Jurnal Pendidikan Matematika
Volume 15, No. 2, July 2021, pp. 133-144
P-ISSN: 1978-0044, E-ISSN: 2549-1040, DOI: https://doi.org/10.22342/jpm.15.2.13800.133-144
Website: https://ejournal.unsri.ac.id/index.php/jpm
Accredited by SINTA 2: http://sinta2.ristekdikti.go.id/journals/detail?id=1811

How to Learning Arithmetic Sequences with Project-Based Learning in Terrace Culture?

Iik Nurhikmayati[1], Nia Kania[2]

[1, 2]Mathematics Education, Faculty of Teacher Training and Education, Universitas Majalengka, Jawa Barat, Indonesia
Email: iiknurhikmayati@unma.ac.id

Abstract

Integrating mathematics into local culture is a way to enhance students' interest in local wisdom. The concept of mathematics is explored to find out the existence of mathematics in society's culture which has not been seen so far. The Mathematical concept is used to explore the existence of mathematics in terrace culture on the Panyaweuyan terrace of Majalengka city. This study to describe the result of exploratory project-based learning of the Panyaweuyan terrace with this kind of exploratory research. The exploring of the relationship between the terrace culture of panyaweuyan and concept mathematics, especially in the concept of arithmetic sequences is analyzed and described through literature studies, observation, and interviews with 4 informants who are local farmers. The results that there is a relationship between the arithmetic sequence concept with the local culture of Panyaweuyan Majalengka city. The results of the study stated that each mound on each step on the Panyeweuyan terraces was formed through an arithmetic sequence formula. Farmers in Panyaweuyan terraces are naturally able to make terraces according to the arithmetic sequence formula without knowing the basics of mathematics. Therefore, the concept of mathematics is part of local culture which has an important role in preserving the nation's culture.

Keywords: Arithmetic, Terraces, Project-Based Learning

Abstrak

Integrasi matematika terhadap budaya lokal adalah cara untuk mempertinggi minat siswa terhadap kearifan local. Konsep matematika pada eksplorasi guna mengetahui keberadaan matematika pada budaya warga yang selama ini tidak terlihat. Konsep matematika digunakan untuk mengeksplorasi keberadaan matematika pada budaya terasering di terasering Panyaweuyan kota Majalengka. Penelitian ini bertujuan buat menggambarkan hasil eksplorasi pembelajaran berbasis proyek pada terasering panyaweuyan dengan jenis penelitian eksplorasi. Eksplorasi keterkaitan antara budaya terasering Panyaweuyan dan konsep matematika, khususnya dalam konsep barisan aritmatika dianalisis dan dideskripsikan melalui studi literature, observasi dan wawancara dengan 4 informan yange merupakan petani setempat. Hasil penelitian menunjukkan bahwa terdapat kualitatif dari hasil penelitian keterkaitan antara konsep barisan aritmatika dengan budaya lokal Panyaweuyan kota Majalengka. Hasil penelitian menyatakan bahwa setiap gundukan pada tiap undakan pada terasering panyeweuyan terbentuk melalui rumus barisan aritmatika. Para petani di lahan terasering Panyaweuyan secara alami mampu membuat terasering sesuai dengan rumus barisan aritmatika tanpa mengetahui dasar-dasar matematika. Oleh karena itu, konsep matematika merupakan bagian dari budaya lokal yang memiliki peran penting dalam pelestarian budaya bangsa

Kata kunci: Aritmatika, Terasering, Pembelajaran Berbasis Proyek.

How to Cite: Nurhikmayati, I., & Kania, N. (2021). How to learning arithmetic sequences with project-based learning in terrace culture?. *Jurnal Pendidikan Matematika, 15*(2), 133-144.

INTRODUCTION

Mathematics is one of the important foundations in science (Costley, 2014; Kania & Arifin, 2019). Mathematics is a science that has a unique character, known for its formulas, symbols, calculations, and all forms of rules that have definite values and results (NCTM, 2000; Caglayan & Olive, 2010; Putri & Zulkardi, 2018; Santia et.al, 2019). Every phenomenon of human life contains mathematical elements, either in the form of symbols, formulas, or rules. Mathematics is a science

Received February 19, 2021; Revised April 24, 2021; Accepted June 29, 2021

that has structure and a strong and clear linkage between the one concept with that concept other and this allows participant’s students to act based on rational and logical thinking (Ratnawulan & Kania, 2019). Mathematics is an important science (Eviyanti, 2017; Muhtadi, 2017; Nurlaily, 2019) to be learned because mathematics is a unique characteristic, which has an abstract object, the pattern on axiomatic and deductive thinking, and based on truth (Imswatama & Lukman, 2018).

