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Numerical Literacy Among Senior High School Students at Alumni Course Institution in Jakarta Branch: Critical Literacy in Numeral Data Interpretation

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ABSTRACT
This article analyses the factors of numerical literacy in critical numeral data interpretation among senior high school students in Jakarta. Moreover, the aim of this article is to identify the factors, the most factor, and the least factor for improvement of the numerical literacy towards critical numeral data interpretation. The study was conducted at Alumni Course Institution in Jakarta Branch. This research also incorporated mixed methods, qualitative and quantitative, which used online questionnaires and interviews by integrating Segzin's mathematics literacy factors using Multiple Linear Regression (MLR). The subject of the study is 373 12th-grade students, a teacher from the institution, a schoolteacher, and an education policy expert. In addition, the variables consist of the affective, family, and student-teacher relationship, school-related, and cultural factors. Then, they were assessed to get detailed and comprehensive results among senior high school students on numeracy. The results present that numeracy is most influenced by the affective factor which means that comprehending and interpreting the numerical data are affected by the students' emotions and cognition. These findings contribute to the educational policy on curriculum development to concentrate on the social system and personalized learning in mathematics subjects.

Keywords: *Affective Factors, Alumni Course Institution, Critical Literacy, Numerical Literacy, Senior High School Students*

1. INTRODUCTION

Indonesia became the second-lowest rank out the five Southeast Asian countries on the mean score of mathematics performance compared to the existing OECD data as stated by PISA in 2018. Additionally, mathematics performance has a correlation to numerical literacy in elucidating, explicating, and reading mathematical data. What is more, numerical literacy or numeracy is the ability to measure, predict, and interpret data in numbers. In this COVID-19 pandemic situation, it is crucial to interpret and read the numerical data in regard to the virus outbreak. Inasmuch as there is much information about the plague spread through the media around the world, it is important to have the capability of information literacy, specifically in critical literacy towards numeracy. Furthermore, it has been known that Indonesia's PISA score on numeracy is still low; consequently, Indonesians remain facing challenges in numeral data interpretation.

Moreover, in this pandemic situation that the Corona virus (COVID-19, as formally known) was first reported in Wuhan, China in December 2019, and was recognized by Chinese authorities as a new virus in January 2020 already spread in the world. While the statistics of infected people, casualties changing rapidly overtime, it is very difficult to put a number. As of 29th of March, there are more than 30,000 deaths reported, while more than 23,000 people are in critical conditions globally [1]. More than 650,000 people are affected. Since the influx of the virus information is very rampant, the ability of interpreting and analyzing data is important to filter the overwhelmed information which is so called critical literacy towards numeracy.

As a matter of fact, numerical literacy is also known as mathematical literacy which an individual has the capacity to identify and understand the role that mathematics plays in day-to-day life, to make well-founded judgments, and to engage in mathematics in ways that meet the needs of that individual's current and future life as a constructive, concerned and reflective citizen [2]. Furthermore, numerical literacy is a skill to make use of various numbers and symbols related to basic mathematics to solve the practical problems in diverse contexts of daily life. Moreover, it is also utilized to analyze information portrayed in varying forms of graphs, tables, charts, and to interpret the results of analysis in order to decide.

In addition, critical literacy towards numeral data interpretation is also interlinked to information

literacy which means the ability to find, evaluate, organize, use, and communicate information in all its various formats, most notably in situations requiring decision making, problem solving, or the acquisition of knowledge [3]. Furthermore, information literacy is a set of abilities requiring individuals to recognize when information is needed and could locate, evaluate, and use effectively the needed information [4]. Moreover, critical math literacy includes cultivating positive and resisting negative mathematics identity formation. Math identities include how teachers and students see themselves as being able to perform and use mathematics [5].

There are some previous studies related to numerical or mathematical literacy in education comprising 15-year-old Indonesian youngsters' view of mathematical literacy [6], the numeracy among junior high school students in Indonesia [7], the contributing factor of Indonesia's low position in mathematical literacy among teachers [8], pre-service teachers' perception on mathematical literacy in Pasuruan [9], Indonesian students' mathematics problem-solving skills in PISA and TIMSS [10], and mathematical literacy processes on grade 10th of high school students in SMAN 1 Muaro Jambi [11]. Nevertheless, there are not a lot of studies about the identification of the most factor, and the least factor that shape numerical literacy among senior high school students in Jakarta, especially numerical data interpretation corresponding to the educational policy. Therefore, this study concentrates on identifying the most contributing variable to numeracy in the scope of critical literacy among senior high school students. Then, the result is used to provide clearer insights to reshape the government's strategy and system to put forward the importance of numerical literacy in numeral data interpretation.

