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RESEARCH ARTICLE

PROBLEM-BASED LEARNING: INCREASING NUMERICAL SKILLS AND STUDENTS' LEARNING OUTCOMES ON REPRODUCTIVE MATERIALS AND SEXUALLY TRANSMITTED DISEASES (STD) AT SMP MUHAMMADIYAH

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Abstract

Learning in the 21st century requires the ability of students who are critically oriented, communicative, and innovative, as well as implementnumeration skills. Problem-Based Learningmodel combined with Lesson Study becomes one of the implementation ways to improve numeration skill. The facts show that numerical literacy skills remain low in Indonesia. Students in class IX F SMP Muhammadiyah 08 Batu frequently struggle with analyzing science material questions presented in the form of calculations and diagrams. This research aimed at discovering the students' numeration skill based on their learning outcomes, particularly on the material of sexually transmitted diseases (STD). The research method used was exploratory descriptive, and the study was conducted at SMP Muhammadiyah 08, Batu City, Malang, during the odd semester period (2022/2023). 25 students of IX-F class were used as the object of this research, of which students were grouped into six groups. This research was based on the Lesson Study for Learning (LS-LC) stages of the plan, do, and see. Student Worksheets (LKPD) and teacher assessment rubrics served as the researchinstruments. The obtained data were analyzed descriptively, quantitatively, and qualitatively. This research indicates that by using the LS-based PBL model, there is an increase in the average student results in cycle one between the first and second meetings, namely 83.3 to 88.9. In cycle II, the first and second meetings present a significant increase in student learning outcomes, ranging from 82.6 to 95.8. Based on these findings, it is possible to conclude that the PBL learning model improves the students' numerical literacy skills at SMP Muhammadiyah 08 Batu.

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Introduction:-

Current educational developments imply that students must be able to construct their knowledge through learning experiences, resulting in a student-centered learning process.Instudent-centered learning, the teachers as educators can involve the students' activeness which can be measured thruaction, facilitate the students to think critically and systematically, and the teachers play a role as facilitators (Andiwatir et al., 2021). Learning orientation has developed toward the 21st-century, one of which is by linking current problems and events. The 21stcentury encourages innovative learning and provides students with enjoyable learning situations and processes(Susetyarini et al., 2022). Achieving stimulants between quality and equality is a critical requirement for schools in carrying out learning. As a result, the learning orientation has shifted from one that emphasizes learning outcomes to one that emphasizes the process so that students can develop their own potential to meet the demands of life and compete with the conditions of the times.

The students are required to master six basic literacy in 21stcentury era, namely: (1) language literacy, (2) numerical literacy, (3) science literacy, (4) digital literacy, (5) financial literacy, and (6) cultural literacy and citizenship. Mastery of these six literacy needs to be balanced with critical thinking ability in solving a problem, creativity, communication, and collaboration(Sunendar et al., 2017). According to the six-basic literacy, in fact, numerical literacy skills in Indonesia are still relatively low. Numerical literacy skill is an ability or skill which involves various kinds of numbers and symbols related to basic mathematics to assist students in finding out a practical solution that is presented in the form of diagrams, tables, charts, and daily problems (Dantes & Handayani, 2021). According toProgramme for International Student Assessment (PISA) of 2018 which is carried out by Organization for Economic Co-operation and Development (OECD) shows Indonesia is ranked 74 out of 79 countries, while in the field of science around 40% of Indonesian students reach level two with an OECD average of 78% which indicates that the education system in Indonesia is still very low(Destri et al., 2022). In 2015, International Mathematics and Science Study (TIMSS) was conducted; Indonesia is ranked 44 out of 49 international countries showing very low numerical literacy skills (Amaliya & Fathurohman, 2022).

Problem-Based Learning(PBL) is one of the learning models that can be used to improve numerical literacy skills.Problem-based learning (PBL) is a curriculum development and lesson delivery system to develop problem-solving skills, and also assist students to gain the necessary knowledge and skills(Addiin et al., 2014). Additionally, the implementation of the Lesson Study thinking pattern is carried out as a combination so that the learning quality can improve since the thinking pattern can welcome the 21st-century model school and its sustainability (Wahyuni et al., 2021). The learning model in 21st-century era needs to be implemented since it can accommodate the student skills, including discovery and real life problem-solving critically and systematically (Susetyarini, 2022).

