health and Well-Being	Dadiah is a healthy food product. This fermented buffalo milk has a high value and is very good for health. It contains higher fat and protein. So that the third goal can be achieved by inviting students to know the nutritional content contained in Dadiah products to create a healthy life.
Goal 8 – Decent Work and Economic Growth	Students can learn that this Dadiah product is one of the food products that can be sold. Thus, students can learn that the manufacture of nutritious traditional food products can be used as a way to support economic growth in the community. Currently, Dadiah is not well known in Indonesia, even in West Sumatra itself, not all regions produce Dadiah. So, if this product can be preserved and traded creatively, then this product can be used as a business field for economic growth.
Goal 12 – Responsible Consumption and Production	Students can understand that every form of consumption and production must be carried out responsibly, in this case, is food. Students can learn that the process of making Dadiah is done naturally, does not cause environmental damage, and uses environmentally friendly materials. Through this Dadiah theme, students will be able to understand these things.
Goal 15 – Life on Land	Students can understand that there is a variety of biodiversity on land. In the process of making Dadiah, it involves bamboo plants which are one of the plants whose species must be maintained. Students can learn how to use natural resources on land responsibly and not cause damage or extinction of other living things.

Based on the table 2 above, of the 17 goals, at least five goals are associated with Dadiah. Each goal can be integrated through learning with this theme. Even so, goals 3 and 12 which have a closer relationship, namely good health and well-being and responsible consumption and production, can be achieved directly through learning, especially if students are invited to make conventional biotechnology products in the form of Dadiah.

There are four main dimentions of food security based on Food and Agriculture Organizations (FAO), there are physical availability of food, economic and physical access to food, food utilization, and the stability (Kumar et al., 2021). Dadiah is a nutrient-rich food, a traditional food that promote local production and reduces reliance on imported or processed foods. It supports zero hunger and good health and well-being. SDGs also seeks to achieve sustainable food production systems through the implementation of resilient agricultural practices that increase productivity by maintaining the health of ecosystems (Dias et al., 2019). Dadiah that is produced and processed naturally by the community can achieve the goals number 8, 12, and 15. The fermentation process is also done naturally. Using sustainable material from buffalo milk which is an animal that is widely bred by the community because

of its functional value which is very useful for the Minangkabau community for farming (Aritonang et al., 2021).

Analysis of the sustainable key competencies related to Dadih

Overall, the Dadiah theme is closely related to food and health issues. In integrating learning with this theme, students can be trained to achieve some of the key competencies needed in sustainability education. Based on the analysis conducted on basic competencies, sustainability objectives, and material suitability, the integration of the Dadiah theme in learning will be able to achieve the following key competencies.

Table 3. Analysis of the sustainable key competencies related to Dadiah

Sustainable Key Competence	Relations to the theme
System Thinking Competency	Students are expected to be able to think of systems in analyzing forms of responsible food consumption and production. In this case, students will have the ability to analyze every impact and problem that occurs so that production and consumption can be accounted for. This process will make students think from a system and find out the relationship between one thing and another.
Normative Competency	Students are expected to act by thinking about the values and norms around them. This key competency can be achieved by showing students that Dadiah is one of the traditional Minangkabau foods that are rarely found even though they have high nutritional value. Awareness of values, norms, and culture that have ties to the theme of this Dadiah will appear in students.
Collaboration Competency	In this lesson, students can understand the importance of collaborating and participating individually, in groups, and society. To preserve this traditional food and ensure its safe and appropriate processing, collaboration is needed.
Critical Thinking Competency	In this Dadiah theme, students will also be able to think critically about overcoming hunger and health problems, especially the health of the digestive system. Students who already know the nutritional values of Dadiah will be able to implement the use of Dadiah to help overcome certain health problems because of its high nutritional content. At this stage, students are expected to be able to think critically about finding solutions and other uses that can be made from these traditional food products.
Integrated Problem Solving Competency	In this topic, students are also faced with how to process products that are expected to be environmentally friendly and do not damage certain habitats around them, so students must integrate problem-solving to deal with the possibilities that will occur when using nature as a food source or food processing source.

This theme has great potential to stimulate the competencies students to need to achieve sustainability goals. So, based on this analysis, further research can be carried out to find out to what extent the curd theme can help students achieve key competencies for sustainability.

Perspectives of ESD related to the theme

Sustainability programs are always linked to three sectors, namely social, environmental, and economic. However, in reality, when implementing the learning process, the approach used is often only from one aspect. For example, for science lessons, more emphasis is placed on environmental aspects. To achieve sustainable education, each of these main sectors must be involved in learning. This means that implementing ESD into learning cannot consider only one aspect such as economic aspects, but must also pay attention to other aspects such as socio-cultural and environmental aspects (Puslitjaknov, 2010). Therefore, on the theme of Dadiah, an analysis is carried out by integrating the three main perspectives, namely social, environmental, and economic.

Table 4. Analysis of ESD Perspectives

ESD perspective		
Social	**Environment**	**Economy**
Human rights • The right to be free from hunger • The right to get adequate nutrition from food **Security** • Live in harmony, peace, and please help regardless of SARA • Honest and responsible towards attitude and treatment towards the environment **Equality** • The same right to get health insurance from the government • Equal rights to education and health, especially access to a safe and healthy environment **Health** • Self-awareness for healthy living through the consumption of nutritious food. • Self-awareness to always maintain the cleanliness and health of the surrounding environment **Governance** • Know the rules that apply in government regarding the regulation of exploitation of natural and social resources • Public accountability, not being exclusive and responsible	**Natural Resources** • Preservation, conservation, and rehabilitation of natural resources, such as bamboo. • Sustainable natural resource management and use • Exploration and Exploitation of Natural Resources following scientific principles without prejudice to social aspects and not prioritizing personal interests	**Corporate Responsibility (CSR)** • Community empowerment in actively participating in economic growth through traditional food products • Encourage community independence in protecting and managing local wisdom in the form of traditional food **Market Economics** • Negotiation and diplomacy skills in solving problems involving conflicts of interest based on scientific insight and sustainable competence

From the table, it can be seen that this issue is appropriate to be implemented in the classroom to implement ESD values that can cover all of the pillars of ESD. All in all, most of the aspects come from the social aspect which may provide prodigious potential within one issue. Further research is open to investigating each of the goods within each aspect. Furthermore, everything in the perspectives is still can be related in the science context.

CONCLUSION AND SUGGESTION

Local wisdom in the form of a traditional Minangkabau food called Dadiah has very good potential to be implemented in science learning. One of the indicators with the most potential to be implemented is conventional biotechnology and digestive system health, which are basic competencies that must be possessed by grade VII and XI students. In addition, through science learning using the Dadiah theme, several key competencies in ESD will be achieved, and students can be more concerned with the environment and the natural surroundings. From the ESD perspective, students also learn to see the potential of traditional food from a social, economic, and environmental perspective. Some of the goals of the SDGs can also be achieved through learning with this theme. Therefore, using the Dadih theme in learning will be able to help in the achievement of the sustainability goals. Students practice being able to care more about the environment, maintain health, be able to sort out the right nutritional values,

be responsible in acting, and cooperate with friends, teachers, and the community in the surrounding environment.

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