Additionally, factors can be performed and implemented in education policies to improve numerical literacy of Indonesian high school graduates coming out from the strongest factors including affective factors, family and student-teacher relationship factors, school related factors, and cultural factors [12]. The purpose of this research is to determine the most factors that influence numerical literacy among senior high school students at Alumni Course Institution, Jakarta Branch. Moreover, because conducting research at Alumni Course Institution is accessible, affordable and reputable. Besides, Alumni Course Institution was chosen since the institution represents the population of senior high school students in Jakarta. Moreover, Alumni Course Institution is researchable because its reputation is gained from University of Indonesia teachers' requirement. This research only focused the 12 graders in Jakarta because it is centralized.

2. RESEARCH METHODS

2.1. Data Collection

The study used mixed methods. A mixed-method design is an approach that incorporates the collection, analysis and combining of quantitative and qualitative data in a single study [13]. For this study, the type of design selected was an explanatory mixed-method or a two-phase model in which the researcher first collects quantitative data and followed by qualitative data. This design enables the researcher to refine or elaborate the findings from the initial quantitative data through an extended and in-depth qualitative exploration of key issues which arise [13]. The quantitative data were complemented by the collection of qualitative data from the participating teachers, giving depth to the study. Furthermore, the data collection integrated to the questions and responses which have been illustrated in Likert scales. Then, the interview was done using semi-structured interview method which will be performed to an education expert who is influential in the field of numerical literacy who has been involved in developing C-13.

2.2. Research Participants of Study

The research participants of this study encompass students from natural and social science programs at Alumni Course Institution translated in Bahasa, Bimbingan Tes Alumni (BTA) Group, Jakarta Branch, Indonesia. The subject of the study was 373 participants who were 12th-grade students, a teacher from the institution, a school teacher, and an education policy expert.

2.3. Data Analysis

In data analysis, the research used multiple linear regressions (MLR). Then, the study was analyzed through SPSS system to calculate and analyze the findings. As a matter fact, the data analysis that were used in this study incorporating descriptive statistic, descriptive analysis, and multiple regression analysis using quantitative research retrieved from the result of distributed online surveys for students through SPSS and Microsoft Excel. In fact, quantitative research means that describing the methods of explaining an issue or phenomenon through gathering data in numerical form [14].

Moreover, the online surveys were conducted to retrieve detailed data from the existing phenomenon of the capabilities of numerical literacy among senior high school students. Furthermore, content analysis taking qualitative research to further explain the quantitative data and the interview was performed with an education expert and a government stakeholder. As a matter

of fact, qualitative research is defined as involving interviews, documents, and observation in order to understand and explain a social phenomenon [13]. Moreover, the research paradigm will be positivism meaning the data are dependent on quantifiable observations that lead to statistical analysis [15].

2.4. Validity and Reliability Testing

For the validity and reliability issue, this paper takes a method of triangulation. Additionally, triangulation is the mixing of methods which take more than two viewpoints leading to the data balance [16]. Creating a data balance by retrieving data from various perspectives and sources can provide valid and reliable data in this study. In addition, for the questionnaires, the questions for the students have undergone the step of validity and reliability testing using the application of SPSS. At first, the students' questionnaire was tested using Google Form, and the samples taken from 32 students, educational practitioners, and education activists. Then, the data was preceded taking Pearson's product- moment correlation on SPSS. Furthermore, the reliability was also tested using Alpha Cornbach on SPSS. Then, the students' questionnaire underwent validity testing using Google Form. Moreover, the reliability testing was also examined using Alpha Cronbach on SPSS.

Additionally, the validity testing in this study integrated Pearson's Product Moment Correlation with one type of questionnaire, since different questionnaires were distributed only for students. At first, students' questionnaire consists of 25 questions. They are usually concluded based on the criteria of validity. Additionally, if 25 questions with correlations value of bigger than its r-table are in the significance level of 5% or 0.05, the questions can be considered valid. In respect of the validity testing, the calculation used the aid of SPSS with the following formula.

