

# Mathematical Literacy: Ethnomathematics in PISA Leveling Representations

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**Abstract.** Mathematical literacy is logical reasoning in solving mathematical problems. But over time, the meaning of mathematical literacy also develops and is often associated with a person's ability to identify and understand problems in which mathematics plays a role in all areas of life. The purpose of this study is to represent Mathematics Literacy Problems in PISA leveling associated with ethnomathematics and can be used as examples to deliver teaching materials in schools. The research used is a qualitative descriptive study with the object of research is the Culture of the Kutai Society, which is represented in the Mathematical Literacy problem of the PISA Socio-Cultural Context Model. From the research, it was found that the Technique of Designing PISA Model Mathematical Literacy Questions Using the Socio-Cultural Context of the Kutai Community contained 3 things in designing the PISA model grids and math problems based on argumentation indicators. The problem design process is carried out by prototyping using three characteristics, namely content, construct, and language.

**Key words:** Mathematical Literacy; Ethnomathematics; PISA Leveling Representation

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## INTRODUCTION

Mathematical literacy is not about mastering calculus, differential equations, topology, analysis, linear algebra, abstract algebra and mathematical formulas in depth, but a broad understanding and appreciation of what mathematics can achieve (Ojose, 2011). Ojose also emphasized that mathematical literacy is knowledge in understanding and applying mathematics in everyday life. People who are mathematically literate are able to make estimates, interpret data, solve everyday problems, reason in numerical situations, graphs and geometry, and communicate with mathematics. Jablonka (2003) suggests the definition of numeracy or mathematical literacy as follows:

"There are a number of perspectives on numeracy or mathematical literacy that vary with respect to the culture and the context of the stakeholders who promote it. It may be seen as the ability to use basic computational and geometrical skills in everyday contexts, as the knowledge and understanding of fundamental mathematical notions, as the ability to develop sophisticated mathematical models, or as the capacity for understanding and evaluating another's use of numbers and mathematical models."

Jablonka's definition means that there are

many perspectives regarding numeracy or mathematical literacy that depend on the culture and context of the people who support it. Mathematical literacy can be viewed as the ability to use basic calculations and geometry in everyday contexts, as fundamental mathematical knowledge and understanding, as the ability to develop mathematical models, or as the ability to understand and assess the mathematical abilities of others.

According to Jablonka (2003), the ability to relate to numbers and the ability to interpret quantitative information is an important literacy component in addition to the ability to speak, write and read. The term mathematical literacy is often equated with quantitative literacy, which according to Wilkins (2010) means a habit of mind characterized by the relationship between a person's understanding of mathematics, and that person's beliefs and dispositions toward mathematics. In contrast to mathematics which is a branch of science, mathematical literacy places more emphasis on habits of mind which are characterized by a person's motivation to use quantitative information.

To use smoothly and comfortably by yourself. Therefore, improving mathematical literacy is highly dependent on the communication opportunities created by the teacher (Özgen & Bindak, 2011; Thompson & Chappell, 2007). Recognizing the important role of

communication in the success of mathematics learning, despite the widely accepted but standard in mathematics practice and research that supports communication as an important part of learning, many mathematics teachers ignore the opportunity to combine communication and mathematical literacy building skills for students (Phillips et al., 2009). ; Seibert & Draper, 2008; Thompson & Chappell, 2007; Turner, 2011).

In addition to quantitative literacy, the term numeracy is also commonly used to refer to the concept of mathematical literacy. Some people argue that mathematical literacy, quantitative literacy or numeracy refers to a practical form or subset of mathematics. Others argue that mathematics is a technical form of mathematical literacy, quantitative literacy or enumeration which has a wider scope.

The five main elements of mathematical literacy are the use of basic mathematical content, the use of authentic real-life contexts, related to solving problems or questions both familiar and unfamiliar, involving decision-making and communication processes, and the use of content and/or problemsolving skills. In addition, one of the skills that need to be possessed in the 21st century is related to mathematical literacy where questions of this type train students to sort between relevant and irrelevant information.

