Numeration Literacy in Integral Calculus Problem Solving reviewed from Student Learning Style

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Abstract. This research aims to find out how numerical literacy in solving calculus II problems as seen from the student's learning style. The subjects in this research were learners of STKIP Kusuma Negara Jakarta who had attended calculus II courses in the 2020/2021 school year, namely 2 students each with Visual, auditorial, and types of kinesthetic learning with purposive sampling techniques. The instruments in this study are researchers, a test to measure numerical literacy in the form of essay questions consisting of 4 questions, interview guidelines, and questionnaires to find out the student's learning style consisting of 60 points of statement. The results showed that out of 28 students who were polled there were 9 it was not possible to assess the learning style of students with visual learning styles, 14 students with auditory learning styles, 3 students with kinesthetic learning styles, and 2 students. Students who have forms of auditorial learning tend to have had higher numerical literacy than students who have visual and kinesthetic types of learning, and students whose type of visual learning tends to better for better numerical literacy than students Which have forms of kinesthetic learning. Students who have an auditory learning style have high numerical literacy, students who have a visual style of learning have moderate numerical literacy, and students with kinesthetic learning style have low numerical literacy.

Key words: numerical literacy; problem-solving; learning style.

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INTRODUCTION

Mathematics in education is a compulsory subject introduced to students. Mathematics is learned from elementary education even to higher education. This shows how important it is to learn mathematics. Learning mathematics can make a person able to solve the problems that are facing. Learning math also makes a person more thorough, careful, and not careless. Besides, learning mathematics can also train how to think and train one's patience. Mathematics is a central component of human intelligence and a core component of the current technological revolution (Nahdi, et.al., 2020). So learning mathematics is an important thing to do to support today's technological advances. The materials in mathematics are very useful for human life. One of them is integral calculus, integral calculus is studied in addition to improving creative power, thinking structure, mathematical concepts about integrals, as well as more structured thinking power, integral calculus can also be used to predict the rate of population growth of a particular area in a given year, by looking at the facts in the field today. Integral calculus can also be used to reduce student numerical literacy ability because in integral material there are operations of symbols or variables, which sometimes in solving problems about integral calculus requires deeper thinking ability. After all, not all students can easily solve problems related to integral calculus, also in integral material of course related to the operation of numbers or numbers, sometimes students are still less thorough in operating the numbers so that the calculation results are not correct. Integral calculus in it also contains material about graphs of functions, where students sometimes cannot interpret the information provided through graphs. In mathematics, Green described the power of RBT (Revised Bloom's taxonomy) in math education by explaining three pre-calculus problems and multivariate calculus associated with matching functions and graphs (Radmehr& Drake, 2017).

Mathematics Education students in particular must have mastered the concept of integral calculus to be able to learn more complex materials at a higher level. But in reality, there are still many students who do not fully understand the integral concept, it is following the observational and interview findings of students who have or are studying integral calculus. Based on the outcome of interviews, it was obtained that students often experience misconceptions when faced with the problem of integral calculus, especially if the problem is about the application of integrals, partial integrals, integral rational functions, the area below the curve and the volume of rotary objects with tube skin methods

and disc methods that result in the results of learning obtained are still low. It can also be seen based on the results of UAS (Final Semester Examination) students of Mathematics Education STKIP Kusuma Negara Jakarta in the 2018/2019 and 2019/2020 school years were in the 2019/2020 school year decreased from the previous year, with the details of the data it is possible to see it in Table 1.

Table 1. Final Semester Test Scores of Students in Calculus II Courses

Score	2019/2020 (%)	2018/2019 (%)
A	18	31
B	45	6310
C	27	6
D	10	-

This means that with low student learning outcomes in calculus courses, there is still low literacy ability of students. Calculus is integral even though it belongs to the basic course especially for students of Mathematics Education, but not many students can master the integral concept and its application to other sciences or fields. This is following the results of the initial observations and interviews that have been conducted, namely that most students are still confused in determining the steps to be done when faced with integral problems. Students' ability to solve integral calculus problems can be improved by often providing problem exercises from basic to requiring deeper analysis. University Education is not, in fact, only related to coaching experts in particular technical fields, but also in various professional fields, by developing self-governed, and lifelong students, among other missions (Lau, 2017).