One of the most famous phenomena or objects in each area even across countries and regions is local wisdom (Scriba & Schreiber, 2015) especially those related to the uniqueness of local culture. Local wisdom can be in the form of local knowledge, local skills, local intelligence, local resources, local social processes, local values or norms, and local customs (Wagiran, 2011; Acharya; 2021). Mathematics and local culture are two different sides. Mathematics in culture (ethnomathematics) is the design of learning experiences and strategies for creating learning environments that integrate culture as part of the mathematics learning process (Supiyati, 2019). The culture context product should be fun and contained concepts of mathematics for learning purposes and aspects of moral values (Risdiyanti & Prahmana, 2020). Alangui (2010) has documented that Ethnomathematics succeeded in establishing a relationship between mathematics and the reality of a society, where there originally were gaps as a result of rigid and not contextual informal education. The cultural context is used to stimulate children's adventures because they are easy to remember, children are directly involved in them and are directly related to children's daily lives (Rohaeti, 2011).

Learning in school, mainly technology would be very excellent if supplied withinside the context of a fun, such local wisdom. Material science is known to be quite difficult and is often (Dewi, Poedjiastoeti, & Prahani, 2017). This gives the author the initiative to create a learning model that can increase interest in mathematics through local culture. One of the innovations in learning mathematics is to use context as a starting point in the learning process (Prahmana, Zulkardi, & Hartono, 2012). As a research discipline, ethnomathematics, which is situated on the borderline between the history of mathematics and cultural anthropology, studies the discipline of mathematics with emphasis on the economic, social, and cultural background of its development, (Ambrosio, 1985). The Project-Based Learning Model Based on Local Wisdom (PjBL-KA) has been developed in previous studies.

Based on these results, learning through the PjBL-KA model resulted in a finding that there is a close relationship between mathematics (Ummah, 2019) and the local culture of terraces in cultivating agricultural land in the city of Majalengka. The learning of mathematics that far from daily life and detaches itself from the culture has an impact on the ability (Coyne, Hollas, & Potter, 2016) of the student in solving a mathematical problem related to real-life (Muhtadi, Sukirwan, Warsito, & Prahmana, 2017). Panyaweuyan-terraces or swales are buildings for soil and water conservation which are mechanically made to reduce the slope of the slope or reduce the length of the slopes by digging or filling the soil across the slope (Sukartaatmadja, 2004). The terraces are made in steps like terraces that are made parallel to the natural contour lines with water infiltration channels as an effort to control erosion. Terraces are made by farmers to reduce the length of the slopes and to hold or reduce the surface runoff so that water can seep into the soil (Maretya, 2017). The number of steps for each terraced land has a close relationship with the arithmetic sequence formula, that is, each terraced land has many regular steps such as an arithmetic sequence. The basic ways of doing mathematics are a result of measuring, counting, comparing, classifying, and deducing, all of which derive from the natural environment in which they develop, (D'Ambrosio, 2002). Within diverse cultural contexts, techniques and arts evolved which expressed the local way of understanding the environment and that the knowledge categories of ethnomathematics should be associated with place, time and community, (D'Ambrosio, 2016).

The terraced relationship with arithmetic sequences is very important to be developed to provide new knowledge related to the concept of local culture which has been considered normal. Developing and applying mathematical concepts based on daily-life problem situations is a part of the student learning process, (Tanujaya, Prahmana, & Mumu, 2017). Most of the farmers who cultivate the terraced fields do not know mathematical concepts related to arithmetic sequences, but farmers can measure the number of steps on each land so that they have an order like the concept of arithmetic sequences. The longer the farming, the more expertise in managing land is also increasing good, (Pratiwi & Sudrajat, 2012).

