The Effect of LSLC - Based Problem Based Learning Model on Student Learning Outcomes on Atomic Structure Material – Nanomaterials for Class X SMA Penggerak

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A B S T R A C T

A proper learning process can improve student learning outcomes. Therefore, appropriate learning models and systems are needed. The LSLC-based Problem Based Learning (PBL) model can be used as a solution. This study aims to determine the effect of the LSLC-based PBL model on learning outcomes in the aspects of knowledge, skills, and attitudes of students on the atomic structure-nanomaterial. This study is a quasi experimental with a randomized posttest only control group design.Which was held to two classes of class X SMAN 9 Padang. The results show that the learning outcomes were normally distributed and had a homogeneous variance. Therefor, the t-test was done to test the hypothesis which the demonstrated $T_{critical} > T_{table}$. For those three kinds of learning outcomes, which were knowledge learning outcomes (1.9595 > 1.669); skill learning outcomes (1.9752 > 1.8124); attitude learning outcomes (2.4206 > 1.8124). The result prove that of the application of the LSLC-based PBL model on the atomic structure-nanomaterial topic has a significant effect on improving knowledge, skills, and attitude.

1. Introduction

Education is the implementation of the curriculum in the form of a learning process that can develop individual qualities in achieving the standards of national education goals. In its application, the learning process will direct each student to an achievement known as learning outcomes (Asmara, 2021). The quality of an education is determined by several factors, including the effectiveness of school leaders, participation of educators, effective learning processes, structured educators, relevant curriculum, clear school vision and mission, conducive learning atmosphere, learning evaluation, good communication and involvement, parents and society.

Based on the concept of quality education above, it can be understood that educational development must focus on the educational process factors so that it can improve the quality of learning (Hope, 2017). One of the learning systems that can improve the quality of learning is Lesson Study for Learning Community (LSLC). LSLC is a learning system that is oriented towards educational recovery to improve the quality of learning by collaborating between students, model teachers, observers and parents who take part in the learning community. LSLC activities include three stages, "plan (planning), do (implementation) and see (reflection)". In the plan stage, the teacher collaborates in the community to prepare the lesson plans that will be implemented. In the do stage, the model teacher carries out learning based on a jointly formulated design, while other community members act as observers. The third stage in the LSLC is to reflect (see), which is a review of the learning outcomes that have been carried out based on the results of observations. At this stage the observer provides input or suggestions for improving learning (Junaid & Baharuddin, 2020).

LSLC-based learning can improve teacher professionalism because LSLC can form learning communities and improve teacher communication and collaboration so that teachers can prepare for learning optimally (Pertiwi & Lukitasari, 2019). In addition, LSLC can also improve student understanding as evidenced by increased learning outcomes (Defista & Andromeda, 2022). The learning outcomes obtained are realized by a value or number so that it causes changes in knowledge, skills and attitudes (Harysandi, 2015).

Based on the analysis of interviews with Chemistry teachers at SMAN 9 Padang, it is known that SMAN 9 Padang is one of the schools that implements the penggerak curriculum. The penggerak curriculum is a curriculum whose learning outcomes are developed by collaborating with each other through training conducted by school leaders, committee boards and all KKG in schools. LSLC is one of the right systems to be applied to the penggerak curriculum considering that teachers must collaborate in developing learning outcomes together in the community to design the learning.

One of the main materials in the chemistry subject in the penggerak curriculum is the atomic structure-nanomaterial. The atomic structure-nanomaterial material is also expected to be able to change the dynamics of thinking and students views on chemistry subjects where students tend to think that chemistry is only theoretical even though chemical concepts tend to be applied in technological developments to nanotechnology. In the achievement of learning chemistry in the penggerak curriculum, students are trained to conduct research both qualitatively and quantitatively simple individually and collaboratively on various real-world phenomena. Based on a questionnaire distributed to 21 students of SMAN 9 Padang who applied the penggerak curriculum, it was found that 66.7% of students could not understand chemistry well. This is also seen in the learning outcomes of class X students who have an average of 63.66 where the average grade X seems to have not reached the minimum completeness criteria. The difficulties faced by students in learning chemistry include students having

difficulty understanding the concepts in chemistry and the assumption that in chemistry there are formulas or equations and terms that are difficult to understand.

Problem Based Learning is an appropriate learning model to overcome the problems of chemistry learning in the penggerak curriculum. Problem Based Learning is a learning model that can train students ability to solve problems through systematic syntax, where students will be stimulated to be able to analyze a problem, formulate hypotheses, collect data, analyze data and draw conclusions from the problems given. (Iswari, 2016). However, based on the analysis of the results of interviews with four chemistry teachers at SMAN 9 Padang, it was found that 100% of the teachers stated that they had applied the Problem Based Learning model, but in practice the teachers did not apply it according to the syntax of the Problem Based Learning model.

Based on the problems that have been described, it is necessary to find a way to improve the quality of learning and improve students understanding of chemistry in the penggerak curriculum that students can get better learning outcomes, both in terms of knowledge, skills and attitudes. The purpose of this study was to determine the effect of the LSLC-based Problem Based Learning model on student learning outcomes in the atomic structure-nanomaterial of class X SMA Penggerak.