The identification results in class about problems that often occur in students of IX-F class at SMP Muhammadiyah 08 Batu was that the students always got difficulties in analyzing Natural Science (IPA) questions. This is evidenced when the students are asked to solve the exercises in the form of word problem literacy and then they are asked to analyze the problems in the form of percentages and diagrams. Previous analysis results conducted by the teacher showed that 5 out of 30 students of SMP Muhammadiyah 08 Batu City, particularly IX-F class had quite good ability to analyze numerical questions, while 25 others were still in the low category.

The low students' ability to analyze is suspected to be due to a lack of numerical skills training, as they receive scores below the Minimum Completeness Criteria (KKM), namely 75, from the results of student'sdaily tests of IX-F classon animal and plant reproduction systems.According to the results, it can be determined that 16,67% of students have completed, while 83,33% of other students have not completed.Based on the problem elucidation, this research is conducted to improve the students' numerical literacy skill. This research aims to describe problem-based learning in improving the student's numerical skill, particularly in the material of sexually transmitted diseases (STD) at SMP Muhammadiyah 08, Batu City.

Methodology:-

Explorative descriptive was used as the type of research, in which it aimed at describing the students' numerical skills by means of qualitative and quantitative approaches. This research was carried out in IX-F class of SMP Muhammadiy'ah 08 Batu City, particularly in the odd semester of 2022/2023 on July to August 2022. There were 25 students of IX-F class in the odd semester were used as the subjects of this research.

Research Procedures and Stages

Stages of this research implemented the lesson study concept based on Susetyarini et al., (2021) who stated that Lesson Study for Learning (LS-LC) was a development method provided by the teachers to improve the learning qualitative in a collaborative way by using several stages, namely plan, do, and see (reflection). This research was planned to use two cycles, each cycle consisted of two meetings; the first meeting was 2 x 40 minutes and the second meeting was 3 x 40 minutes. Each cycle consisted of 3 stages that would be elucidated as follow:

1) **Plan,**the model teacher, and the Lesson Study teachers collaborated to develop a Lesson Plan (RPP) based on student-centered learning. Planning was started by The planning process began with an analysis of the needs and problems encountered by teachers and students in teaching and learning activities, such as basic competencies, methods of teaching students, dealing with shortages of learning facilities and tools, and so on, so that various real conditions that would be used for the benefit of learning could be identified. Furthermore, discovered solution for a problem found. The conclusion from the results of needs and problem analysis became a part that should be considered in creating a Lesson Plan (RPP) so that it became a mature plan that could anticipate all possibilities that would occur during the implementation of learning, both at the initial stage, the core stage to the final stage of learning. The last stage was the creation of Student Worksheets (LKPD) to know the students' numerical skill along with the assessment rubrics.
2) **Do,**there were two main activities, namely: (a) learning implementation activities that had been agreed upon by the teacher and the School Subject Teacher Consultation (MGMPS) to practice the lesson plan that had been prepared together, and (b) observation activities carried out by members or the Lesson Study community.
3) **Reflection (see)**, the most important stage since there were two main stages, namely observation and reflection. In the observation stage, activities carried out by the observer on the course of the teaching and learning process in the classroom aimed at analyzing the learning process of students as an effort to analyze the improvement of the learning process further.This depended on the sharpness of the observer's analysis based on observations of the implementation of the learning that had been carried out. The next activity was reflection, at this stage it was carried out in the form of a discussion which was attended by all Lesson Study participants. The discussion started with the submission of comments and impressions of the teacher both in general and specifically on the learning process carried out in the learning process. Moreover, all observers postulated wise responses or suggestions for the learning process that had been implemented(not the teacher in question). Observers' suggestions must be supported by evidence derived from observations rather than opinions. The outcomes of the discussion that emerged could be used as feedback in each cycle.

Data Collection Techniques and Assessment Instruments

Data collection techniques used in this research were learning planning (plan), results of observations (do), results of assessments of numerical skill and reflection (see); as well as documentation of students' work. After the research stages were completed, the next stage was data analysis/data processing. The obtained data were the numerical literacy skill with the indicators presented in Table 1.Indicators (Table 1) were contained in the question of Student Worksheets (LKPD). The questions referred to the indicators of numerical literacy skill were presented in the Table 2and Table 3. Learning was considered successful if classical completeness exceeded 75%, particularly in numerical literacy skills. Tables 4 and 5 showed how the numerical literacy skill assessment rubric assisted students improve their numerical literacy skills. Scores would be converted to values, and the resulting data would be analyzed quantitatively and qualitatively descriptively.