Therefore, this research is important to provide a stimulus for students, researchers, and readers, in general, to be sensitive to the relationship between mathematics and the surrounding culture. Mathematics does not only talk about abstract formulas but can be seen and applied in everyday life, including in local culture. This research has never been done before. Most of the relevant research related to terracing is related to the analysis of the slope of the terraced slopes against landslide hazards (Haryadi, Mawardi, & Razali, 2019) and the effect of terracing on slopes on the potential for landslides (Sumiyanto & Patria, 2010) This research is a new thing as an effort to increase students interest in mathematics through mathematical concepts that are extracted from the potential of local wisdom. This study aims to describe the result of exploratory project-based learning of Panyaweuyan-terrace.

METHODS

The method used in this study is a qualitative with an exploratory research approach. Exploratory research used to explore, find and find out a symptom or event (in this case the mathematical concept) through exploration of the study. Exploratory research that aims to describe and analyze mathematical concepts related to a local culture based on (fieldwork). The focus of the research is to describe the results of explorations of how the forms of local cultural relationships are terraced with mathematical concepts through literature studies, observations (observations), and interviews with informants (residents) because this research is qualitative, there must be a clear date, when to do it. The following is the research procedure with an ethnographic approach (Rakhmawati, 2016) namely assigning informants, interviewing, take ethnographic notes, ask descriptive questions, analyze ethnographic interviews, analyzing domains, asking structural questions, taxonomic analysis, and writing ethnographies. The object of the research was carried out in the hill terraces of Panyaweuyan, Argapura District, Majalengka Regency, West Java Province, Indonesia. The research informants were 4 radish farmers in the Panyaweuyan-terraced area consisting of 3 men and 1 woman with an average age between 45-56 years. The four informants have been farming on the terraced field of Panyaweuyan for more than 20 years. They know very well how the farming process has been passed down from their previous ancestors.

RESULTS AND DISCUSSION

The culture of Panyaweuyan -hill terraces in the city of Majalengka is a form of relationship between mathematics and local culture. Mathematical and cultural integration means contextual and realistic mathematics, (Supiyati, 2019). Panyaweuyan-terraces or swales are buildings for soil and water conservation which are mechanically made to reduce the slope of the slopes or reduce the length of the slopes by digging or filling the land across the slope (Sukartaatmadja, 2004) which is made in steps like terraces made parallel to natural contours. Terraces in general resemble a hill with steps transversely. It is not widely known that terraced forms have a close relationship with the concept of arithmetic sequences and sequences. The following is the terraced land of Panyaweuyan-hills in Majalengka Regency.

Figure 1. Panyaweuyan Hill, Majalengka
(Source: wisatajabar.com)

Regarding the Panyaweuyan-terraced hills, observations during the project-based learning show that one terraced field is related to mathematical concepts, especially arithmetic sequences. Consider the following picture for example:

Figure 2. Observation activity on the Panyaweuyan terraces

The picture above is an observation activity on Panyaweuyan -terraced land. We will suppose that:

l = teasing's field

u = steps/terrace

d = the distance between the terrace

This terracing field (1) includes one area of terraced land calculated from the lowest soil to the lowest land on the Pnyaweuyan land. Steps/terraces (u) are structures or forms of soil-forming ladders to reduce slope length and prevent landslides. While the distance between steps (d) is the length of the slope which is calculated between steps/terraces on terraced land.

In not unusual place parlance the term 'agricultural terrace' is nicely understood, and it is nicely understood too that terraces can produce some advantages including restricting floor water run-off and riveting soils, water infiltration and retention, improving drainage, or redirecting extra water flows, maintaining water and protecting dry adapted plants; in addition to growing soil temperatures, thereby promoting seed. In this study, three observations were made on three different cabbage fields in Panyaweuyan-terraces to prove the existence of a relationship between terraces and the concept of arithmetic sequences. Will it be proved whether different forms of the most frequent fields will still form arithmetic sequences or series?

Observation on Field 1

In the 1st field, the number of steps in 1 field is 26, the distance between the steps is 24 cm and the length of the first step is 1050 cm.

Field 1 forms a trapezoid. The first step can be written as U_1, the second step is written as U_2, and so on until the last step is U_{26} as the 26th step. The distance or difference between steps b and the length of the first step is a. it will be shown that the 1st field forms an arithmetic sequence.

We have that: $a = 1050$ cm , $b = 24$ cm and $n = 26$

$$\begin{aligned} U_n &= a + (n-1)b \\ U_{26} &= 1050 + (26-1)24 \\ U_{26} &= 1050 + (25)24 \\ U_{26} &= 1050 + 600 \\ U_{26} &= 1650 \end{aligned}$$

Based on measurements at the time of the study, the last land length was 1650 cm. It will be proved that the last measured land length is the same as the result of the calculation using the arithmetic sequence formula. Thus it is evident that the 1st terraced landforms an arithmetic sequence. Thus it is evident that the 1st terraced landforms an arithmetic sequence.

