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Integrating Living Values Education by Bridging Indigenous STEM Knowledge of Traditional Salt Farmers to School Science Learning Materials

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ABSTRACT The lack of bridges between formal science taught in schools and indigenous STEM knowledge is a problem that leads to the abandonment of cultural values and local wisdom. This article aimed to (1) describe the traditional salt production process by farmers and their living values education (LVE), and (2) transform indigenous STEM knowledge into scientific knowledge that can be applied to school science learning. This research was conducted in Central Java, Indonesia using observation, interviews, and literature and document review. A qualitative, ethnographic approach revealed that the traditional salt production process includes (1) draining the land; (2) making plots; (3) draining the pond plots; (4) compaction of the land surface; (5) seawater drainage; and (6) harvesting the salt. Identifiable living values include collaboration, simplicity, happiness, responsibility, and corporation. Indigenous knowledge is found in salt farmers' understanding of the characteristics and the process of salt crystal formation and their use of traditional equipment. Indigenous STEM knowledge can be transformed into school science learning materials as an example of integrating LVE.

Keywords Indigenous STEM knowledge; Traditional salt farmers; School science learning materials; Living values education

1. INTRODUCTION

Indigenous knowledge has been ignored and is not included in the school curriculum. Some have argued that traditional knowledge is not appropriate for students to learn because it will limit non-indigenous groups' access (Aikenhead & Ogawa, 2007). The current science curriculum represents knowledge originating from the western world that often forgets things closely in the social environment and student reality (De Beer & Whitlock, 2009). The rapid development of science and technology has encouraged science education, which is currently integrated with STEM education (Science, Technology, Engineering, Mathematics) in bringing about specific formal sciences as taught in schools. The school describes and optimizes STEM education to prepare students for future colleges and careers (Seage & Türegün, 2020). As a world education trend, STEM is an educational approach that facilitates individuals to acquire information and skills with an interdisciplinary approach (Kurt & Benzer, 2020). Meanwhile, indigenous knowledge has developed in various legal community forms, such as symbolic messages, customs, and culture. These things often contain multiple concepts, principles, or scientific knowledge that have not been formalized, including developments that lead to knowledge in various technologies, engineering, and mathematics (Duit, 2007).

The community's actual science knowledge, the pattern of development is passed on continuously between generations, randomly structured without curriculum, local, informal, and generally constitutes knowledge of people's perception of a natural phenomenon (Battiste, 2005). Indigenous knowledge provides a specific perspective on certain phenomena held by local communities. This knowledge offers a different view from the science developed in the Western world (Zidny, Sjöström, & Eilks, 2020). At the scientific level, indigenous science is often referred to as folk knowledge, traditional knowledge, or traditional ecological knowledge (Battiste,

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2005; Duit, 2007). On the other hand, the formal experience can only be understood scientifically and based on scientific work. Therefore, scientific knowledge is objective, universal, and value-free processes and can be justified. Chiappetta and Koballa (2010) explained that science is a systematic effort to create, build, and regulate knowledge about natural phenomena that begin with human curiosity. An investigation into the phenomenon is carried out. Various phenomena in the universe can be tested and studied with science (Ogunniyi, 2011).

The scope of scientific knowledge and its extension to STEM can cover chemistry, biology, physics, agriculture, ecology, and medicine (Battiste, 2005). Medical expertise and medicine can be seen in the knowledge of indigenous peoples in using traditional medicines and the production of *Simplicia* from plants to cure certain diseases and traditional therapeutic systems (Robbins & Dewar, 2011; Winkelman, 2009). Knowledge of indigenous peoples related to physics and engineering can be seen in the Javanese Joglo house (Idham, 2018; Widayati, Rakhmawati, & Pratama, 2019). The knowledge in agriculture can be reviewed in the Sundanese understanding of the photosynthetic cycle and plant respiration (Djulia, 2005) and how farmers' knowledge in producing palm sugar (Sumarni, Sudarmin, Wiyanto, & Supartono, 2016).

Indonesia is the country with the second-longest coastline in the world. According to the Geospatial Information Agency, Indonesia's coastline length reaches 99,093 kilometers (Rochmi, 2017). However, the coastline's length is not the main factor that makes automatic salt production directly proportional to salt production. Many factors cause salt production to affect factors, both in science and technology and other socio-economic aspects. Students or ordinary people often understand that the salt production process is so simple: evaporating seawater. Coastal community (salt farmer) knowledge about salt production is a culture shared by Kertomulyo village residents, Trangkil sub-district, Pati Regency, Central Java Province, Indonesia. The process of salt production traditionally contains values full of local wisdom, but not all school students understand the process. Suastra (2005) explained that indigenous people's values that are full of local genius and recognition had been ignored in learning, especially in learning science in schools. Thus, learning science or STEM in schools becomes "arid" and lacks meaning for students.