Table 1:- Indicators of numerical literacy skill that were used as a reference for implementing and drawing conclusions in the solution of a simple problem.

No	Numerical Literacy Skill Indicators
1	Using various numbers and symbols related to basic mathematics to solve problems in various contexts of everyday life
2	Analyzing information presented in various forms (diagrams, tables, charts, diagrams, and so on)
3	Interpreting the results of the analysis to predict and make decisions

Table 2:- Questions that referred to numerical skills (questions listed on the Student Worksheet (cycle I)).

No	Questions
a	Calcule the % (percentage) of students infected with HIV as a result of heterosexual sexual relations, the use of needles, heterosexual sexual relations and blood transfusions
b	Draw a diagram on a piece of paper to show the results!

c	Write the conclusions that can be drawn by researchers from the results of the research!

Table 3:- Questions that referred to numerical skills (questions listed on the Student Worksheet (cycle II)).

No	Questions
a	Calculate % (percentage) of people infected with sexually transmitted diseases chlamydia, trichomoniasis, gonorrhea and syphilis!
b	Draw a diagram on a piece of paper to show the results!
c	Write down the conclusions that can be drawn from the case

Assessment by assigning a score based on the descriptions in Tables 4 and 5.

Table 4:- Assessment of learning outcomes on Student Worksheets (LKPD).

No	Assessment Aspects	Scores			
		1	2	3	4
1.	Problem-Solving	Students were only able to answer 1 question correctly	Students were only able to answer 2 question correctly	Students were only able to answer 3 question correctly	Students were only able to answer 4 question correctly
2.	Percentage Determination	Students could not analyze problems in LKPD and determine the percentage correctly	Students were less able to analyze problems in LKPD but were unable to determine the percentage correctly	Students could analyze problems in LKPD but were unable to determine the percentage correctly	Students could analyze problems in LKPD and determinethe percentage correctly
3.	Drawing Conclusions	Students were not able to conclude correctly	Students were less able to concludecorrectly	Students were quite capable of concluding correctly	Students were able to concludecorrectly

$\text{Score} = \frac{\text{Score obtained}}{\text{Maximum score}} \times 100 = \ldots\ldots$

Assessment indicators were adapted from: (Winarji et al., 2019)

Table 5:- Numerical Skill Scoring.

No	Assessment Aspects	Scores			
		1	2	3	4
1.	Processing data in the form of diagrams	Students could not process problem data into diagrammatic form	Students were less able to process problem data into diagrammatic form	Students were sufficiently able to process problem data into diagrammatic form	Students could process problem data into diagrammatic form
2.	Defining percentages in charts	Students could not analyze problems in LKPD and determine the percentage correctly to be presented in the form of a diagram	Students were less able to analyze problems in LKPD but were unable to determine the exact percentage to be presented in the form of a diagram	Students could analyze problems in LKPD but were unable to determine the exact percentage to be presented in the form of a diagram	Students could analyze problems in LKPD and determine the correct percentage to be presented in the form of a diagram
3.	Drawing Conclusion	Students were not able to draw diagram conclusions correctly	Students were less able to draw diagram conclusions correctly	Students were quite capable of drawing diagram conclusions correctly	Students were able to draw diagram conclusions correctly

$\text{Score} = \frac{\text{Score obtained}}{\text{Maximum score}} \times 100 = \ldots\ldots$

Assessment indicators were adapted from: (Winarji et al., 2019)

Result:-

The results of implementing learning with the Lesson Study-based PBL model, namely plan, do, and see is that in the planning stage (plan) is by discussing the material that will be used to conduct the do with the teacher. The material used discusses reproductive system diseases, complemented by reading literacy activities and making diagrams (numerical skills), to solve the problems that have been given.The topic of sharing tasks on reproductive diseases is discussed. Students are instructed to calculate the percentage into the number. Following that, students will conclude and discuss the results of the answers. The jumping task question is about reproductive diseases, with research data from year to year presented. Students are asked to draw diagrams, and it is hoped that they understand how to do so. The X and Y axes, for example, must be annotated (Cycles I and II).

At the time of do (cycles I and II), the numerical skill values and learning outcomes of students are obtained after working on the questions presented in the Student Worksheet (LKPD); it can be seen in Figures 1 and 2.