Observation on Field 2

Field 2 is more curved than field 1 and forms more of a pyramid plane. Noted that: a = 1280cm, b = 25 cm and n = 23. Based on the measurement at the field, the researcher measured twice, namely the length of the 5th step and the length of the last step, namely 23. The measurement results obtained were U_5 = 1479.6 cm and $U_{23} = 1830$ cm. It will be proved that the measurement result is the same as the calculation result.

For the 5th step we have:	For the 23th step we have:
$U_n = a + (n-1)b$ $U_5 = 1280 + (5-1)25$ $U_5 = 1280 + (4)25$ $U_5 = 1280 + 200$ $U_5 = 1480$	$U_n = a + (n-1)b$ $U_{23} = 1280 + (23-1)25$ $U_{23} = 1280 + (22)25$ $U_{23} = 1280 + 550$ $U_{23} = 1830$

The calculation results with the formula correspond to the measurement results directly. This shows that the terraced fields have the form of arithmetic sequences.

Observation on Field 3

The third observation was carried out by calculating the number of radish plants on each step. Look at the following picture:

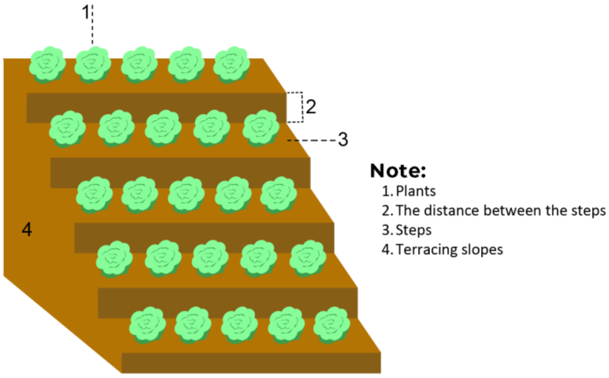

Figure 3. For example radish plants in Panyaweuyan terraces

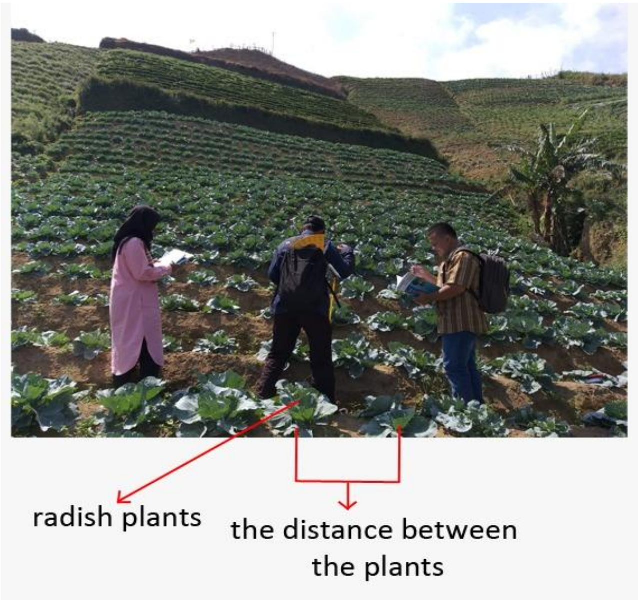

Figure 4. Count The Number of Radish Plant and Measurement Distance

Based on the measurement results, the distance between the radish plants is the same, which is 15 cm. The students calculated the number of turnips on the first step was 70 radishes with a step length of 1050 cm. Furthermore, students randomly counted the number of turnips on the 15th and 26th steps. The results were 92 radishes on the 15th step and 110 radishes on the 26th step with the distance between the steps being 24 cm (in the 1st field experiment). It will be shown that the number of turnips in field 1 also forms an arithmetic sequence.

Note that the number of radishes on each step will have the same regularity if the spacing between the radishes is the same. The number of radishes per step can be calculated by dividing the distance between the steps by the distance between the radishes.