The lack of bridges between formal science taught in schools and indigenous STEM knowledge is a problem that leads to the abandonment of cultural values and local wisdom. The existence of indigenous STEM knowledge and many other aspects of society and culture (Hofstein, Eilks, & Bybee, 2011) have become neglected and do not touch the existing curriculum (Kibirige & van Rooyen, 2006). Even students become strangers to the STEM knowledge that develops in the surrounding local communities. This evidence will continue to the moral, social, cultural, and natural crisis that has caused a humanitarian crisis (Herusatoto, 2012; McInnes, 2017). The implementation of traditional knowledge of the community is in line with attitudes and traditions which reflect the soul and values that develop in social life. This phenomenon also happens to Indonesian people who base their life values on the values of Pancasila. Pancasila as the value system of the life of the Indonesian nation includes five precepts (sila), namely: 1) Belief in the Almighty God (in Indonesian "*Ketuhanan Yang Maha Esa*"); (2) A just and civilized humanity (in Indonesian "*Kemanusiaan yang Adil dan Beradab*"); (3) A unified Indonesia (in Indonesian "*Persatuan Indonesia*"); (4) Citizens led by the wisdom of representatives consensus (in Indonesian "*Kerakyatan yang dipimpin oleh Hikmat Kebijaksanaan dalam permusyawaratan/perwakilan*"); (5) Social justice for all Indonesians (in Indonesian "*Keadilan Sosial bagi seluruh Rakyat Indonesia*"). The need to instill values is in line with the concept of the Living Values Education Program (LVEP). LVEP is an effort in conceptualizing education to encourage the development of value-based learning and the search for meaning. The United Nations Educational, Scientific and Cultural Organization (UNESCO) developed values of LVEP, which include (1) peace, (2) respect, (3) love, (4) cooperation, (5) happiness, (6) honesty, (7) humility, (8) responsibility, (9) simplicity, (10) tolerance, (11) freedom and (12) unity (Tillman, 2012). Thus, it becomes important to bridge indigenous STEM knowledge of traditional salt farmers to school science learning materials integrating living values education of Indonesia. This research aimed to (1) describe the traditional salt production process by farmers and their living values education, and (2) transform indigenous STEM knowledge into scientific knowledge that can be applied to school science learning in accordance with the education curriculum of Indonesia.

2. METHOD

This research is an ethnographic study, which in the process involves investigating and recording the results. The research process results in a precise reconstruction of a particular group (Cohen, Manion, & Morrison, 2007). The research describes the condition of salt farmers and finds the keys to their original knowledge related to the values of life and aspects of science and the technology that develops in the salt production process. This research was conducted in the village of Kertomulyo, Trangkil sub-district, Pati Regency, Central Java Province, Indonesia. This location was chosen because Kertomulya Village has the largest salt pond area among 16 other villages in the area (6°38'27.089" S 111°6'58.590" E). According to livelihoods, the number of salt farmers is around 398 people out of 3,857 people based on population data. The area of this village is 460,268 Ha (Pemerintah Desa Kertomulyo, 2016). Researchers dealt with three key

Table 1 Characteristics of key informants

Key Informants	Age	Educational Background	Experience being a salt farmer	Land area owned
KI_1	29	Graduated from high school	7 years	1.8 Ha
KI_2	50	Graduated from elementary school	10 years	0.5 Ha
KI_3	54	Graduated from elementary school	15 years	1.9 Ha

informants who were determined (Goctz & LaComte, 1984; Spradley, 1979) based on the village leaders' instructions to represent groups of traditional farmers. This sampling is a type of reputational-case sampling (Cohen et al., 2007), where the researcher asks an expert, in this case, a person who understands the area where the research is located. Three key informants were obtained with detailed characteristics shown in Table 1.

The method used is a qualitative approach by reconstructing activities with indigenous STEM knowledge in the production of salt in ponds for scientific transformation and transforming the actual knowledge from salt farmers into scientific concepts, which are used as formal science content taught in schools. Data collection techniques include primary data collection by observation and interviews and secondary data collection by studying literature and documents about making salt.

The research instrument used in the study was the observation sheet and interview sheet, which were tested directly to the key informants at the research location. Observations were made by observing the stages of salt production, the details of the location of salt production, the processes that occur in each salt field plot, and the identification of the characteristics of seawater processing into salt in each plot. Researchers explored the stages of salt production from the process of preparing the farmland to the harvesting process. Researchers took saltwater samples on ponds to determine salinity conditions with the Salt hydrometer 0-35 Baumé. Interview with ten main questions covering five components, namely (1) Raw material in salt production; (2) Salt production process; (3) The process of forming salt crystals, which includes understanding when the crystals were formed, the speed at which they were formed, and the purification process; (4) Water salinity which includes farmers' understanding of salinity and identification of salinity in the process of transporting brine to each existing plot; (5) Product characteristics which include how farmers explain salt and iodized salt. Sumarni et al. (2016) explained to ensure the level of trust in data is done by (1) conducting intensive field research (2) triangulating data and methods; (3) preparing adequate references (4) containing negative case studies. The level of dependency and certainty of the study results are enhanced by reviewing all traces of research activities and informants (Suastra, 2010; Sumarni et al., 2016).