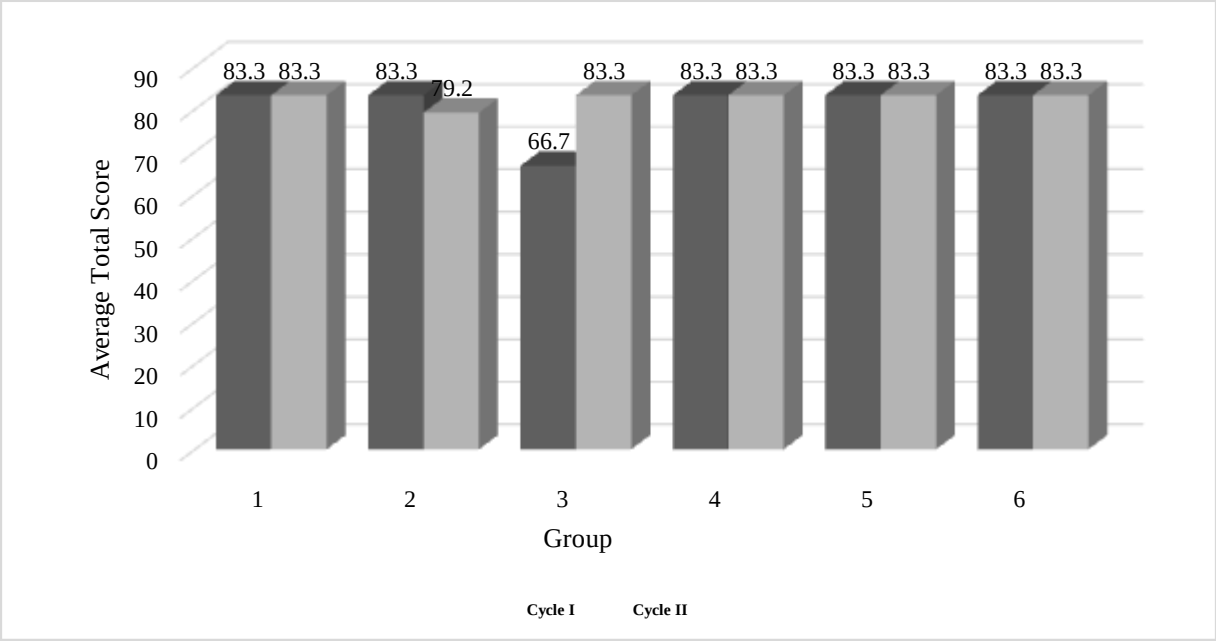

Figure 1:- Student Numerical Skill Assessment Results Diagram.

The research results indicate that the students of IX-F class at SMP Muhammadiyah 08are divided into 6 groups with with a total of 25 students. According to diagram (Figure 1), the assessment is carried in 2 cycles, namely cycle I by using the material of Sexually Trasmitted Disease (STD) due to HIV and the cycle II is by using the material of STD due to microorganism infection. Groups 1, 4, 5, and 6 indicate the average total score of the same numerical skill, namely 83.3.Since individual students receive the same number of scores based on numerical skill scoring (Table 5), the mean total score is the same. There is a difference in the mean total score of numerical skills between cycles I and II in group 2, namely 4.1. This is due to the individual scores of two students in group 2, cycle II, namely 75 (n = 2 students) and 83.3 (n = 2 students),resulting in a total average score of 79.2.The mean results in group 3 experience an increase from the average total score in cycle I, which is 66.7 to 83.3 in cycle II (Figure 1).As shown in Figure 3, assessment of students' numerical abilities is carried out in the form of group analysis to create pie charts based on the topic of the material provided.