Supporting students' learning about math processes and rules is the main task of teachers in schools (Niklas, et.al., 2016). Likewise in higher education, lecturers must support student learning in the process and rules of mathematics, but not entirely the task of lecturers, students also contribute to it. Moreover, with the current condition that can not do direct learning, the role of students in learning becomes more important and desperately needs attention so that student learning outcomes following expectations. In 'School Mathematics Curriculum and Assessment Criteria, NCTM (2000) places problem-solving as fixing the main vision of mathematics education in addition to reasoning, communication, and connection. Problem-solving is a dynamic mechanism involving multiple cognitive operations, such as knowledge collection and selection, heuristic processes, strategies, and metacognition. In problem-solving, there are two major metacognitive abilities: self-monitoring and preparation. Yadnya et.al (2020) stated that students' problem-solving skills are very necessary for solving questions that contain problems, such as problems or math problems. Soemarmo&Hendrina (2014) said that mathematical assignments can be said to be a mathematical problem if they cannot find a way out but through other relevant activities. Problem-solving skills are needed to find solutions to a given mathematical problem. Arwizet and Saputra (2019) stated that In this age, the problem in education is how to train human capital that is not replaced by machinery. Many routine and regular work have been taken over by computers nowadays. In the future, tasks that computers and robots also can not take over are jobs that require the ability to interpret, make choices, interact, and communicate to do so.

Anwarudin (2019) said that the method of learning aims to give influence Or have an effect on the implementation stage problem-solving, merging, separation, and planning between concepts in the type of problem. Students at elementary schools can solve problems with scaffolding-called advice or encouragement from others. Scaffolds can be questions, stimulus, reminders, and small steps. Ariana, Hasbi, and Sukayasa (2016) argue that " awareness and abilities exist in students in their practices of studying and metacognition, the achievement of cognitive features. Information relevant to the translation and application of meaning something measures to do something and the blend of other's understanding and application in completing something is the domain of metacognition. Polya (2014) recommends four troubleshooting steps: understanding problems, planning solutions, executing plans, and looking again. According to the National Council of Teachers of Mathematics (1989) indicators of problem-solving ability areas, (a) identifying known elements, being applied, and the adequacy of the elements necessary; (b) formulating mathematical problems or drawing up mathematical models; (c) implement strategies for solving (similar and new) problems inside or outside mathematics; (d) describing or interpreting the outcomes according to the original problem; (e) meaningfully using mathematics. The synthesis results of problem-solving indicators used in this study can be

presented as; (a) understand the problem; (b) choose an appropriate problem-solving strategy plan; (c) solve problems using correct mathematical concepts; (d) verify and interpret the results appropriately.

The low ability to solve student problems is caused by difficulty in understanding the sentences in the question, students are unable to distinguish known information and question requests, have difficulty in using known knowledge, weak strategies in turning story sentences into memetic sentences, and use different ways in planning the solution of a problem. One of the skills that students should have in learning mathematics is the ability to literacy numerical ideas to clarify icons, charts, diagrams, or other media with things or problems. Math problems faced by students are often not easy to find solutions, while students are expected to be able to solve the problem. Therefore, students need to have thinking skills to find the right way to solve their problems. To increase student knowledge can be by improving student literacy skills. One of the literacies that play a role in improving students' math knowledge is numeration literacy ability. Numeration literacy is the knowledge and proficiency to (a) be able to acquire, interpret, use, and communicate a wide variety of mathematical numbers and symbols to solve practical problems in a wide variety of contexts of daily life; (b) can analyze the information displayed in various forms (graphs, tables, charts, etc.) to make decisions (Atmazaki, et al., 2017).