Data analysis is carried out continuously and intensively, categorized, and then transformed into scientific knowledge. Data interpretation is made through group discussions and literature reviews related to science concepts. The research was continued by transforming the original findings in the form of formal science linked to the existing curriculum in Indonesia and the values of life in Indonesia that were based on Pancasila. The analysis stage was carried out with stage modification (Cohen et al., 2007), which includes: (1) Analyzing each observation data by grouping them into code units which include tool drawings, salt field area drawings, salinity in seawater, and a collection of activity documentation which implies the values of life; (2) Analyze interview data by grouping them according to code; (3) Creating a group code that includes (a) Indigenous Knowledge, (b) Formal Science, (c) Science Concept, (d) Traditional Technology, and (e) Living Values; (4) Linking codes; (5) Transforming native knowledge with formal science; (6) Summarizing the findings to provide an overview; and (7) Summarizing the relevance of each code. Analysis of the linkage to the code created with the Atlas.Ti software (ATLAS.Ti, 2020).

3. RESULT AND DISCUSSION

3.1 Result

Traditional Salt Production by Farmers and the Living Values Education

Researchers conducted observations and interviews to determine how the salt production process was arranged, starting from land clearing to harvesting. The series of processes presented by key informants are then categorized as indigenous STEM knowledge. Based on the explanation of critical informants, how the values that are activated in each activity are also analyzed. The lived values are categorized based on the Living Values Education

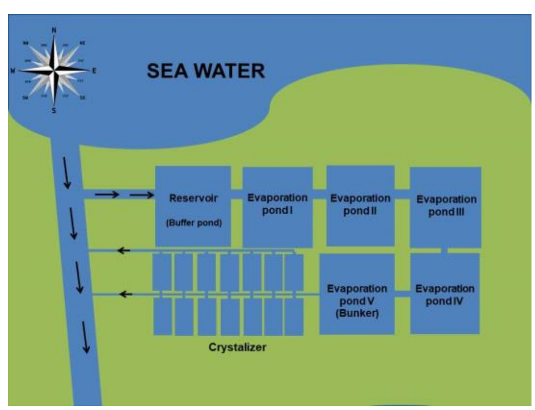

Figure 1 A sketch of the land for traditional salt production owned by farmers

Table 2 Stages in the salt production by farmers in Kertomulyo Village

No	Stages	Description	Living Values Education
1	Draining Water on Land	Drainage of ponds that had previously been used for the cultivation of fish, milkfish, and shrimp. Draining pond water by using a water pump machine aims to eliminate standing water	Collaboration and cooperation carried out by farmers in the process of drying land and making plots.
2	Stages of Making Plots on Pond Farms	This stage is to divide the land of ponds that were previously used for milkfish cultivation into salting complexes which are located in plots of a regular size. Plots are used as a place for seawater collectively in the process of making salt.	
3	Draining in Pond Plots	The salt-pond drying is done by drying the soil surface in the sun. Drying usually takes about 5-7 days to see cracks on the ground surface. Drying aims to remove lichens that stick to the surface of the salt ponds, before smoothing and compaction on the surface of the salt ponds.	Simplicity in the process of making salt. In this process also demonstrated how the hard work of salt farmers in the process of getting salt to be consumed by the community. Furthermore, at this stage it is shown how the responsibility of the salt farmers is to complete their tasks and comply with the series of processes in salt production.
4	Compaction of Land Surface in Plots	The stage of land encroachment after drying, (in this first stage the cracks of the dried soil will be slightly docked) The plot area is filled with seawater with a height of about 1cm The plot is back in the sun for about 2 days until the plot is dry The plot is refined until the cracks on the surface of the soil are tightly closed. The plot is re-dried in the sun until the soil in the plot is tight and dense, until visible splashes of salt from the soil surface, The final soil refinement is carried out again.	
5	Seawater drainage in pond plots	This process flows seawater to each plot periodically along with changes in water salinity levels.	
6	Harvesting salt	The activity of collecting salt products from the crystallization plot. The harvesting process is carried out at least 4-5 days. The salt is transported and then put into a storage warehouse.	Salt harvest as a form of appreciation is given for the patience of farmers. How happiness arises when the harvest is successful, as well as the owner's responsibility to the workers. Besides, there are cooperative values in the harvesting process. From this activity, they also captured how in general they have humility and honesty in their interactions during the buying and selling process of salt.

Table 3 Processes on land used for salt production

Section	Function	Depth	Storage Time	Process
Reservoir (Buffer Pond)	Stock of seawater	±1 m	± 10 days	Precipitation of impurities Increased seawater density, from 3^{o} Be to 7^{o} or 10^{o} Be
Evaporation Pond I	Evaporation of seawater from buffer ponds	±10 cm	± 2 days	Increased salinity up to 10^{o}Be or 12 ^{o}Be
Evaporation Pond II	Evaporation of seawater from buffer ponds	±10 cm	± 2 days	Increased salinity up to 12^{o}Be or 14 ^{o}Be
Evaporation Pond III	Evaporation of seawater from buffer ponds	±10 cm	± 2 days	Increased salinity up to 14^{o}Be or 16 ^{o}Be
Evaporation Pond IV	Evaporation of seawater from buffer ponds	±10 cm	± 2 days	Increased salinity up to 16^{o}Be or 18 ^{o}Be
Evaporation Pond V (Bunker)	Brine storage area (water with salinity up to 25^{o}Be)	±10 cm	Check the salinity level up to 25^{o} Be.	Increased salinity up to 20^{o}Be or 25 ^{o}Be
Crystalizer	The salt leachate crystallization process	≤ 5 cm	± 3 days	The crystallization of brine Obtained by bittern (liquids with a salinity level of more than 28^{o}Be)

developed by UNESCO and are associated with living values that refer to Pancasila, which is the source of life values in Indonesia. Based on the identification of results on the values that are turned on in the salt production

