Heat exchanger in process of making sagu sep as papua's contextual science learning media

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Abstract. This paper aimed to examine the indigenous culture of the Kanume tribe in the process of making Sagu sep as a medium for Papuan contextual science learning. This research was conducted in the Sota district of the Merauke Regency. The method used is descriptive qualitative research. The data collection technique is done through observation, literature study and in-depth interviews. The data obtained is then represented and interpreted in the concept of the heat exchanger. The results of the study show that there are scientific concepts that exist in the process of making Sagu sep and can be implemented in science learning.

1. Introduction
Science continues to experience rapid development, not least in the fields of science and education. Science and education are knowledge that cannot be separated from everyday life. Science is a very important science because it touches almost all aspects of life. Various innovative learning media are produced to be able to increase the learning potential of students in the field of science. This learning potential becomes the initial capital in developing and building human civilization in the future. Through innovative learning media, educators channel messages about the learning objectives to be achieved. But science in the world of education is not so much noticed. Science is considered as a stand-alone science and has no benefit to human life. This results in the assumption that science is an elusive material and concept. Science should have a close relationship with the lives of students [1]. If students can feel the benefits of learning science, students will be more serious in learning about science [2].

Various efforts were made to make learning science easier. One of them is the application of innovative learning media. Innovative learning media are developed using various approaches to facilitate the learning process [3–6]. The approach used, one of which is the ethnoscience approach. Ethnoscience is the approach to science learning using culture [7–9]. Ethnographic-based learning media must be applied. This has become one of the efforts in cultural preservation [8,10,11]. Local culture needs to be integrated into science and non-science education. But in reality, learning in schools has not accommodated local culture in learning. The author conducted a study to reconstruct the original science that developed in the Kanume (Merauke) tribe so that it could be integrated into science learning.
The Kanume tribe is a part of the Malind tribe. The Malind tribe is a native tribe that inhabits the Merauke district. In daily activities, the Kanume tribe has various unique and interesting ceremonies or activities to study. The study can be reviewed from fields of science, non-science, and education. Some research results show that the culture of the Malin tribe contains scientific elements [12,13]. This science element can be integrated into learning [12]. The results of the study on the culture of the Kanume tribe can be applied in science learning in junior high school. Learning science by using ethnoscience-based media is expected to change the mindset of students about science learning that is considered difficult.

Based on this background, the researcher made a paper about the study of ethnoscience on the process of making Sagu sep. The results of the study are expected to provide an initial description of the development of science learning media.

2. Research methods
The method used is descriptive qualitative method with an ethnoscience approach. The study focused on the process of making Sagu sep which is a typical food of the Kanume tribe community. This research was conducted in the Sota district of Merauke Regency. The research location was chosen because it was one of the districts inhabited by the Kanume tribe. Data collection techniques through primary data collection and secondary data [14–17]. Primary data in the form of interview data and direct observation results in the field. While secondary data is a literature study and documentation related to the process of making Sagu Sep. For the data to be obtained to have a high level of trust, several steps were taken such as making observations made by the researcher intensely, triangulating data and preparing references. Data processing is done by reducing, presenting and verifying data. So that a good representation of the data can be obtained.

3. Result and discussion
The research begins with observations and interviews with the Kanume tribe community. Interviews and observations were carried out to carry out the indigenous reconstruction of science in making Sagu Sep. Respondents in this study consisted of two speakers who used to make Sagu on traditional celebrations. The expert speaker is the customary leader of the Kanume tribal community, the Papuan New Guinea (PNG). The second speaker was the Kanume tribe who lived in the Sota District. Both speakers are selected based on several criteria. First, the resource person must be willing to be interviewed. Second, that the Sota district (border of NKRI-PNG) had just held a traditional release ceremony related to the rebuilding of the state border post. In the ceremony, there was also a stone burning activity (making Sagu Sep).

Sota District is a District in the Merauke Regency, Papua. This area is a border area and the direction of the entry of RI-PNG border crossers or vice versa. Kanume tribes are indigenous Papuans who live in the Sota district area even in the PNG region on the border. Although different countries, Indonesian and PNG Kanume tribes are best friends. Many traditional activities are carried out simultaneously including making Sagu Sep, Kumbili harvest, or other customary activities.

Based on the results of interviews with informants, information was obtained about the implementation of making Sagu Sep at the Kanume tribe traditional ceremony. The researcher began the interview by asking questions about the stages of making Sagu Sep. The first informant's answer is as follows:

“...yes, sep it burns rocks. Sep it is for Sagu, cauliflower, meat. There is also a stone here, we have used this kind (pointed musamus), but he is shorter. But this is not what is used. If this musamus is thin, there are many empty places. We use keni. So we use unloaded axes. They separate, burn them using wood. It's just Sagu with meat, whatever. When this refueling (demolition of the border monument) we make our release sep. I was with Ndiken Sota's family to wake up this past week, last month with the Regent. I follow. You follow to take off the land with this Sot family. I am this shaman, it has already been done. It can't be made. Only my Ndiken Sota family, the government asked to, so we give it.”
After explaining the reasons for making sago, the researcher continued the question regarding the arrangement of tools and materials in making sago. The answers of the interviewees related to this question are as follows:

“This is wood anyway, arranged like this (demonstrating) so wood is brought. Finally, put the keni (stone) on top, now the split wood is put on the stone again."