We have $a = 1050, b = 24$, so:
$U_{15} = 1050 + (15 - 1)24$
$U_{15} = 1386$ cm

We have $a = 1050, b = 24$, so:
$U_{26} = 1050 + (26 - 1)24$
$U_{15} = 1650$ cm

The number of radishes on the 15th step is:
$nl = \frac{U_{15}}{15\ cm} = \frac{1386\ cm}{15\ cm} = 92{,}4 \approx 92$ radishes

The number of radishes on the 26th step is:
$nl = \frac{U_{26}}{15\ cm} = \frac{1650\ cm}{15\ cm} = 110$ radishes

Based on the description, it is obtained the correspondence between the results of calculations through formulas with direct calculations. Thus, the number of radish plants in terraced fields is closely related to arithmetic sequences. This relationship can be seen from the regularity of shape, number, and measurement results which show that each terraced landforms an arithmetic number. The results showed that each mound on each step of the Panyeweuyan-hill terraces was formed through an arithmetic sequence formula.

So how can there be a link between the regularity of the terraced fields created by the farmers and the concept of arithmetic sequences? Of course, most of us consider this impossible. Could it be that a farmer who did not know arithmetic sequences was able to make terraces that form arithmetic sequences? The answer is possible. It has been proven that the land created by farmers is not based on mathematical formulas.

In general, a farmer in Panyaweuyan terraces makes terraces on agricultural land based on farming methods that have been passed down from their ancestors. They can naturally make terraced fields without mathematical calculations. Agricultural landscapes are the product of the interaction of the natural environment of an area and the practices of its farmers, (Kizos, T., Dalaka, A., & Petanidou, T., 2009). Therefore, the concept of mathematics is part of local culture which has an important role in preserving the nation's culture "*Local wisdom are related specifically to a particular culture and reflect the way of life of a particular community*" (Parwati, 2012). Another opinion says that the truths that "*have become traditions or consistent in an area are called local wisdom"* (Mungmachon, 2012).

Knowledge regarding how a steep slope can be used for farming is related to farmer behavior adapting to surrounding conditions. According to Green (Levis, 2013) in the theory of behavior assessment, it explains that behavior is influenced by various factors, namely customs, beliefs, and habits of the community as well as factors of land ownership, income, culture, social strata, and information. The conduct of farmers withinside the Panyaweuyan -hill vicinity is strongly prompted through the situation of the land for farming as a supply of lifestyles and has been carried out from technology to technology from their preceding ancestors (Maretya, 2017) as local culture.

Researchers have conducted interviews with three farmers who have terraced land on the Panyaweuyan -hill, the results of the interviews show that they are mostly elementary school graduates and do not or do not know how to conceptualize arithmetic sequences. Dominant 75% of farmers in Sukasari Kaler Village, Argapura District, Majalengka Regency are 75% of elementary school graduates, (Maretya, 2017).

Based on the results of these interviews, the researchers concluded that farmers in Panyaweuyan did not pay attention to the existing relationship between the terraces where they worked and the concept of mathematical numbers. However, indirectly, these farmers have been able to apply mathematical concepts at work. For example, when measuring the spacing of his crops, a farmer has been able to make a pattern like a pattern in numbers. Farming systems are complex systems of attitudes, implicit rules, knowledge, experiences, etc., (Kizos, Dalaka, & Petanidou, 2010). Local wisdom was being a part of the culture of the farmers' family for so long. One of the applications of local wisdom on rice farming was working time allocation, (Sasana, 2017).

The results of the research are ethnomathematics becomes new things to be used as learning material in mathematics classes. Of course, ethnomathematics can be applied in learning through the Project-Based Learning approach. Project-Based Learning through the introduction of local cultures to explore the existence of a mathematical concept in each existing culture.

CONCLUSION

Based on the results of the study, it was concluded that there was a close relationship between the concept of arithmetic sequences and the planting pattern on the Panyaweuyan-terraced fields of Majalengka City. This relationship can be seen from the regularity of shape, number, and measurement results which show that each terraced landforms an arithmetic number. The consequences confirmed that every mound on every step of the Panyeweuyan hill terraces changed into shaped through n mathematics series formula.

ACKNOWLEDGMENTS

First of all, we would like to thank students of Mathematics Education at Universitas Majalengka for helping this research to completion. Then, We thank the farmers in the Panyaweuyan - environment who have provided these opportunities to develop research and be facilitated until the research is complete.

REFERENCES

Ambrosio, U. D. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics*, *5*(1), 44–48. https://doi.org/10.1007/978-3-319-59220-6_12 .