Table 4 Transformation of the indigenous STEM knowledge of salt production into formal science

No	Indigenous STEM Knowledge	Formal Science
1	**Characteristics of salt products**	
	KI_1, KI_2, KI_3: Salt (or "uyah" or "sarem": informants' language) is a supplement to seasonings in cooking, as well as a mixture of ingredients in livestock drinks in the village, which includes goats, buffaloes, and cows. Salt is mixed with water added with tofu waste as a livestock drink.	Salt is an ionic compound consisting of an acid and base product with a component of positive ions (cations) and negative ions (anions) to form a neutral compound. The largest constituent of salt is the NaCl compound and impurities consisting of $CaSO_4$, $MgSO_4$, $MgCl_2$ (Rini, Pramono, & Nugraheni, 2017). Science concepts: **Elements, Compounds, Ionic Bonds**
2	**The raw materials of salt production**	
	KI_1, KI_2: Seawater is transported to small rivers and flowed to ponds. N_3: Salt is formed from seawater.	Salt can be formed in 3 ways, namely evaporation of seawater, mining rock salt (rock salt), and obtained from salt well water. (Hadi & Ahied, 2017b) Science concepts: **Separation of mixture** and **heat transfer**
3	**The process of salt production**	
	KI_1, KI_2, KI_3: Making salt is done by evaporating seawater which is distinguished by traditional and modern ways.	Salt production can be done in several categories based on differences in NaCl content. Evaporation with the source of sunlight energy in the salt-making fields. Evaporation with the heat energy source of the fuel in the evaporator and the crystallization process of salt in the crystallizer, The electrochemical separation of salt solutions by electrolysis, and the process of crystallization using a crystallizer. (Rositawati, Taslim, & Soetrisnanto, 2013) Science concepts: **Heat Transfer**, **Electrochemical**, and **Crystallization**
4	**When did salt crystals form?**	
	KI_1, KI_2, KI_3: When the process of evaporation of seawater in the land of salt plots (respondent's language: koeng). About biweekly deposition, when the water has aged and salt grains have been seen.	Crystallization is the formation of solid particles in a homogeneous phase. Salt crystals are formed from a homogeneous solution of seawater with a concentration of 20-30° Be. The most influential factor in crystal size is the nucleation velocity and growth rate which is affected by supersaturation. Supersaturation is a condition where the concentration of solids (solute) in a solution exceeds the saturation concentration of the solution. To present the condition of supersaturation, one way is to evaporate the solvent through the evaporation process. If the solvent in a saturated solution is reduced, the saturation concentration of the solution will drop so that the supersaturation conditions are reached and crystals are formed (Fachry, Tumanggor, & Yuni L., 2008). Science concepts: **Saturated** and **Unsaturated Solution**
5	**How to find out the salinity of salt water?**	
	KI_1, KI_2, KI_3: Touch the water in the map, and then feel the water stickiness level. The more sticky, the higher the salinity level.	The instrument used to determine the salinity level is a Salinometer. Salinometer is a device used to measure the density of various liquids (measure the density of a liquid object). The Salinomemeter scale unit is denoted by the degree Baume, Be. The volume of distilled water is 0. This scale is often used to measure the concentration (Wibawa, Putra, & Wendri, 2019). Science concepts: **Concentration Measurement**

process by farmers, it can be seen that the values practiced are the values in the 5th precept, "Social Justice for All Indonesians". Details of the stage identification results can be s een in Table 2.

The process of crystallizing seawater into salt crystals that exist on the farmer's land in Kertomulyo Village is still carried out conventionally, in which knowledge is obtained from generation to generation. Details of the land owned by farmers are shown in Figure 1.

The salt crystallization technique is by processing seawater inserted into the reservoir at first and followed by the evaporation process in several areas of the pond to reduce salinity levels. The evaporation process will be stopped when the salinity level of salt is $20^o - 25^o$Be, or the salt is ready to enter the crystallization area. The process for each area of land is shown in Table 3.

T ransformation of The Indigenous STEM Knowledge of The Salt Farmer Into Formal Scien ce

Knowledge transformation is based on several questions addressed to crucial informants related to salt crystallization from seawater. There are ten questions related to the production process. The answers are then transformed into formal science through a series of research and literature reviews. Detailed results can be seen in Table 4.