Through the Program for International Student Assessment (PISA) organized by the OECD, the term mathematical literacy was defined and began to be widely known, but before that, NCTM had described the characteristics of a person called mathematically literate, namely being able to explore, make guesses, and reason logically. and use various mathematical methods effectively to solve problems. OECD (2016) defines mathematical literacy as follows:

“Mathematical literacy is an individual's capacity to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens.”

The above definition means that mathematical literacy is a person's ability to formulate, use and interpret mathematics in various contexts or situations. This includes mathematical reasoning and the use of mathematical concepts, procedures, facts and tools to describe, explain

and predict phenomena. Mathematical literacy helps constructive, active and reflective citizens recognize the role of mathematics as well as in making judgments and making decisions. From the above definitions, it can be concluded that mathematical literacy is the ability of students to formulate, use, and interpret mathematical content in various life contexts.

Many studies support that ethnomathematics has a relationship with mathematical concepts. A study conducted by Arwanto (2017) about ethnomathematical exploration batik Trusmi Cirebon in uncover philosophy and draft mathematical show that in in batik Trusmi Cirebon contained elements mathematical, among them is concepts geometry symmetry, transformation (reflection, translation, and rotation), and congruence. In line with this research, research by Laurens (2016) about analysis ethnomathematics and implementation in increase quality learning show that a number of draft mathematics which taught through Maluku culture can be used to understand the concepts of numbers, fractions and geometry. Study other by Abi (2015) about exploration ethnomathematics on ethnic group Amanuban and its relation to mathematical concepts show that the concept of mathematics has owned Public since long. Thing this realized from form ethnomathematics of the Amanuban tribe which contains many mathematical concepts, especially in the field geometry and algebra.

Related research was also conducted by Zayyadi (2017) on ethnomathematical exploration on Madurese batik shows that the mathematical concepts contained in the motifs Madura batik are: straight lines, curved lines, parallel lines, symmetry, points, angles, squares length, triangle, circle, parallelogram and similarity concept. The concepts that there is on motive batik Madura the could utilized for introduce mathematics through culture local. Temporary that, a study about exploration ethnomathematics on culture Public Dayak border Indonesia.

Sanggau Borneo West which conducted by Hartoyo (2012) show that Ethnomathematics at a simple level is widely used by the Dayak community in live everyday life. The concept that is often used is the concept of counting, say, measure, weigh, determine location, designing, make get up- build symmetry. Further research on ethnomathematics in the numbering system on the Riau Malay community conducted by Nuh and Dardiri (2016) showed that the activity of

counting, the Riau Malay community has mastered the concept of counting, this can be seen from the publication of the manuscript "A Vocabulary of the English, Bugis and Malay Language" in 1833. The manuscript contains a translation of numbers in the language Malay, such as salaksa (ten thousand) and saketi (one hundred thousand). Activities say other than applied to numbers, it is also found in the process of building a house and even related to religious traditions in the form of death feasts (niga days, seven days, four days) twenty and a hundred day) and birth.

From the results of research on ethnomathematics, it can be concluded that ethnomathematics possessed by each region has a relationship with mathematical concepts that could integrated in learning level school base and medium including culture Public kutai in Kutai kabupaten district Kartanegara province Borneo East. Ethnomathematics refers to mathematical concepts embedded in practical practice culture and confess that all culture and all person develop method unique for understand and change reality community culture. Next said that ethnomathematics a studies about difference method Public solve practical math problems and algorithms from a mathematical perspective Public alone. Ethnomathematics refers to on shapes mathematics which varied as consequence which embedded in activity culture. Ethnomathematics is one of the ways used to explain mathematics in a way that pleasant and interesting, so that easy understood. So could concluded that Ethnomathematics is a method used for learning mathematics through aspect culture local Public certain so that interesting and easy understood. Ethnic group Kutai is wrong one

ethnic group oldest in island Borneo, specifically in Borneo East Regency Kutai Kartanegara Subdistrict City Get up. Activity life Public daily no free from culture they have.