D'Ambrosio, U. (2016). *An overview of the history of ethnomathematics*. 5–10. https://doi.org/10.1007/978-3-319-30120-4_2

Dewi, I. N., Poedjiastoeti, S., & Prahani, B. K. (2017). ElSII learning model based local wisdom to improve students' problem solving skills and scientific communication. *International Journal of Education and Research*, *5*(1), 107–118. https://doi.org/10.1088/1742-6596/1157/2/022014 .

Haryadi, D., Mawardi, M., & Razali, M. R. (2019). Terracing slope analysis in landslide management efforts fellenius method with geostudio slope program. *Inersia, Jurnal Teknik Sipil*, *10*(2), 53–60. https://doi.org/10.33369/ijts.10.2.53-60

Imswatama, A., & Lukman, H. S. (2018). The effectiveness of mathematics teaching material based on ethnomathematics. *International Journal of Trends in Mathematics Education Research*, *1*(1), 35. https://doi.org/10.33122/ijtmer.v1i1.11

Kizos, T., Dalaka, A., & Petanidou, T. (2010). Farmers' attitudes and landscape change: Evidence from the abandonment of terraced cultivations on Lesvos, Greece. *Agriculture and Human Values*, *27*(2), 199–212. https://doi.org/10.1007/s10460-009-9206-9

Levis, L. R. (2013). *Farmer behavior research methods.* Maumure: Ledalero.

Maretya, D. A. (2017). Farmers' behavior in managing terraced land in Sukasari Kaler Village, Argapura District, Majalengka Regency. *Jurnal Bumi Indonesia*, *6*, 4.

Muhtadi, D., Sukirwan, Warsito, & Prahmana, R. C. I. (2017). Sundanese ethnomathematics: Mathematical activities in estimating, measuring, and making patterns. *Journal on Mathematics Education*, *8*(2), 185–198. https://doi.org/10.22342/jme.8.2.4055.185-198

Mungmachon, M. R. (2012). Knowledge and local wisdom : Community treasure. *International Journal of Humanities and Social Science*, *2*(13), 174–181.

Prahmana, R. C. I., Zulkardi, & Hartono, Y. (2012). Learning multiplication using indonesian traditional game in third grade. *Journal on Mathematics Education*, *3*(2), 115–132. https://doi.org/10.22342/jme.3.2.1931.115-132.

Pratiwi, E. R., & Sudrajat. (2012). Farmers' behavior in managing agricultural land in landslide prone areas (Case study of Sumberejo Village, Batur District, Banjarnegara Regency, Central Java). *Jurnal Bumi Indonesia*, *1*(3), 355–362.

Rakhmawati, R. (2016). Cultural-based mathematics activities in Lampung society. *Al-Jabar : Jurnal Pendidikan Matematika*, *7*(2), 221–230. https://doi.org/10.24042/ajpm.v7i2.37

Risdiyanti, I., & Prahmana, R. C. I. (2020). The learning trajectory of number pattern learning using barathayudha war stories and uno stacko. *Journal on Mathematics Education*, *11*(1), 157–166. https://doi.org/10.22342/jme.11.1.10225.157-166

Rohaeti, E. E. (2011). Cultural transformation through meaningful mathematics learning in schools. *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam*, *16*(1), 139. https://doi.org/10.18269/jpmipa.v16i1.274

Sasana, H. (2017). Working time allocation of rice farmer households with Batak Toba tradition at Toba Samosir North Sumatera. *International Journal of Economic Research (IJER)*, *8*(3), 50–58.

Sukartaatmadja. (2004). *Soil and water conservation*. Bogor: IPB Press.

Sumiyanto, S., & Patria, A. N. (2010). Effect of terracing on slopes on landslide potential. *Jurnal Ilmiah Dinamika Rekayasa*, *6*(2), 50–55.

Tanujaya, B., Prahmana, R. C. I., & Mumu, J. (2017). Mathematics instruction, problems, challenges, and opportunities: A case study in Manokwari Regency, Indonesia. *World Transactions on*

Engineering and Technology Education, *15*(3), 287–291.

Wagiran. (2011). Development of local wisdom education models in supporting the development vision of the special region of Yogyakarta 2020 (Second year). *Jurnal Penelitian Dan Pengembangan N*, *3*(5), 1–29.