2.   Methodology

This research is a quantitative experimental study in the form of a quasi-experimental study with a randomized posttest only control group as the design. This type of research has a simple method to determine the effect of certain treatments (Yusuf, 2013). Researchers used two groups in this research design, namely the experimental group and the control group. In the experimental group, the researcher applied the learning process using a Problem Based Learning model based on Lesson Study for Learning Community, while the control class used a conventional learning model. The research design can be seen in Table 1.

Table 1. Research Design

Class	Treatment	Learning outcomes
Experiment	X	Y
Control	-	Y

Description :
X : Application of LSLC-based Problem Based Learning model
Y : Student learning outcomes

All students of class XE Even Semester SMAN 9 Padang for the academic year 2021-2022 which consists of 11 classes are the population in this study. Samples were then taken using simple random sampling technique . This technique is a sampling technique where each population has the same opportunity to be

selected as a sample (Sugiyono, 2016). Then class XE 3 was selected as the experimental class and class XE 4 as the control class. There are three variables in this study, namely the independent variable; Problem Based Learning model based on Lesson Study for Learning Community, dependent variable; learning outcomes on the atomic structure-nanomaterial of class X SMAN 9 Padang in the academic year 2021-2022, and control variables; teachers who teach, allocation of time and learning materials. The data obtained in this study are student learning outcomes consisting of aspects of knowledge, skills and attitudes.

The instruments used in this study were knowledge test questions in the form of test questions and standard evaluation documents used by SMAN 9 Padang teachers to assess students skills and attitudes. The knowledge test instrument used in the form of multiple choice questions totaling 20 pieces related to the material of the atomic structure-nanomaterial of class X SMA which had been discussed with the chemistry teacher at SMAN 9 Padang and the chemistry lecturer at Padang State University.

Data on student learning outcomes were analyzed through data analysis techniques. The data analysis technique used in this research is statistical analysis, which is a collection of numbers that describe an event or certain events that are arranged systematically in the form of tables or diagrams.

1. Normality test
    Normality test aims to test a research sample whether the sample comes from a normal population or not. The normality test was tested on the SPSS application with the Kolmogorov-Smirnov test . If the significant value is <0.05, then the data is said to be normally distributed. If the significant value is >0.05, then the data is said to be not normally distributed (Widana & Muliani, 2020).

2. Homogeneity Test
    The homogeneity test aims to test the similarity of each variance of the data group. Homogeneity test can be done with a test of homogeneity of variance. If the significant value is <0.05, the data is said to be inhomogeneous. If the significant value is >0.05 then the data is said to be homogeneous (Widana & Muliani, 2020).

3. Hypothesis testing
    Hypothesis testing is done to determine whether or not a research hypothesis is accepted. The hypothesis test carried out in this study is a parametric test in the form of a similarity test of two averages with the following formula:

$$T_{hitung} = \frac{\overline{X_A} - \overline{X_B}}{\sqrt{\frac{S_A^2}{N_A}} + \sqrt{\frac{S_B^2}{N_B}}}$$

Description:

$\overline{X_A}$: the average value of the experimental class

$\overline{X_B}$: the average value of the control class

S_A^2 : experimental class variance

S_B^2 : control class variance

N_A: the number of samples of the experimental class

N_B : number of control class samples

3.   Results and Discussion

The results obtained in this study are that there is a significant influence on the application of the Lesson Study for Learning Community (LSLC)-based Problem Based Learning (PBL) model on student learning outcomes in aspects of knowledge, skills, and attitudes. Data on student learning outcomes were obtained from 2 classes, namely class XE 3 as the experimental class and class XE 4 as the control class. Learning activities in the two classes were carried out with different treatments where the experimental class applied the LSLC-based PBL model while the control class applied the conventional learning model. Learning activities in the experimental class were carried out for 6 LSLC cycles with data on learning outcomes of knowledge, skills, and attitudes which can be seen in Table 2.

Table 2. Learning Outcomes

No	Learning outcomes	Average	
		Experiment Class	**Control Class**
1	Knowledge	80.97	75.69
2	Skills	81,20	74.79
3	Attitude	83.94	78.72

Data on learning outcomes of knowledge, skills, and attitudes obtained in this study were analyzed through normality test, homogeneity test, and hypothesis testing.

1.   Normality test

The normality test in this study uses the SPSS application with the Kolmogorov-Smirnov test. The results of the normality test can be seen in Table 3.

Table 3. Normality Test

Aspect	Experiment Class	Conclusion	Control Class	Conclusion
Knowledge	0.134	Normal Distribution	0.090	Normal Distribution
Skills	0.200	Normal Distribution	0.200	Normal Distribution
Attitude	0.200	Normal Distribution	0.200	Normal Distribution

Based on the data in Table 3, it can be concluded that the learning outcomes of knowledge, skills, and attitudes in the experimental class and control class are normally distributed.

2. Homogeneity Test
The homogeneity test in this study used the SPSS application with a test of homogeneity of variance. The results of the homogeneity test can be seen in Table 4.