## METHODS

This research is a descriptive research with a qualitative approach. According to Krisyanto (in Kusumawati, 2017: 10), qualitative descriptive methods are used to explain phenomena that occur through collecting data about facts in the field. The object of this research is the culture of the people of KUTAI, Kalimantan Indonesia and mathematical literacy in PISA leveling. The data in this study were obtained by observing the culture of the people of KUTAI, Kalimantan Indonesia and conducting interviews with people who know information about the culture of the people of KUTAI, Kalimantan Indonesia. In addition, research data is also obtained from document studies in the form of books, journals or from the internet.

## RESULTS AND DISCUSSION

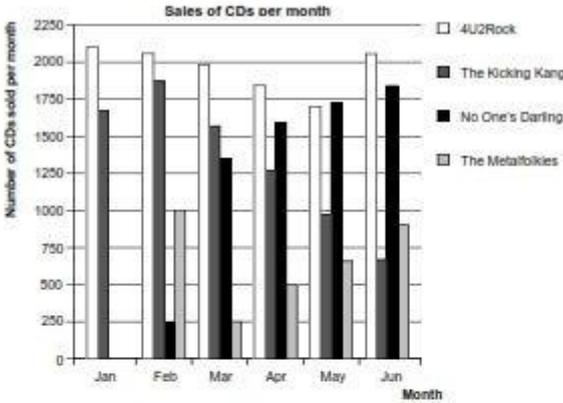
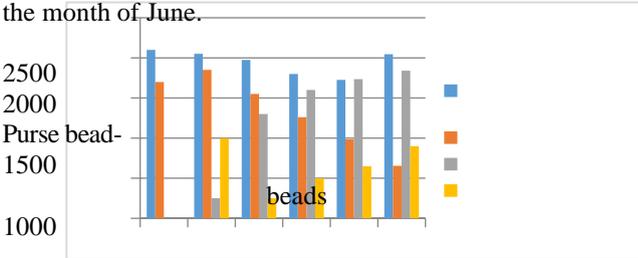
In a learning process, it cannot be denied that the ability and level of absorb each student vary. As consequence, speed mastery of the basic competencies that have been determined in a teaching material is not the same between student which one with which other. Competence on PISA classified on three group (cluster), namely reproduction, connection, and reflection. As for ability mathematics student in PISA shared Becomes six level (level), level 1 as the lowest level of achievement and level 6 the most tall. Each level shows the level of mathematical competence achieved by students. In more detail the levels which meant depicted on table 1.

**Table 1.** Six Level Ability Mathematics in PISA

Level	Aspect Literacy Mathematics
1	Students are able to answer questions in a general context as well as all Relevant information is clearly available. Able to identify information and receive all instructions based on clear instructions in the situation there is. Capable show something action in accordance with simulation which given.
2	Student capable interpret and recognize situation with context which requires immediate conclusions. Able to sort out relevant information from source which single and use method presentation single. Capable working on basic algorithms, using formulas, carrying out procedures or deal in solving problem. Capable conclude by appropriate from results the solution.
3	Student capable doing procedure with clear, including procedure which requires sequential decisions. Able to choose and implement strategiessolve problem which simple. Capable interpret and use representation based on information which different. Capable solve problems in the form of percentages, fractions and decimal numbers, and proportional. Capable describe based on results interpretation and reason they.

- 4 Students are able to work with certain methods effectively in situations complex but concrete that may involve obstacles or make assumptions. Be able to select and use appropriate representations different including on symbol, then connect it with aspect situation in life daily. Capable use Skills and his knowledge on context which clear. Capable explain his opinion based on on understanding, reason and formula they.
- 5 Students are able to develop and work with models for different situations complex, identify problems and establish assumptions. able to choose, compare and evaluate strategy for solve problem which complex associated with the model. Able to use thinking and his reasoning as well as by appropriate connect representation symbol with situation which faced. Capable describe and formulate results her job.
- 6 Student capable make draft, generalization and use information based on analysis and modeling in complex situations, and can use their knowledge in relatively non-standard contexts. Capable Connect and translate different sources of information flexibly. Capable think and reason mathematical level carry on. Capable apply understanding with mastery symbol and operation mathematics, develop new strategies and approaches in dealing with new situations. Able to reflect on his actions, formulate the results of his work appropriately with considering his discovery, interpretation, opinion and accuracy on situation real.