Three special literacy components related to the development of children's reading ability are print knowledge, spoken language, and phonological awareness (Napoli & Purpura, 2018). The initial calculation requires a logical operation, number representation, and number estimation which are all important prerequisites for the development of basic arithmetic (Segers, Kleemans& Verhoeven, 2015). Adult literacy programs aim to improve skills, and hence the potential for income and other socioeconomic outcomes, illiterate adults (Deshpande, et.al., 2017). Reading, writing, and math are not just basic skills for learning but are related to a better quality of life, personal well-being, national stability, and prosperity (Ball, Paris &Govinda, 2014). This low literacy rate is closely related to high levels of unemployment and social exclusion (Hong, Thakuriah, Mason & Lido, 2020). Numerical and language ability testing internationally and nationally becomes a regular part of the education system in many countries (Parnis, &Petocz, 2016). Numeration is the ability to understand and use numbers (Smith, et.al., 2015). Numerical literacy taken in this study is knowledge and proficiency in two things, namely 1) using a variety of numbers and symbols related to basic mathematics that can later be implemented in practical problem-solving in various contexts of daily life, and 2) analyzing the information provided in various forms, ranging from graphs to charts, and then making the results of such analysis as a tool for making decisions, through activities in manipulating symbols or mathematical languages found in everyday life, and expressing such statements through writing or oral. Based on the definition of numerical literacy mentioned earlier, indicators can be formulated to measure numerical literacy ability as presented in Table 2.

Table 2. Indicators for measuring Numeris Literacy Ability

No	Measured Indicators
1	Students can use a variety of numbers related to basic mathematics that can be implemented in practical problem-solving in various contexts of daily life
2	Students can use a variety of symbols related to basic mathematics that can be implemented in practical problem-solving in various contexts of daily life
3	Students can analyze information in the form of graphs, then make the results of the analysis as a tool to make decisions in manipulating symbols or mathematics in everyday life, then express the statement through writing or oral

It has long been known that students often develop different ideas than they are accepted by the scientific community and intended by their facilitators (Cukurova, Bennett & Abrahams, 2018). Various reforms have been made and are being carried out in recent years on the issues of specialist training, their professional quality, level of knowledge, and improved effectiveness of training (Kirschner, 2017). The learning style is related to the subjective aspect of learning but not the objective aspect of learning. In other words, the question arises about whether students really "know" what's best for them (Schoenfeld, 2013). In many ways, we're all different from each other and therefore, we also prefer a lot of different things, whether it's music, food, or learning. As a result, many students, parents, teachers, administrators, and even researchers

believe that it is intuitively correct to conclude that because different people tend to learn visually, auditorily, kinesthetic or whatever people think, we must also adjust the teaching, learning environment and learning materials for those preferences (Rahman, Ahmar &Rusli, 2016). It has long been known that students often develop different ideas than they are accepted by the scientific community and intended by their facilitators (Cukurova, Bennett & Abrahams, 2018). Various reforms have been made and are being carried out in recent years on the issues of specialist training, their professional quality, level of knowledge, and improved effectiveness of training (Kirschner, 2017). The learning style is related to the subjective aspect of learning but not the objective aspect of learning. In other words, the question arises about whether students really "know" what's best for them (Schoenfeld, 2013). In many ways, we're all different from each other and therefore, we also prefer a lot of different things, whether it's music, food, or learning. As a result, many students, parents, teachers, administrators, and even researchers believe that it is intuitively correct to conclude that because different people tend to learn visually, auditorily, kinesthetically, or whatever people think, we must also adjust the teaching, learning environment and learning materials for those preferences (Rahman, Ahmar &Rusli, 2016).

METHODS

Research Goal (Sub-titles should be italic and not bold)

This study aims to find out how student numerical literacy in integral calculus problem solving is reviewed from student learning style.

Sample and Data Collection

This research is included in descriptive qualitative research. This research focused on "Numeris Literacy in Integral Calculus Problem Solving as seen from Student Learning Style" whose main subject is students of STKIP Kusuma Negara who have or are studying Integral calculus in the 2020/2021 school year.