The researcher asked about the sago that will be in sep. Then the second informant's justifies and continues the information from the first informant's:

“...sagu take banana leaves or bamboo split, sago given in banana leaves and then tied. The base of the banana leaves again, only the stones that were dated again were moved. The bottom stone, sago, stone, then meat, then cover with Bus bark ...

The first resource person provides additional information. The first informant gave a simulation with banana leaves.

“...close until he has no steam coming out. This can be used to burn, sago it can burn. So mom must know the time. Because it passes, it means that you can't eat. This is when the hour is certain that Sagu is broken, black. This is taro, petatas, bananas, can be sep. Here is an example, for example, sago, as thick as meat, tie it, cover it on stone, wood, if it is finished, then put a large stone that is thin, but brings it with stones, then covers with leaves and bark of the bus. This is the same as in Wamena (North Papua) if we use keni here if at Torase (PNG) there are stones. If musamus can't. It's light, hollow, food doesn't burn, the stone must be solid ...

The second informant shows the rest of the keni burnt sep:

“Sir, this is the normal stone we use (showing stones), this is keni, it is thicker than musamus. If musamus is thin ...

The second informant's added by mentioning:

“...sweet potatoes, sago, we can also get cows. We pack the meat with the cow, the language is 'nggramun'. This is our wooden bus using its skin to cover it."

Based on the results of interviews with the first resource person and the second informant, several processes were obtained in how to make the sago sep containing elements of science and can be integrated into learning as a learning medium, among:

1. How to make grilled stone (sep)
   In making firewood (sep) the Kanum tribe community started by burning stones using firewood. This is so that the heat in firewood moves to the rock (conduction).
2. Cover the sep using bark and leaves
   The process of covering sep using leaves is intended to prevent hot steam from coming out and used to cook sago, meat, and tubers. This indicates that the Kanume tribe has basic knowledge regarding the adiabatic process. The adiabatic concept is a system that does not exchange heat for the environment.
3. Estimating the time of ripe food based on stone embers

Kanume tribes (Mothers) will estimate the time of ripe Sagu based on stone embers. This shows that the Kanume tribe also has a basic knowledge of excessive heat which will make food burnt. The results of interviews conducted on the first and second informants were different, so there must be confirmation of the data by considering other sources of information. So that the final data obtained in this study is valid.

From the data obtained, the researcher created a connection table to connect the science concepts in the process of making Sagu sep with basic competencies in the junior high school science curriculum. This is done to determine the type and core of the media to be developed. The table in question is as follows

**Table 1. Relationship Of activities for making Sagu sep with basic competence in junior high school**

| No. | Basic Competence | Science Concept in Making Sagu Sep |
|-----|------------------|-----------------------------------|
| 3.4 | Analyzing the concept of temperature, expansion, heat, heat exchanger, and its application in everyday life including the mechanism of maintaining body temperature stability in humans and animals | • The process of making fuel stone (sep) is the process of the heat exchanger by conduction  
• Cover the Sagu sep using bus bark and leaves to produce an adiabatic process  
• Keep the septum from burning as the application of heat to changes in substance |
| 4.4 | Conduct experiments to investigate the effect of heat on the temperature and shape of objects and heat exchanger | |

From the table of relations between science and cultural activities of the Kanume tribe, there are several scientific concepts in the material of temperature and heat that can be taught using ethnoscience based learning media. Among them are adiabatic, the concept of the heat exchanger, and the effect of heat on changes in the form of matter. This is consistent with previous research which states that there are cultural activities that contain elements of science and can be used in teaching science [8,10,18].

Based on the results of data analysis on the local wisdom of the Kanume tribe, there are several benefits for the development of science learning. Learning that can be developed for example the development of learning is contextual. Contextual learning using local cultural backgrounds of students can make it easier for students to understand science concepts more easily. This is in line with the results obtained in previous studies [2,9,10,19].

Science learning the concept of temperature and heat is one of the scientific concepts that can be developed based on kanume tribal cultural activities. there are still many other cultural activities that contain elements of science. Further research is needed to examine these cultural activities using the ethnoscience approach [13].

State of art in this study is about the application of science learning by using science-based learning media native to the Kanume tribe of Merauke, Papua. In carrying out this research there are still limitations to the research. These limitations are the limitations of research time. The limited-time of the study resulted in the limitations of the ethnoscience study carried out. The results of this study can’t be used in learning. Furthermore, depth research is needed regarding the development of ethnoscience ready to be used in the learning process.