**Table 3.** Question mathematical literacy model PISA Context Social Culture Public of Kutai Kalimantan Indonesia

Level Question Literacy Mathematics Model PISA PISA	Question Literacy Mathematics Model PISA Context Social Culture Public Kutai																																																																						
<p data-bbox="212 1361 228 1384">1</p> <div data-bbox="256 1025 847 1568"> <p style="text-align: center;"><b>CHARTS</b></p> <p>In January, the new CDs of the bands 4U2Rock and The Kicking Kangaroos were released. In February, the CDs of the bands No One's Darling and The Metalfoolies followed. The following graph shows the sales of the bands' CDs from January to June.</p>  <table border="1" data-bbox="284 1160 847 1563"> <caption>Sales of CDs per month</caption> <thead> <tr> <th>Month</th> <th>4U2Rock</th> <th>The Kicking Kang</th> <th>No One's Darling</th> <th>The Metalfoolies</th> </tr> </thead> <tbody> <tr> <td>Jan</td> <td>2100</td> <td>1650</td> <td>0</td> <td>0</td> </tr> <tr> <td>Feb</td> <td>2050</td> <td>1850</td> <td>200</td> <td>1000</td> </tr> <tr> <td>Mar</td> <td>1950</td> <td>1550</td> <td>1350</td> <td>200</td> </tr> <tr> <td>Apr</td> <td>1850</td> <td>1600</td> <td>1250</td> <td>500</td> </tr> <tr> <td>May</td> <td>1750</td> <td>1700</td> <td>1700</td> <td>650</td> </tr> <tr> <td>Jun</td> <td>2050</td> <td>1850</td> <td>1850</td> <td>900</td> </tr> </tbody> </table> <p>Translation Note: The term "charts" does not refer to the mathematical term, but to the weekly listing of the best selling music CDs.</p> <p>Translation Note: Translate band names with fictitious band names in your language.</p> <p>Translation Note: The names of the months are shown in abbreviated form in the graphic. Full names can be used if space allows, as shown in the PIR version.</p> <p><b>Question 1: CHARTS</b></p> <p>How many CDs did the band The Metalfoolies sell in April?</p> <p>A. 250 B. 500 C. 1000 D. 1270</p> </div>	Month	4U2Rock	The Kicking Kang	No One's Darling	The Metalfoolies	Jan	2100	1650	0	0	Feb	2050	1850	200	1000	Mar	1950	1550	1350	200	Apr	1850	1600	1250	500	May	1750	1700	1700	650	Jun	2050	1850	1850	900	<p data-bbox="879 987 997 1021">Chart stem</p> <p data-bbox="879 1021 1396 1234">A shop export souvenir kutai export beaded purses and handbags starting in January. Then in February, the shop also started to export doyo ulap (a typical woven cloth) kutai and dress beads. Following this is chart stem which show quantity export The souvenir is from January to the month of June.</p>  <table border="1" data-bbox="879 1211 1517 1469"> <caption>Quantity Export of Souvenirs</caption> <thead> <tr> <th>Month</th> <th>Purse bead</th> <th>Magic Doyo</th> <th>Bags Anjat</th> <th>othes Beads</th> </tr> </thead> <tbody> <tr> <td>Jan</td> <td>2500</td> <td>2200</td> <td>1800</td> <td>1500</td> </tr> <tr> <td>Feb</td> <td>2500</td> <td>2200</td> <td>1800</td> <td>1500</td> </tr> <tr> <td>Mar</td> <td>2500</td> <td>2200</td> <td>1800</td> <td>1500</td> </tr> <tr> <td>Apr</td> <td>2500</td> <td>2200</td> <td>1800</td> <td>1500</td> </tr> <tr> <td>May</td> <td>2500</td> <td>2200</td> <td>1800</td> <td>1500</td> </tr> <tr> <td>Jun</td> <td>2500</td> <td>2200</td> <td>1800</td> <td>1500</td> </tr> </tbody> </table> <p data-bbox="879 1480 1013 1570">Bags Anjat Magic Doyo 500</p> <p data-bbox="879 1603 1005 1659">othes Beads 0</p> <p data-bbox="879 1659 1225 1693">Jan Feb Mar April May Jun</p> <p data-bbox="879 1727 1374 1906">How many many dress beads which exported on April? A. 250 B. 500 C. 1000 D. 1270</p>	Month	Purse bead	Magic Doyo	Bags Anjat	othes Beads	Jan	2500	2200	1800	1500	Feb	2500	2200	1800	1500	Mar	2500	2200	1800	1500	Apr	2500	2200	1800	1500	May	2500	2200	1800	1500	Jun	2500	2200	1800	1500
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**Question 5: CHARTS**