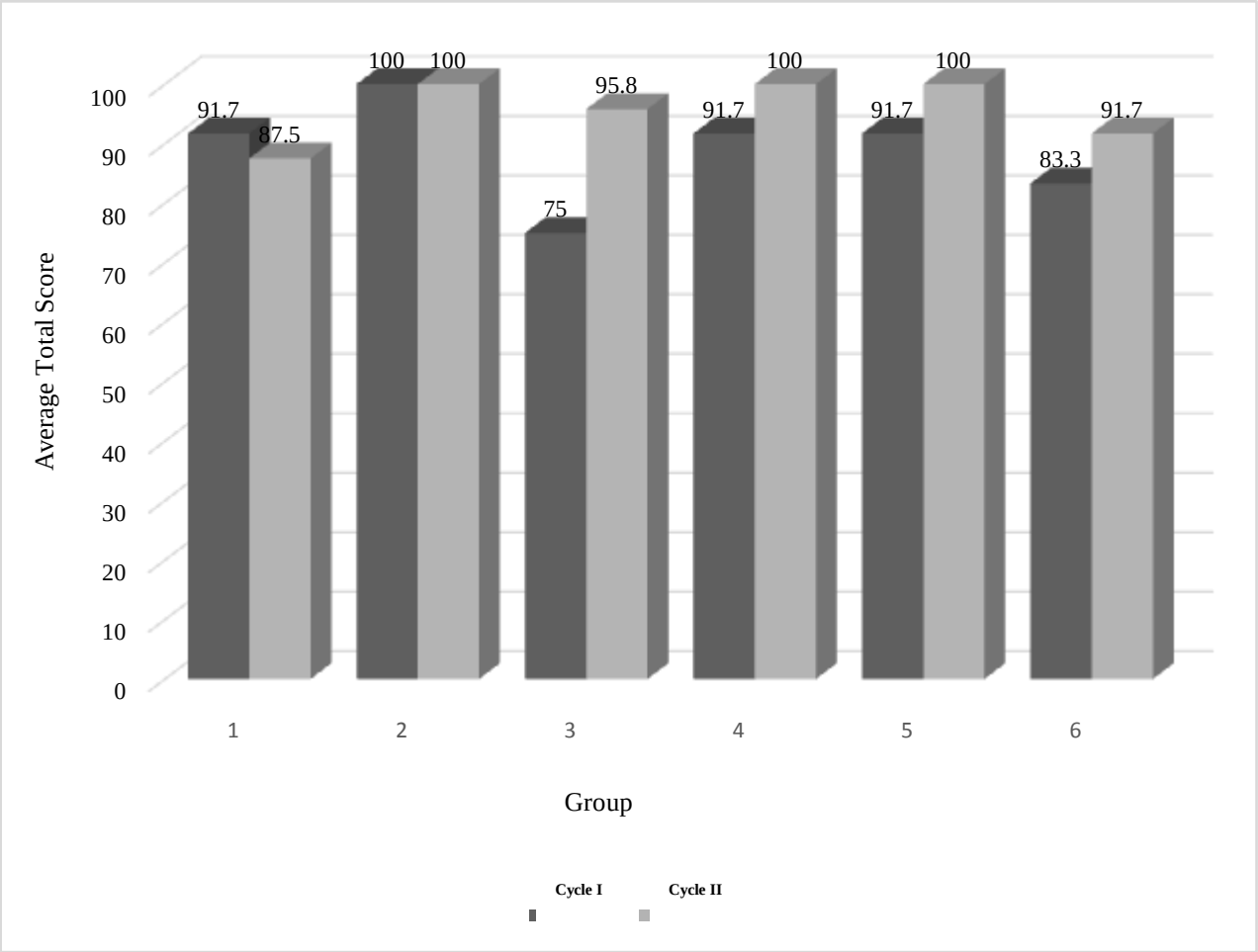

Figure 2:- Diagram of Student Learning Outcomes Assessment Results.

According to the findings, the assessment of learning outcomes based on the LKPD assessment (Table 4) is also done in two cycles. Cycle I employsSTD material as a result of HIV infection, while Cycle II employs STD material as a result of microorganism infection. There are 25 students divided into six groups. There is a difference in the average total score from 91.7 (cycle I) to 87.5 (cycle II).This is because two students each receives a score of 83.3, while two other students receive a score of 91.7. For group 2, cycles I and II achieve the same average total score, 100, indicating that the assessment of each participant's learning outcomes is optimal (100).In cycle I, the average in group 3 is 75, and in cycle II, it rises to 95.8. This is demonstrated by the fact that 3 students receive a maximum score of 100, while one other student receives an 83.3. In groups 4 and 5, the mean total score is the same, ranging from 91.7 in cycle I to 100 in cycle II.This increase demonstrates that each student's learning outcomes improved by 8.3.In group 6, there are 4 students who get a score of 83.3 and 1 student get a score of 91.7 so that the total average score is 83.3 in cycle I. The average total score in cycle II is 91.7, with 5 students receiving the same score, namely 91.7. (Figure 2).