DF = N-2 with the significance level of 0.05

Explanation:

DF = Degree of Freedom

N = Total respondents/ Samples

DF	= N-2 with the significance level of 0.05
DF	= 32-2 = 30 with the significance level of 0.05 in Table R
Thus, R Table towards DF 30 with Probability 0f 0.05 is 0.3610	

Figure 1 Reliability Result Test [2]

After the correlation coefficient was obtained, the significance testing was then carried out in order to understand the validity of every question using the R-value. Based on the calculation of the validity testing that had been done, it was derived that 25 questions of students' questionnaire were all valid. Moreover, the reliability testing in this study used the formula of Alpha Cronbach supported by SPSS. Additionally, students' questionnaires underwent the testing using SPSS. First, the students' questionnaire got the value of 0.905 which confirmed that the questions were also considered excellent and highly reliable.

3. RESULT AND DISCUSSION

Results are presented in order to explain and state the factors that shape numerical literacy and to know the significant factors that influence numerical literacy. First, results regarding multiple linear regressions were presented.

3.1. Factors That Influenced Numerical Literacy

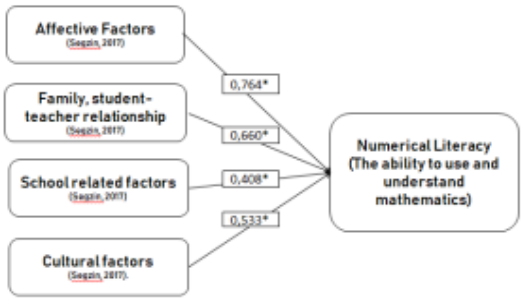

Figure 2 Diagram of Numerical Literacy [17]

In Figure 2, it is stated that numerical literacy is influenced by the affective factors, family, student-teacher relationship, school related factors, and cultural factors. Additionally, affective factor consists of mathematics self-efficacy and self-concept. Furthermore, mathematics achievement has associated with mathematics anxiety and mathematics motivation [12]. Another factor is student-teacher relationship which happened when identified factors which influence students' mathematics achievement, researchers found that student-teacher relationship has also an effect on their mathematics achievement [17]. Moreover, if the family members have mathematics anxiety, their children would have more mathematics anxiety; this badly affects their mathematics achievement. Furthermore, school related factor which is classroom management. Some studies show that classroom management influences students' mathematics achievement [18]. Besides, attitude towards school and sense of belonging to school which is school related factors such as classroom management and instructional quality, attitude towards to school and sense of belonging to school have an importance effect on mathematics achievement [19].

Additionally, a cultural factor includes social-economics status. In this case mathematics achievement has a direct relationship with race and family socio-economic status; that is; students' achievement can reduce, if there is a big gap in socioeconomic status [12].

In addition, an affective factor which is mathematics self-efficacy has the most statistically significant relationship in mathematics achievement positively. There is a statistically significant positive relationship among mathematics achievement and mathematics self-concept, index of social, economic and cultural status, mathematics teacher's classroom management. However, the least factor is the school related factors.

Moreover, through the regression analyses were conducted for numerical literacy as the dependent variable while the affective factors, family student-teacher relationship, school related factors, and cultural factors as the independent variables. In these regression analyses, the components consist of the mathematics self-efficacy, mathematics self-concept, teacher-student relations, index of economic, social and cultural status, mathematics teacher's classroom management, mathematics anxiety, attitude towards school: learning outcomes, attitude towards school: learning activities, sense of belonging to school, and mathematics interest. Lastly, based on standardized coefficient (p) value, it shows the significant results of numerical literacy factors by using Excel or SPSS application statistics tools.

Additionally, this result examined the extended factor is gender which is affected the capability of numerical literacy of the senior high school students. The gap of numerical literacy between female and male students is influenced on how the students can decrease the level of affective factors. If the affective factor is low, the students feel safe in making mistakes without judgments and constant corrections, students feel empowered to interact with their peers and seek out models of numeracy, and students feel safe in answering questions and sharing their thinking with peers and the teacher [20]. However, if the affective factors are high, students feel anxious and self-conscious. Moreover, the lack of self- confidence might constrain success in acquiring the capability of numerical literacy and students are reluctant to participate and search for opportunities to collaborate and the students will experience boredom and disinterest [9].