PMB1

- 2 The manager of *The Kicking Kangaroos* is worried because the number of their CDs that sold decreased from February to June.
- What is the estimate of their sales volume for July if the same negative trend continues?
- A. 70 CDs
  - B. 370 CDs
  - C. 670 CDs
  - D. 1340 CDs

Owner shop feel worry because bag anjat experienced a decline in export demand from month February to June. When the downward trend export Keep going continues, estimate how many fruit bag anjat exported in July? (Select one answer under this which according to You most Correct!)

- A. 70 fruit
- B. 370 fruit
- C. 670 fruit
- D. 1340 fruit

Leve Question Literacy Mathematics Model PISA  
1  
PISA

**WHICH CAR?**

Chris has just received her car driving licence and wants to buy her first car.

This table below shows the details of four cars she finds at a local car dealer.



Model:	Alpha	Bolte	Castel	Dezal
Year	2003	2000	2001	1999
Advertised price (zeds)	4800	4450	4250	3990
Distance travelled (kilometres)	105 000	115 000	128 000	109 000
Engine capacity (litres)	1.79	1.796	1.82	1.783

3

**Question 2: WHICH CAR?**

Which car's engine capacity is the smallest?

- A. Alpha
- B. Bolte
- C. Castel
- D. Dezal

**Question 3: WHICH CAR?**

Chris will have to pay an extra 2.5% of the advertised cost of the car as taxes

- 4 How much are the extra taxes for the Alpha?

Extra taxes in zeds: .....

Question Literacy Mathematics Model  
PISA Context  
Social Culture Public Kutai

Choose Amplang?

Udin wants to buy amplang at an SME shop Center on Jl. Kartini, Tenggara. The table below by details show quality and price deep amplang packaging in store the.

Merek Amplang	A	B	C	D
Berat Kemasan (gr)	500	700	400	100
Harga (Rupiah)	70.000,-	100.000,-	71.000,-	130.0
Waktu Simpan (bulan)	12	10	6	9
Komposisi	30,79%	30,796%	30,82%	30,78

Which brand has the most fish composition? a little?

If the store gives a 2.5% discount, how much discount earned Kiss if buy brand amplang C?

5

**CLIMBING MOUNT FUJI**

Mount Fuji is a famous dormant volcano in Japan.



Translation Note: Please do not change the names of locations or people in this unit: retain "Mount Fuji", "Gotemba" and "Toshi".

**Question 2: CLIMBING MOUNT FUJI**

PM942Q02 - 0

The Gotemba walking trail up Mount Fuji is about 9 kilometres (km) long.

Walkers need to return from the 18 km walk by 8 pm.

Toshi estimates that he can walk up the mountain at 1.5 kilometres per hour on average, and down at twice that speed. These speeds take into account meal breaks and rest times.

Using Toshi's estimated speeds, what is the latest time he can begin his walk so that he can return by 8 pm?