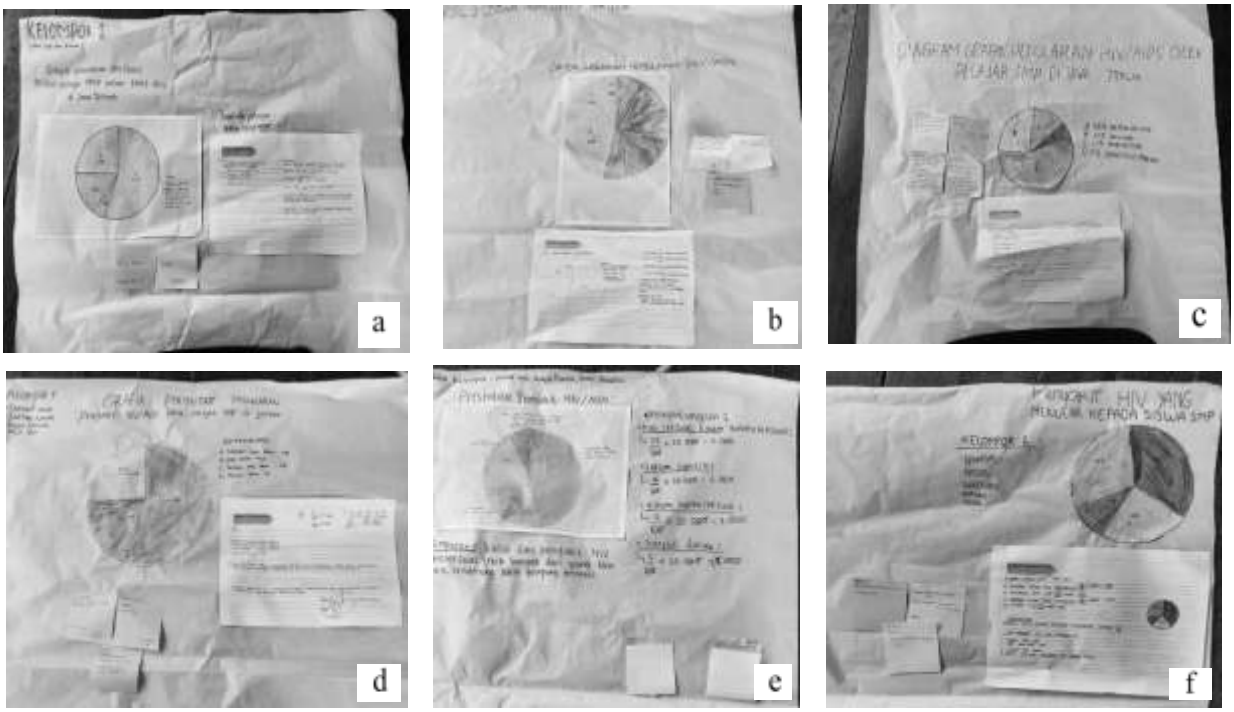

Figure 3:- Student worksheet (LKPD) answers in groups.

The results of implementing numerical skills and drawing conclusions from students of SMP Muhammadiyah 08 with reproduction and sexually transmitted diseases, specifically HIV, are carried out by each group, each group consisting of 4 people, and each group obtains different results (Figure 3).Creating pie charts for each group is based on the numerical skill indicators listed in Table 1. Students work in groups to answer LKPD questions (Table 2) and draw conclusions based on the joint analysis results. According to the teacher's instructions, the response is written on a piece of paper. The results of each group are presented in Figure 3 with the description as the following: (a) results of analysis and drawing conclusions using a pie chart of group 1; (b) results of analysis and drawing conclusions using a pie chart of group 2; (c) results of analysis and drawing conclusions using a pie chart of group 3; (d) results of analysis and drawing conclusions using a pie chart of group 4; (e) results of analysis and drawing conclusions using a pie chart of group 5; and (6) the results of the analysis and drawing conclusions using a pie chartof group 6 (Figure 3).

Discussion:-

The numerical skills of students in class IX-F at SMP Muhammadiyah 08 are still relatively low; thus, this research is carried out to discover the solution to solve these problems. Reviewed from theAstutik (2020) assessment that previously carried out, she obtains the results that there is an increase on the numerical skill from the cycle I to cycle II of 18.94% towards the students thru Problem Based Learningmodel. Another relevant research is conducted by Firdaus et al., (2021), it can be reported that PBL model is able to improve the students' numerical literacy skill so that this model is suitable to be developed in the middle to high school levels. Hence, independent assessment in groups by the teacher is carried out on students with reproductive material and sexually transmitted diseases (STDs) in two cycles.