4. Conclusions

Based on the results of data analysis and discussion, it can be concluded that there are elements of science in the process of making Sagu sep which can be integrated into learning as a media for
learning science. Elements of science contained in the process of making Sagu sep include the concept of the heat exchanger, adiabatic concepts and the effect of heat on changes in the form of matter. Further research is needed to explore and examine other scientific elements and to develop original science-based teaching materials.

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5. References
[1] Aikenhead G S and Jegede O J 1999 Cross-cultural science education: A cognitive explanation of a cultural phenomenon J. Res. Sci. Teach. 36 269–87
[2] Supriyadi H and Nurjannah 2016 Peningkatan kemampuan memecahkan masalah antara model penalaran kausal berbasis etnosains dan sains modern JRKPF 3 35–9
[3] Sumarsono A, Anisah A and Iswahyuni I 2019 Implementasi media interaktiv untuk meningkatkan pemahaman pengenalan permainan bola tangan J. Pendidik. Jasm. Indones. 15 1–11
[4] Kusrini S, Bahri S, Palittin I D, Mitra Rahayu H, Silubun C A and Loupatty M 2018 Efektivitas Model Pembelajaran Discovery Learning Berbantuan Media Powerpoint Untuk Meningkatkan Hasil Belajar Siswa Musamus J. Sci. Educ 1 27–32
[5] Waremra R S and Bahri S 2018 Identification of Light Spectrum, Bias Index and Wavelength in Hydrogen Lights and Helium Lights Using a Spectrometer Int. J. Mech. Eng. Technol. 9 72–6
[6] Bahri S, Rahayu M, Arsyad M, Supriyadi S, Arafah K and Waremra R S 2018 Implementation of Basic Physics I Computer-Based Teaching Material on Physics Education Students of Masamus University Animation Teaching Material of Basic Physics I International Conference on Science and Technology (ICST 2018) (Atlantis Press)
[7] Osman K and Har E 2012 Budaya Sains Asli dan Budaya Sains Moden dalam Kalangan Pelajar: Keselanjaran Usaha ke Arah Enculturation of Science (Culture of Natural Science and Culture in the Modern Science among Students: Continuity Efforts towards the Enculturation of Science) Akademika 82
[8] Shidiq A S 2016 Pembelajaran Sains Kimia Berbasis Etnosains Untuk Meningkatkan Minat dan Prestasi Belajar Siswa Seminar Nasional Kimia dan Pendidikan Kimia (SNKPK) VIII (Surakarta: UNS) pp 227–36
[9] Suastra I W 2010 Model Pembelajaran Sains Berbasis Budaya Lokal Untuk Mengembangkan Kompetensi Dasar Sains dan Nilai Kearifan Lokal di SMP J. Pendidik. dan Pembelajaran 43 8–16
[10] Rahayu E W and Sudarmin 2015 Pengembangan Modul IPA Terpadu Berbasis Etnosains Tema Energi Dalam Kehidupan Untuk Menanamkan Jiwa Konservasi Siswa Unnes Scince Educ. J. 4
[11] Supriyadi S and Nurvitasari E 2019 Inventarisisasi Sains Asli Suku Malind: Upaya Dalam Pengembangan Kurikulum Ipa Konteksual Papua Berbasis Etnosains Edu Sains J. Pendidik. Sains dan Mat. 7 10–20
[12] Palittin I D and Hallatu T G R 2019 Sar: Kanume tribal culture in environmental conservation to reduce global warming effects IOP Conference Series: Earth and Environmental Science vol 235 (IOP Publishing) p 12062
[13] Supriyadi, Waremra R S and Betaubun P 2019 Papua contextual science curriculum contains with indigenous science (Ethnopedagogy study at Malind Tribe Merauke) Int. J. Civ. Eng. Technol. 10
[14] Mangkoedihardjo S 2006 Biodegradability improvement of industrial wastewater using hyacinth J. Appl. Sci. 6 1409–14
[15] Mangkoedihardjo S, Albeta S and April L 2012 Compost on evapotranspiration bed planted
with yellow flag for treatment of wastewater containing anionic surfactant. *J. Appl. Sci. Res.* 1630–3

[16] Pratama N, Manggau F X and Betaubun P 2019 Attitude Quadrotor Control System with Optimization of PID Parameters Based On Fast Genetic Algorithm *Int. J. Mech. Eng. Technol.* 10 335–43

[17] Waremra R S and Betaubun P 2018 Analysis of Electrical Properties Using the four point Probe Method *E3S Web of Conferences* vol 73 (EDP Sciences) p 13019

[18] Suja I W 2011 Analisis Kebutuhan Pengembangan Buku Ajar Sains SD Bermuatan Pedagogi Budaya Bali *J. Pendidik. dan Pengajaran* 44 84–92

[19] Saputra A, Wahyunı S and Handayani R D 2016 Pengembangan Modul Ipa Berbasis Kearifan Lokal Daerah Pesisir Puger Pada Pokok Bahasan Sistem Transportasi Di SMP *J. Pembelajaran Fis.* 5 182–9