**Boat Tour Mahakam Indonesia**



The Mahakam tourist ship is one of the tourist rides in Indonesia city Samarinda. Boat the sail from Samarinda to Kumala Tenggarong island and back back to Samarinda. The length of the Samarinda river Tenggarong about 50 km. The speed of the ship going to Tenggarong around 25 km/hour and when return to samarinda, speed Becomes two time fold. With use estimation speed

Level Question Literacy Mathematics Model PISA  
PISA

Question Literacy Mathematics Model PISA  
Context  
Social Culture Public Kutai

the, o'clock how much most slow boat began to depart from Samarinda so that the ship it came back in samarinda hit 6 pm?

6

**HELEN THE CYCLIST**



Helen has just got a new bike. It has a speedometer which sits on the handlebar.

The speedometer can tell Helen the distance she travels and her average speed for a trip.

**Question 3: HELEN THE CYCLIST**

PM957Q03 - 0 1

Helen rode her bike from home to the river, which is 4 km away. It took her 9 minutes. She rode home using a shorter route of 3 km. This only took her 6 minutes.

What was Helen's average speed, in km/h, for the trip to the river and back?

Average speed for the trip: ..... km/h

kiss si Driver Bicycle

Azam received a gift in the form of a new bicycle which advanced. The bike has a speedometer that can measure bicycle average speed and distance go in one trip. kiss bicycle from house to garden City King through a route of 4 km. he is cycling During 9 minute. Then he go home to house through route other which more close that is only along 3 miles, so that he only need only for 6 minutes. What is the average speed flat kiss (in km/hour) for whole journey going to to garden City King untilreturn to his house?

Technique designing Question Literacy Mathematics Model PISA Use Context Social Culture of Kutai Kalimantan Indonesiaan people. The design of the PISA model grids and math

problems based on argumentation indicators. The problem design process is carried out by prototyping using three characteristics, namely: contents, constructs, and language.

**Table 3.** Technique designing Question Mathematical Literacy Model PISA

No	Characteristics	Information
1	Content	Make Question in accordance with content, level as well as cluster in PISA. Make question in accordance with context social culture Publickutai. make question in accordance with indicator question level PISA.
2	Construct	Use say ask or order which demand answerdecomposed. Give instruction which clear about method do the problem. Picture, chart or like served with clear andlegible.
3	Language	Suitability with Spelling Which Perfected (EYD). Sentence easy understand. Not there is sentence which give rise to interpretation double. Formulas sentence in question must communicative. Not use word/expression which could touch onany party

### CONCLUSION

It is written in one paragraph without numbering. Answering the research objectives. Wrong one method in support literacy mathematics is innovation which implemented on learning mathematics, for example with enter element ethnomathematics in learning. Learning mathematics based culture (Ethnomathematics) is wrong one method which perceived could make learning mathematics more mean and contextual which related close with community culture. Besides that, learning mathematics based culture will Becomes an interesting, fun, and innovative learning alternative because it allows happening meaning by contextual based on on experience student as members of a cultural community so that they are expected to participate in supporting the movement literacy. Ethnomathematics provides a learning environment that creates motivation which good and more pleasant so that student have interest which big in follow learning mathematics which expected could influence ability their math, specifically ability literacy mathematics.

Ethnomathematics in its development is associated with political content that bringsthe issue of emancipation in mathematics learning, especially related to mathematical literacy. Load The politics that are brought are related to the cultural context of *indigenous peoples* as representation of primitive culture. This paradigm has become an obstacle to success student *indigenous* learn mathematics which have perspective and view different.

*Indigenous* is a term which means a group of people who inhabit an area place in a long period and has cultural heritage, values, and philosophical aspects different with Public other. *Indigenous* often associated with population

indigenous people of an area that has lagged behind in civilization and literacy. lag the possible by connection between Public which relatively closed and not yet adequate access to education. These conditions produce a paradox in the context learning scale national which require existence demands minimum in in curriculum

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