In the process of salt production, farmers also utilize simple technology in the process of preparing salt ponds to

Table 4 Transformation of the indigenous STEM knowledge of salt production into formal science (*continued*)

No	Indigenous STEM Knowledge	Formal Science
6	**Why is the evaporation of saltwater made up to four stages to get the right level, which is the level of 20°-25°Be?**	
	KI_1, KI_2, KI_3: To find out the salt content.	If the water concentration has not reached 20°-25° Be, $CaSO_4$ will partly settle, whereas if more than 25° Be, the Mg salts will cause a bitter taste (Hadi & Ahied, 2017a). Science concepts: **The characteristics of elements and compounds, solubility and solubility product.**
7	**Analysis of the relationship that the older the state of water, the faster the formation of salt.**	
	KI_1, KI_2, KI_3: Because the salt level is getting higher.	The condition of the brine contains NaCl compounds which will become salts with salinity levels reaching> 15° Be so that these levels affect the evaporation of water levels which causes the rapid formation of salts (Sartono, Soedarsono, & Muskanonfola, 2013). Science concepts: **Salt salinity** and **crystal growth**.
8	**How to purify salt**	
	KI_1, KI_2, KI_3: Salt washing is done by washing with saltwater	Purification is done by adding impurities binder, $Na_2C_2O_4$ and Na_2CO_3, or adding $Na_2C_2O_4$ and $NaHCO_3$ with varying concentrations. Fe^{3+} ion impurities will form $Fe(OH)_3$ compounds while impurities from Mg^{2+} and Ca^{2+} will form $MgCO_3$ and $CaCO_3$ compounds. The addition is carried out in drops so that no deposits are formed. Purification is expected to reduce the water content contained in the purified salt so that the salt does not melt easily (Gemati, Gunawan, & Khabibi, 2013). Science concepts: **Chemical bonds and Separation of Mixture**
9	**Characteristics of iodized salt**	
	KI_1, KI_2, KI_3: Salt added with iodine.	Based on the Indonesian National Standard (SNI) Number: 01 - 3556-2000, iodized salt is a consumption salt containing the main component of NaCl 94.7%, a maximum of 7% water and Potassium Iodate (KIO_3) of 30 ppm, as well as other compounds following specified requirements (Maulana, Jamil, Putra, Rohmawati, & Rahmawati, 2017). Science concepts: **Elements**, **Compounds**, and **Concentrations**
10	**At the beginning of the salt, crystals are formed, crystals are small, and the longer the size gets bigger. Why did this happen?**	
	KI_1, KI_2: Not Responding **KI_3**: Because the earth's temperature is hot, when the existing water is added (koeng) coated with new water, crystal seeds will form, so the thicker the layer of water the crystal seeds will get bigger and bigger.	Salt crystals experience growth. Crystal growth is an increase in the size of an enlarged salt crystal. Salt crystals will get bigger because the crystals grow because of the crystallization process. This process consists of two stages, primary nucleation, and secondary nucleation. Primary nucleation or nucleation is the stage where crystals begin to grow but have not yet settled. The more nuclei that join, the faster the crystal will grow. Secondary nucleation at this stage accelerates crystal growth which is characterized by the attachment of the nuclei to solid crystals (Desarnaud, Derluyn, Carmeliet, Bonn, & Shahidzadeh, 2018). Science concepts: **Nucleation** and **Crystal growth**

harvest. Some of the STEM knowledge of the salt farmer community in Kertomulyo Village can be identified based on how many tools they make and use. Some of the technologies that are utilized include:

a. Glondongan

Before salt production, the soil is usually cleaned of moss and peeling or cracked soil. The pond's bottom is flattened and compacted using a tool made from pieces of coconut tree called "*glondongan*" (Figure 2). With a stable and flat surface, the salt formed is at the same level as the soil surface so that the formation of salt crystals has the same thickness. Thus, it is easier for farmers to dredge (when harvesting) and reduce salt's dirt.

b. Ebor

The "*Ebor*" is used to raise water to the salt-making plot. This tool is driven manually by human power by applying the principle of a simple machine that is a lever of type I, with the fulcrum located between the load point and the point of power. The figure of *Ebor is* shown in Figure 3.

c. Kitiran

To drain seawater into the land on plots that have been made, traditional salt farmers utilize wood windmills "*Kitiran*" in addition to manually moving them with the "*Ebor*" tool. Figure 4 shows how water moves by utilizing wind power in the salt pond area.

d. Kerik

Kerik is a traditional tool used to collect salt (Figure 5). This tool is made of bamboo and boards. In choosing bamboo, bamboo should be as old, and the size of the bamboo is usually 1 inch in diameter, and the length is following salt plots. The board is about 60 cm long and 10 cm high. To simplify the salt collection process, several types of "*Kerik*" are divided into three types, namely:

1) Long-sized *Kerik*

Figure 2 "Glondongan" as a traditional tool that is used to compact and flatten a salt pond plot

Figure 3 "Ebor" as a traditional tool that is used to move water into salt fields

Figure 4 "Kitiran" as a traditional tool that is used to move water into salt fields

Figure 5 "Kerik" as a traditional tool that is used to collect salt

Long-sized *Kerik* is used to collecting the grain of salt that is furthest or in the middle of a land plot. On this *Kerik*, there are small nails on the board that function to destroy thick and hard salt.

2) Medium-sized *Kerik*
This *Kerik* is usually used after a long-sized Kerik has collected the salt. Only after that do we use medium-sized *Kerik*.

3) Short-sized *Kerik*
This tool has the same function, which is to collect salt. This peach is used when the salt has been collected and is loaded into a bucket.