Additionally, due to the fact that the (p) value in gender (-0,373) correlated to the affective factors of female students are lower than the male students. It means that the gender gap in numerical literacy is negative which means female students' affective factor is low. The existence of gender gaps in the senior high school students could be linked to both social gender roles and to differences in psychological traits, as well as in timing of cognitive and emotional development. Moreover, increasing gender gaps in numeracy are then consistent with a greater specialization of men in fields of studies and occupations that make more intensive use of numeracy skills. The narrowing of gender gaps in literacy can instead be explained by the fact that literacy is a more transversal skills that everybody is called to master in order to succeed in education and in the labor market, irrespective of the chosen field of study or occupation [11]. This result is shown in Figure 3.

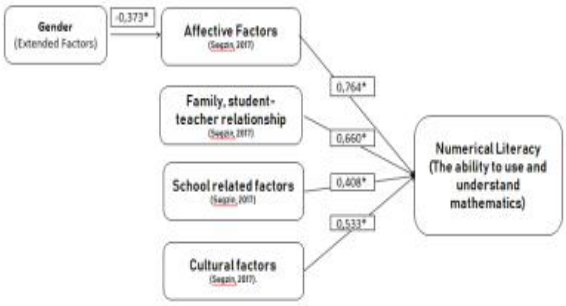

Figure 3 Extended Diagram of Numerical Literacy [17]

3.2. The Most Factor of Influencing Numerical Literacy

After conducting the data collection and making survey online, the capability of numerical literacy among senior high school students is based on the affective factors, family student-teacher relationship, school related factors and cultural factors. Those are factors shape the numerical literacy among senior high school students at Alumni Course Institution, Jakarta branch in Indonesia.

Moreover, based on the analyzing through Excel and SPP statistic tools application, it shows that the significant factors are affective factors by the p value is (0,764) the highest than other factors. The affective factors are the most influential factors that shape the mathematical achievement among senior high school students at Alumni Course Institution, Jakarta branch in Indonesia. The affective factors are also influenced by the gender. The data shows that the women have more percentages than men in facing the capability of numerical data interpretation.

Furthermore, the affective factors which consist of the mathematics self-efficacy, motivation and mathematics interest are the most factors that need to be improved. The researcher developed a new perspective towards the numerical data interpretation. This research contributed to the

educational policy by improving the school curriculum and mathematical strategy at school. Reading numbers and mathematics has become extremely important for students' academic achievement and future carrier. To assess students' performance and achievement level of mathematics, some international exams have been developed for high school students. Two of these prestigious exams are the Programmed for International Students Assessment (PISA) and Trends in Mathematics and Science Study (TIMSS). PISA and TIMMS results allow the participating countries to evaluate their students' mathematics literacy and mathematics achievement, respectively. The results indicate that there is a variety of factors that are significantly related with students' academic performance. For example, these factors are mathematics self-efficacy, mathematics self-concept, mathematics anxiety, and classroom management, socio-economic status of family, family education background, gender differences, mathematic interest, and attitude towards school and sense of belonging. Additionally, if the students have a negative emotion such as fear or disliking towards their teacher, that can negatively affect their attitude toward the subject as a whole (Pipit, personal communication, August 19th 2020). If a teacher shows a preference towards certain students or uses derogatory and humiliating language, that can lower their motivation in learning process. On the other hand, kindness, optimism, positive feedback, and encouragement can positively affect students' motivation to learn.

Moreover, motivation in learning numerical literacy can have a dramatic impact on students' performance and results as well. Therefore, parents and teachers who are willing to help their children do better in school should be aware of the factors that affect student motivation (Agus, personal communication, 21st August 2020).

3.3. The Least Factor of Influencing Numerical Literacy

Since an affective factor is the most influential factor in numerical literacy, the school related factors become the least factor with the (p) value is 0,533. School related factors related to classroom management and school environment in which students are imparted with different types of learning experiences [21]. The term school environment encompasses the terms school culture and school climate that affect the behavior of teachers and students. School culture is the shared beliefs and attitudes that characterize the district wide organization and establish boundaries for its constituent units. Moreover, school climate characterizes the organization at the school building and classroom level. It refers to the "feel" of a school and can vary from school to school within the same region. While an individual school can develop a climate independently of the larger organization, changes in school culture at the regional or local level can positively or adversely affect school climate at the building level. School culture reflects the shared ideas-assumptions, values, and beliefs-that give an organization its identify and standard for expected behaviors. These ideas are deeply inserted in the organization and, to a great extent, operate unconsciously. They are so ingrained that they are often taken for granted. Understandings shared by teachers, staff, and students structure their responses to demands made from outside (e.g., by parents and the community), and from inside (e.g., by the top administration and its communication of directions from the higher government authorities). School culture is based on experience which provides a template for future action based on how the students do things in this organization. School environment or school climate is another factor that affects motivation in education [22]. School environment refers to different norms and regulations that determine the overall climate in the school.