In this research, the assessment of students using problem-based learning (PBL) with Lesson Study (LS) stages in cycles I and II with the assessment aspect being numerical abilities and student learning outcomes is presented in the form of bar charts (Figures 1 and 2).PBL is one of the best learning models that can be developed because it encourages students' problem-solving abilities, critical thinking, and creativity(Hidayati & Wagiran, 2020). Lesson Study is a model for professional development that emphasizes collaborative learning and builds on the principles of collaboration and mutual learning(Purwatiningsih et al., 2017). Additionally, according to Susetyarini & Miharja (2017)who assert that the benefits of implementing Lesson Study (LS) by the teacher are to get a profitable, consistent, and systematic learning so that they can strive for students to improve managerial abilities independently.

In cycle I, testing iss carried out on the students of IX-F class, particularly on sexually transmitted diseases (STDs) caused by HIV material. Referring to the results of the numerical skill assessment, there are four students who are not proficient in analyzing the problems given so that they obtain a score below the minimum completeness criteria (KKM), namely 66.7 (Figure 1). It can be interpreted that the students have a limitation in understanding the text problems in the form of long narrative and the lack of ability to calculate. In addition, students also tend to be individualistic and have high competitiveness; thus, sharing knowledge with other students in a group is lacking. In cycle I, the second meeting is re-assessed to find out changes in students' numerical skills. In groups, students work on the questions listed in the LKPD (Table 2) and shows that the results of the numerical skill assessment have increased so that the average total score is from 83.3 to 88.9 (Figure 1).The PBL model, when combined with the LS stages, can improve the numerical skills of students from the six groups. This is supported by Yustinaningrum, (2021)who postulates that literacy or numerical skill has a close attachment to the ability to solve problems that begins with understanding the problem, formulating solutions, and implementing relevant solutions. The numerical literacy skill is not only used as a solution in the scope of mathematics but also it can be a provision in managing various facts as a basis for making decisions related to calculations in life(Budiono, 2017).

In cycle II with STD material on the topic of sexually transmitted diseases due to microorganism infection shows a significant increase in score results (Figure 2). According to cycle II in the first and second meetings, there is an increase in the average total score from 82.6 to 95.8. According to Ekowati, et al (2019);Baharuddin et al., (2021), An increase in numerical ability is indicated by the student skills in formulating, applying, and interpreting mathematics in the context of solving problems, including being able to reason mathematically and conceptually based on events that occur. Students' proficiency in numerical literacy can also stimulate students to improve critical thinking so that the solution to a problem can be resolved properly. Critical thinking becomes a skill that involves rational thinking in the learning process so that it can provide a reasonable solution to a problem(Yokhebed, 2019).Nuryanti et al., (2018)state that critical thinking can assist to analyze and evaluate an information, raise important questions and issues, formulate questions and problems clearly, conclude and evaluate relevant information with abstract ideas, has an open-minded orientation, and able to communicate effectively.

The learning processes in SMP Muhammadiyah 08 Batu using problem-based learning combined with the LS is suitable to be used with the research results, in which it can improve the learning outcomes and the students' numerical skill. Problem-based learning assist in conditioning students to be able to develop their critical thinking skills through the problem-solving process carried out during the learning activities. This is in line with the philosophical foundations of constructivism embraced by the PBL modelthat learning activities are centered on learners (student-centered). This statement is supported by the research results of Ambarwati & Kurniasih (2021)that PBL becomes a learning that involves the students since the learning system encompasses the indicators of numerical literacy skills from the problems given.

The results of this research comprehensively show that the implementation of PBL combined with the LS can improve students' learning outcomes and numerical skills (Figures 1 and 2). The results are relevant to the PBL model that accommodate the skills of students. According toMasek, (2011); (Masrinah et al., 2019),Problem Based Learning (PBL) is a learning model that motivates the students to study by solving problem and developing their abilities. The PBL focuses on the problems presented by the teacher and students solve these problems with all their knowledge and skills from various sources that can be obtained(Lidinillah, 2007). The activity phases of the Problem Based Learning (PBL) model can accommodate students' 21st-century abilities(Putri et al., 2015).

Conclusion:-

The research concludes that Problem-Based Learning in the implementation of Lesson Study can improve students' learning outcomes and numerical literacy skill of IX class at SMP Muhammadiyah 08, Batu City, particularly on STD material due to HIV and STD material due to microorganism infection.

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