3.2 Discussion

In salt production, there are a variety of living values that include aspects of cooperation, simplicity, happiness, responsibility, humility, and honesty. The identified values

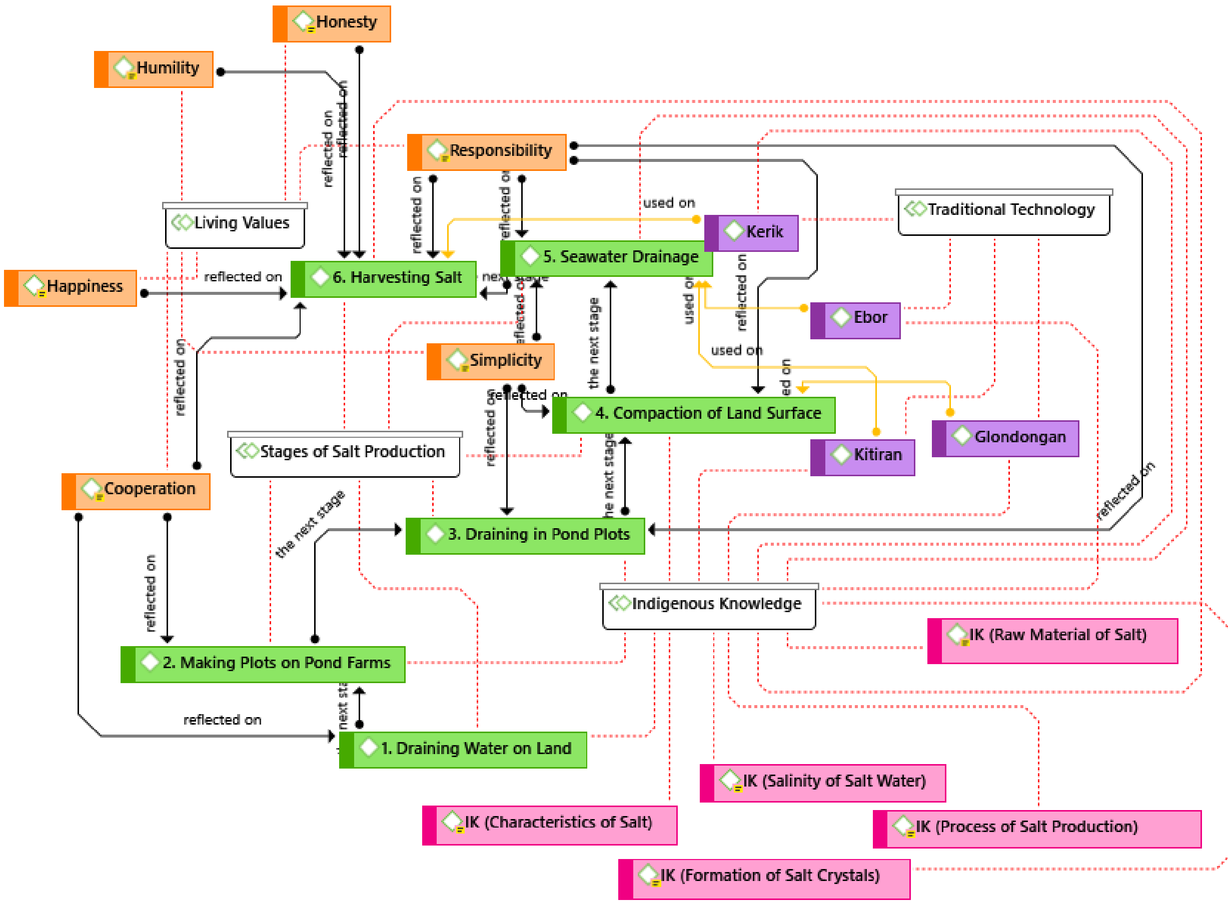

Figure 6 Reflection of living value into indigenous STEM knowledge

are representations of Pancasila values, namely the 5th precepts (*sila*), *Social justice for all Indonesians*. The production process carried out by farmer groups is based on teamwork in preparing the salt plot land for the harvesting process. The use of simple tools, the calculation of the drainage period of each plot, and the estimation of the harvesting process shows how the STEM knowledge possessed by salt farmers. This knowledge was passed down from previous generations and developed according to the times. This conserved community knowledge can be a source of learning for future generations and can reference scientific knowledge (Sumarni et al., 2016; Zidny et al., 2020). Living values in a series of salt production processes become a community culture that can be inherited and more optimized to improve salt production quality and quantity. We can learn values through LVE about beliefs in fundamental human rights, self-esteem, and a person's value as a human being (Qomaruzzaman, Al Bustomi, & Busro, 2018).

Understanding the process of making salt not only looks at the scientific aspect, but it also understands how community interaction occurs in the series, both attitudes, values, and actual knowledge. Identified living values become a source of learning to educate students to understand better what they learn from various perspectives, not just science. If education is the main target in teaching science to students, the view that represents the perspective on science education must lead to "education through science" (Holbrook, 2010; Imaduddin & Zuhaida, 2019). Science is a means to educate the aspects of knowledge, skills, and attitudes and values thoroughly. Pancasila values used as a way of life for Indonesian people are often seen as a form of pluralism and moderation that creates a balance of the interests of certain groups and the wider community (Faisal & Martin, 2019). That is, the inculcation of the values of Pancasila becomes essential to determine student self-identity.