The data in this study are primary data and secondary data. The primary data in this study are student work documentation, student learning style questionnaire, and interview results of some students to explore the information needed in research. While the secondary data in this study is the results of previous research that has been published. This research instrument is a test question to measure student numerical literacy in the form of a description of 4 questions with Integral calculus material, and a study style questionnaire of 60 questions with positive and negative categories.

Analyzing of Data

Data analysis in this study with data triangulation, namely observation, interview, and documentation.

RESULTS AND DISCUSSION

The data in this study include student numerical literacy data, student learning style data, and interview result data. Based on the results of the analysis of student learning style questionnaires from 28 students who were given questionnaires there were 9 students with visual learning styles, 14 students with auditory learning styles, 3 students with kinesthetic learning styles, and 2 students with learning styles could not be determined. Then taken 6 students with an auditory learning style of 2 people, the visual style of 2 people, and the kinesthetic style of 2 people. The following will be discussed about the work of several students, with different categories. Data of students' answers with visual learning style in question number 1 is seen in Figure 1.

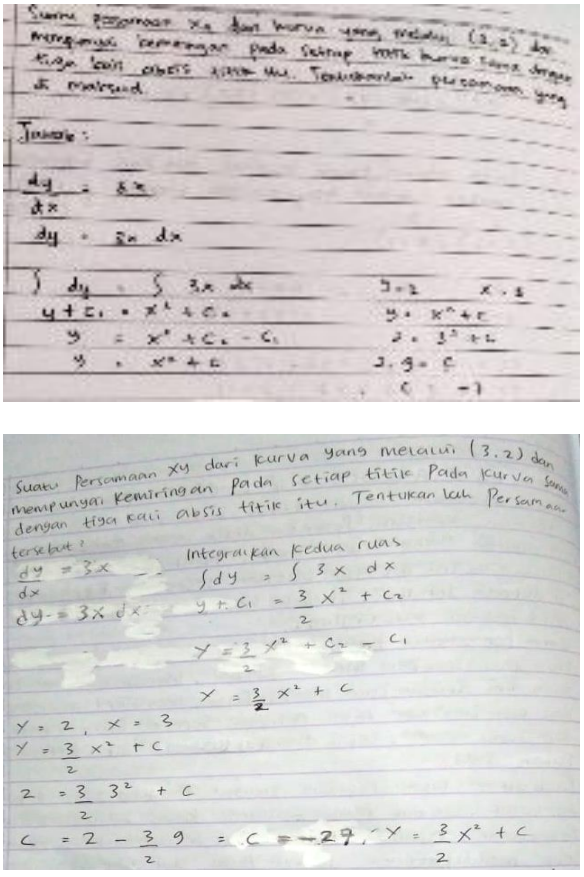

Figure 1. WDR & VK answer results

In working on question number 1 about the application of integrals in everyday life, WDR and VK have tried to answer existing problems, operating numbers, and symbols in integrated, the strategy used in solving problems is also correct, but WDR is still wrong in centralize so that the value of the constant obtained is not correct, while VK has correctly integrated, but in search of constant value there are still errors, so WDR and VK have not given the correct answer. After the interview, they both said they could do the problem if it fits the example or see how it works through youtube. Following their learning style that is visual where someone who has this learning style tends to prefer learning by looking at either videos or pictures. In this study students with visual learning style have moderate numerical literacy, this is because individuals with visual learning style are easier to receive information by looking at books so that it is easier to absorb information, by looking at the examples in the learning book or video can follow the instructions correctly.

Data of students' answers with the auditory learning style in question number 3 is seen in Figure 2.