Furthermore, positive school environment makes students feel safe and secure, meets their basic needs such as daily meals, and provides an optimal environment for them to build healthy social relationships. Besides, many classes and learning environment that's too serious can also lower motivation in education. Adding a fun element to classes can help to ease the atmosphere and improve motivation and results. Allowing enough time for play and rest can also have a positive effect.

3.4. Students' perception on the Importance of Numerical Literacy

Based on the result and discussion, the numerical literacy is influenced by the social factors and affective factors. The social supports consist of the emotion, appraisal aspect, informational aspect, and instrumental aspect (Barry, personal communication, on August 25th, 2020). Additionally, students are suggested being neutral and unlearning in order to escape the negative thoughts towards mathematics. Moreover, teachers have to provide such an option or alternative way to solve mathematics problems. Students are encouraged to solve, analyze and interpret numerical data correctly. Furthermore, in terms of the appraisal aspect, teachers ought to give meaningful feedback for students in order to follow up their progress towards their capability in critical literacy towards numeracy. Additionally, feedback will be more efficient to know students' understanding and weakness toward numeral data interpretation rather than giving the standardized of

scoring results in their works (Barry, personal communication, August 25th, 2020). It is also interlinked between students and teachers' interaction in the school. Moreover, in informational aspects which the students can easily access the numerical data in the technology platform and analyze the data critically. Moreover, the instrumental aspect is somewhat important to improve students' numerical literacy by giving additional courses for students who actually needed.

However, for some students who have lack of motivation to study numbers and have no interest to learn numerical data interpretation, they must be full of mathematics anxiety and mathematics motivation which affects students' affective factors (Pipit, personal communication, August 19th, 2020). Besides, the affective factors can help students' cognition and emotion. Students' creating knowledge is also important to create students' logical understanding towards numeral data interpretation and to implement the knowledge in daily activity. Although PISA assessment scores are valid, there is no absolute measurement to point out the holistic of students' capability in numeral data interpretation.

4. CONCLUSION AND POLICY RECOMMENDATION

4.1. Conclusion

As a conclusion, numerical literacy among senior high school students at Alumni Course Institution, Jakarta Branch in Indonesia is most influenced by the affective factor which means that comprehending and interpreting the numerical data are affected by the students' emotion and cognition. These findings contribute to the understanding of the most factor that has an impact on numeracy in the context of critical literacy among senior high school students in Jakarta towards data interpretation. Moreover, the least factor that needs to be improved is the school related factors related to classroom management and school environment. Besides, school related factors must be involved in curriculum development as the education policy recommendation for the improvement of the numerical literacy. Furthermore, students who learn numeracy or numerical literacy with low motivation, little self-confidence and a high level of anxiety, to which teachers should give correct guidance on their affective factors. The results regarding learners' attitudes toward teacher feedback and guidance show that the majority of learners view teacher feedback and guidance with a positive attitude. The data have illustrated that teacher feedback and guidance contribute greatly to students' emotional states, especially their motivation, self-confidence and anxiety.

4.2. Recommendation

There are some policy recommendations able to be proposed:

1. Experts working for the Ministry of Education from each country can analyze results closely to identify factors affecting student achievement factors for their curriculum or education systems.
2. Countries can make a contact and help each other to improve their lacking parts to decrease effects of factors.
3. Specifically, experts who prepare mathematics curriculum and annual plans for schools could identify the effects of negative factors on mathematics achievement. Workshops could be organized for teachers to raise awareness on instructional issues.
4. The researchers can analyze deeply mathematics-related factors in affective factors in details.
5. The Ministry of Education could organize workshops for teachers in order to teach how they can help students with their mathematics anxiety.
6. Teachers who are from any subject area can focus on developing students' self-concept in their high school. This may be helpful for their mathematics achievement.
7. Teacher could create an engaging learning environment with interesting activities in their lessons. In other words, they can increase students‟ interest in mathematics to change the effect of mathematics interest on students' mathematics achievement.

AUTHORS' CONTRIBUTIONS

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Rizky Aryan Selvi Utami, Jordy Satria Widodo, Tiodora Hadumaon Siagian dan Safendri Komara Ragamustari. The first draft of the manuscript was written by Rizky Aryan Selvi Utami and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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