At every stage of salt production, various life values emerge, which are reflected in social interaction and the individual identity of the salt farmers. Besides, salt farmers understand each process with indigenous knowledge and various traditional technologies to optimize the production process. The relationship of the process stages, live values, indigenous knowledge, and traditional technology is shown in Figure 6.

As one of the subjects studied by students, science also plays a role and has the potential to instill living values. In the Indonesian national education curriculum, in each subject, representation appears as the First Core Competence, which is about spiritual attitude, and the

Table 6 The relationship between the process of salt production and basic competencies in indonesian curriculum of primary and secondary school

Level	Basic competencies on Education Curriculum of Indonesia	Science concepts in the process of salt production
Primary School → 5th Grade	3.7 Analyzing the effect of heat on changes in temperature and appearance of objects in everyday life.	Changes in the form of substances from seawater to salt.
	3.9 Classifying material in daily life based on its constituent components (single and mixed substances).	Salt is a compound formed from a single substance, Na, and Cl.
Secondary School → 7th Grade	3.3 Explaining the concepts of mixtures and single substances (elements and compounds), physical and chemical properties, physical and chemical changes in everyday life.	a. The names of compounds contained in seawater. b. The process of forming seawater crystals into salt (crystallization).
	3.4 Analyzing the concept of temperature, expansion, heat, heat transfer, and its application in everyday life including the mechanism of maintaining stable body temperature in humans and animals.	a. The evaporation process is caused by heat transfer from sunlight to seawater. b. Each plot has its period in the evaporation process, depending on the heat capacity of sunlight and water salinity.
Secondary School → 10th & 11th Grade	3.5 Comparing ionic bonds, covalent bonds, coordination covalent bonds, and metal bonds and their relation to the properties of substances.	The ionic bonds formed in the salt (Na + and Cl-) produce ionic NaCl compounds.
	3.7 Linking interactions between ions, atoms, and molecules with the physical properties of substances.	In the process of salt formation there are changes in the physical properties of substances, namely, (1) the form of substances; seawater becomes gas (evaporation) and gas becomes solid (crystallization), (2) hardness of substances; from dilute to hard, (3) The shape of a compact substance becomes irregular.
	3.11 Analyzing the equilibrium of ions in a salt solution and connecting the pH	The concept of ion solubility in the salt deposition process.

Second Core Competence, which is social attitude (Sukitman & Ridwan, 2016). Both of them are achieved by indirect learning through the existence, habituation, and school culture, by paying attention to the characteristics of the subjects as well as the needs and conditions of students (Peraturan Menteri Pendidikan Dan Kebudayaan Republik Indonesia Nomor 24 Tahun 2016 Tentang Kompetensi Inti Dan Kompetensi Dasar Pelajaran Pada Kurikulum 2013 Pada Pendidikan Dasar Dan Pendidikan Menengah 2016). Teaching subjects with STEM activities has also been recommended for elementary grade students because it can provide them scientific process skills from an early age (Ultay et al., 2020). The transformation of STEM Knowledge that is owned by salt farmers into aspects of content in line with Indonesia's national curriculum is demonstrated through the existence of basic competencies in salt making. This evidence leads to information on traditional equipment in the production process. Details of this are shown in Table 5.

In the aspect of the production process change from raw material, namely seawater, to salt crystals, the original concepts that develop in the community can be used to reference learning essential competencies in the aspects shown in Table 6.

The appropriate learning resources in learning science for the ability to develop students' creative thinking are the natural environment and social culture and utilizing textbooks/ textbooks, audiovisuals, and the internet (Suastra, 2010). Salt farmer communities still retain knowledge across generations in producing salt because they have seen and experienced the truth for years according to their own experiences and through trial and error. Indigenous STEM Knowledge is transformed through oral traditions from their parents to the next generation. Furthermore, real experiences in interacting with their environment complement their knowledge more deeply. During the time process, there is a possibility that new cultures come following technological developments and science, but the way of thinking (trust), which is a legacy from the previous generation, is still maintained. Thus, when a student studies science in school, scientific knowledge in the community also exists. However, students may not know what the community knows and think that what they learn has nothing to do with the local community's life. The transformation from local community knowledge into formal science learned in schools is shown in Figure 7.