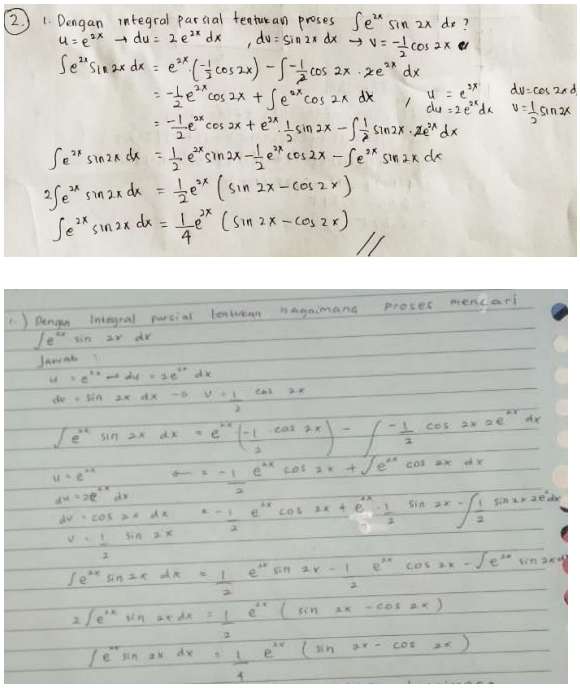

Figure 2. HF and IF answer results

In working on question number 3 which measures the second indicator that can use a variety of symbols related to basic mathematics that can be implemented in solving practical problems in various contexts of daily life, HF and IF have answered the existing problems correctly, and after an interview to confirm the answers that have been written, HF already understands the question asked and the solution process, while IF can work on the calculus problem, after looking at the examples of workmanship in the book and looking at the learning videos. Based on the results of answers and interviews with HF and IF it is understood that HF and IF have high numeral literacy.

Data of students' answers with kinesthetic learning style on question number 3 is seen in Figure 3.

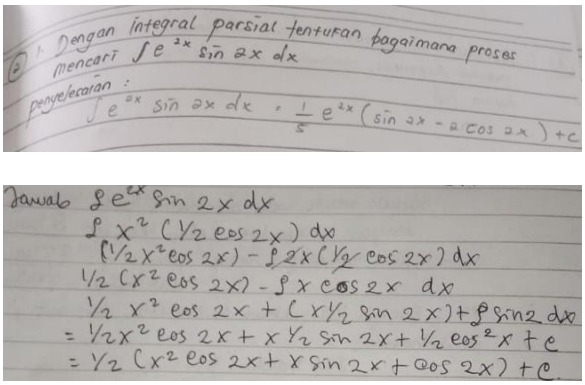

Figure 3. NF and ADR answer results

In working on question number 3 which measures the second indicator that can use a variety of symbols related to basic mathematics that can be implemented in solving practical problems in various contexts of daily life, NF and ADR have tried to answer the existing problems, but not yet correct, NF only writes down the final results, because actually, NF has done its way but because long and do not understand the steps of the workmanship NF only writes down the final answer it gets, while the ADR solution procedure is not yet appropriate, because it has been explained to use partial integrals in solving the problem, but ADR immediately integrated. After an interview to confirm the written answer, NF and ADR said that resolving the issue was obtained after seeing a tutorial on a partial integral resolution on youtube. Based on the results of answers and interviews against NF and ADR it can be understood that NF and ADR who have kinesthetic learning style where a person with this learning style is more likely to like learning involving the senses of motion, in this case, prefer to practice directly how to solve problems, but because of indirect learning, lack of direction resulting in low numerical literacy. A visual learning style is a learning style in which individuals learn better when they see images they learn and can learn by reading. Visual

learners think about photos and understand visual images better. Auditory learning style is a style when people hear what they are learning, they learn better. Individuals usually learn to use their hearing and appear to be interested. Kinesthetic learning style is a learning style based on engagement, motion, experience, and experimentation (Rahman, Ahmar &Rusli, 2016).

CONCLUSION

The conclusion in this study is that students who have auditorial learning style tend to have higher numerical literacy than students who have visual and kinesthetic learning styles, and students who have visual learning style tend to have better numerical literacy than students who have a kinesthetic learning style. Students who have an auditory learning style have high numerical literacy, students with visual learning style have moderate numerical literacy, and students with kinesthetic learning style have low numerical literacy.

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