This finding can be the basis for reforming the science curriculum based on indigenous knowledge and beliefs in

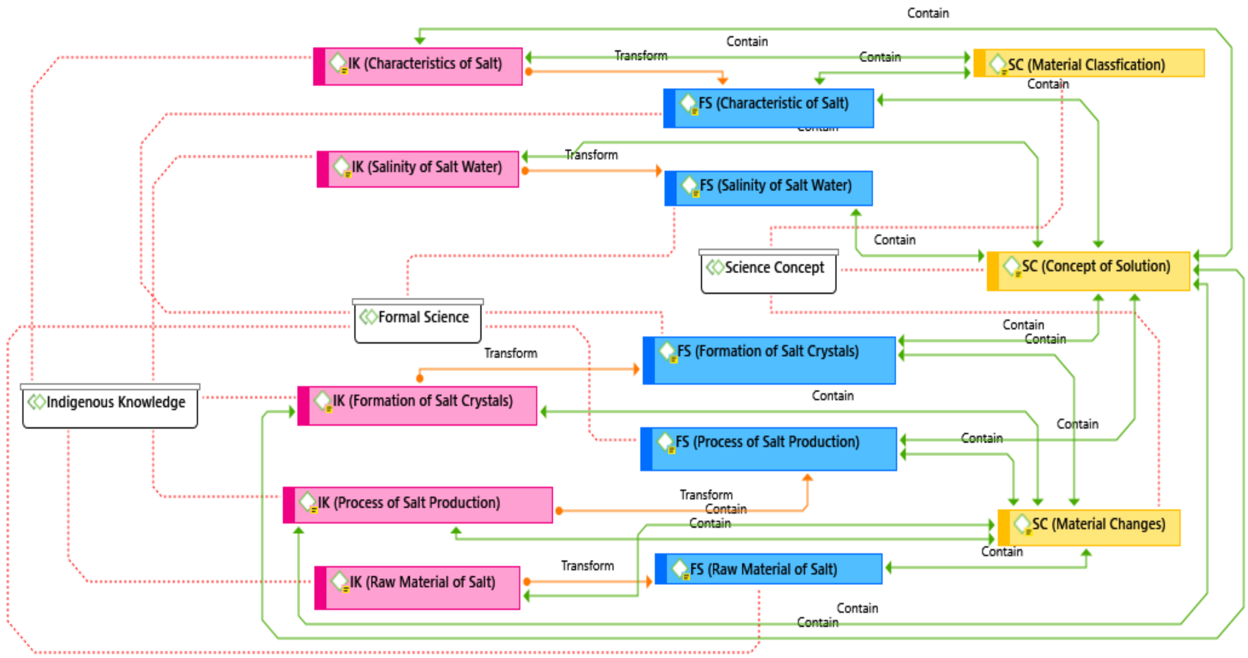

Figure 7 Transformation of salt farmers' indigenous STEM knowledge into formal science containing school science concept

Table 7 Phases and storylines that have the potential to be implemented in school science learning

Phase	The Storyline of Instruction
The phase of contact	1) Exploring students' initial ideas and knowledge related to the traditional salt making process 2) Providing an overview of the profession of traditional salt farmers, farmworkers, and the production process from the beginning until they harvest salt 3) Exploring ideas related to the production process in terms of materials, tools, and existing process phenomena
The phase of curiosity and planning	1) Cultivating curiosity about the scientific process that occurs in traditional salt production 2) Planning a project to optimize the seawater evaporation process
The phase of elaboration	1) Collecting data through salt production activities 2) Performing several salt crystallization techniques 3) Writing down results and reporting the activities undertaken
The phase of deepening and networking	Learning more about various activities related to the crystallization process of salt and the separation of other mixtures.

society. The natural and social environment is a learning resource around students and can be used by teachers to organize learning following the learning material provided. An example of an implementation that might be done by the teacher as a modification of the previously initiated model (Imaduddin & Zuhaida, 2019) is shown in Table 7.

Students will find it easier to connect school science materials with their daily lives based on natural learning resources and social culture. The better the student's understanding of science concepts or principles at school, the better their way of thinking about natural phenomena in daily life. The better understanding of natural phenomena found around students, the easier it is to understand the concept of school science. Therefore, learning science must be strived to balance scientific knowledge with the cultivation of scientific attitudes and the values of local wisdom that develops in society. The socio-cultural environment of students needs to receive serious attention in developing science education in schools.

4. CONCLUSION

The traditional salt production process includes several stages, which include (1) Draining water on the land; (2) Stages of making plots on pond farms; (3) Draining in pond plots; (4) Compaction of the land surface in plots; (5) Seawater drainage in pond plots; and (6) Harvesting salt. There are identifiable living values at each stage of salt production that include aspects of collaboration, simplicity, happiness, responsibility, and corporation. The identified values are representations of Pancasila values, namely the 5th precepts (*sila*), *Social justice for all Indonesians.* Indigenous knowledge is found in salt farmers' understanding of salt's characteristics and the process of salt crystal formation. At each stage of the process, indigenous STEM Knowledge is also found in traditional equipment, namely *Glondongan, Ebor, Kerik,* and *Kitiran*. Indigenous STEM knowledge can be analyzed for its relevance and can be bridged to transform into school science learning materials integrating Living Values Education of Indonesia.

This research's limitation is that it has not fully revealed salt production techniques in several regions of Indonesia. Communities in different regions may have different techniques. Further research needs to be done to reveal how the differentiation of traditional salt farmer techniques can be revealed to reveal the diversity of knowledge in the salt production process. The area of research studies can be expanded to be multi-site in several salt production areas in Indonesia. This community knowledge can be used as a reference source for contextualizing the science learned by students in school. Thus, in the future, textbooks or science learning sources can be developed further with databases from indigenous STEM Knowledge found in Indonesian regions.

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