Table 4. Homogeneity Test

Aspect	Experiment Class	Control Class	Conclusion
Knowledge	0.329		Homogeneous
Skills	0.663		Homogeneous
Attitude	0.746		Homogeneous

Based on the data in Table 4, it can be concluded that the data on learning outcomes of knowledge, skills, and attitudes in the experimental class and control class have a homogeneous variance.

3. Hypothesis testing
Based on the normality and homogeneity test of the learning outcomes of knowledge, skills and attitudes, it was found that the data were normally distributed and had a homogeneous variance. The results of hypothesis testing can be seen in Table 5.

Table 5. Hypothesis Test

Aspect	Class	T_{table}	T_{count}	Information
Knowledge	Experiment Control	1.6669	1.9595	H1 accepted _
Skills	Experiment Control	1.8124	1.9752	H1 accepted _
Attitude	Experiment Control	1.8124	2,206	H1 accepted _

Based on the results of the hypothesis test above, it can be concluded that H1 in this study is acceptable where there is a significant effect on the application of the LSLC-based PBL model on the learning outcomes of knowledge, skills, and attitudes of experimental class students where the value of $T_{count} > T_{table}$.

Learning activities with the LSLC-based PBL model are carried out online and offline. During learning, students are required to join the zoom meeting, both students in the classroom and students at home. This is intended so that students are always under the supervision of the model teacher and the LSLC community who observe learning activities. In addition, using online learning media can also make it easier for teachers to control and ensure students follow learning at the same time even though they are in different places (Yunitasari & Hanifah, 2020). Learning activities in the experimental class were carried out for 6 LSLC cycles

through 3 stages, namely the plan, do and see stages with a description of each cycle as follows:

1. Cycle 1

The first stage in cycle 1 is the plan activity. Plan activities are carried out jointly by the model teacher and the LSLC community. The activity plan cycle 1 discusses the achievements that must be possessed by class XE students at the end of learning, the division of the flow of learning objectives and time allocation, as well as the technical implementation of learning where the model teacher must inform students regarding things needed during learning such as zoom meeting applications and networks. Internet. In addition, the LSLC community also provides suggestions for model teachers to divide groups in a mixed manner between online student groups and offline student groups. According to Hosnan., et al (2018), collaboration between group members can create learning activities between each other and not make one student feel neglected in learning activities. In the do stage, the sub-material discussed is atomic structure. During the learning process, the model teacher together with the LSLC community observed learning activities which consisted of assessing students' skills, attitudes and activities during learning. The average value of student skills in cycle 1 is 72,44, while the average value of student attitudes in cycle 1 is 79,45. The third stage in cycle 1 is the see activity. See activities are carried out to find solutions to problems in do activities that have been carried out so that they can be improved in the next cycle (Defista & Andromeda, 2022). Based on the observations of the LSLC community in each study group, several obstacles and problems were found, including technical problems, namely internet network problems when attending zoom meetings, students who had not installed the zoom application , students who looked doubtful when using breakout zoom, and 5 students who not activate the zoom meeting camera .

2. Cycle 2

The first stage in cycle 2 is the plan activity. Cycle 2 plan activities are based on the problems contained in cycle 1. In cycle 2 plan , the model teacher together with the LSLC community discuss solutions to problems in cycle 1 and the design that will be given in cycle 2 activities including internet network constraints, zoom meeting application constraints , and cycle 2 learning design. The second stage in cycle 2 is do activity. The sub material discussed in cycle 2 is a continuation of the atomic structure sub material discussed in cycle 1. Students also carry out literacy together in study groups to explain the benefits of these elements. According to Syaifuddin., et al (2022), literacy activities are one of the activities to understand information from various sources that are accessed via computers or smartphones . The average value of student skills in cycle 2 is 76,44 while the average value of student attitudes is 80,62. At the see stage, it was found that all XE 3 class students had installed the zoom meeting application . However, there are still students who have network problems, do not activate the camera, and students with visual impairments.

3. Cycle 3

The activity plan cycle 3 is based on the problems contained in cycle 2. The problems discussed include internet network constraints, students not activating the zoom meeting camera, students with visual impairments, and learning design cycle 3. The second stage in cycle 3 is do activities . The sub-material discussed in cycle 3 is the electron configuration according to Bohr's atomic theory. The average value of student skills in cycle 3 is 80,78 while the average value of student attitudes is 83,54. In the see activity cycle 3, the LSLC community conveyed several advantages in the do cycle 3 activity where students looked more active than the previous cycle and students collaborated well during discussion activities. In cycle 3 activities, students also seemed enthusiastic in answering questions during discussions in front of the class, this was seen from the student learning activities observed by the LSLC community. Good student activities in learning activities will also have a good impact on learning outcomes (Haryanto, 2013).

4. Cycle 4

The activity plan cycle 4 discusses the learning design in cycle 4. According to the LSLC community, the model teacher design learning plan can already be used but the student worksheet (LKPD) section needs to be improved and clarified in the image section presented in the fourth point. The second stage in cycle 4 is the do activity. The activity in cycle 4 discusses the atomic radius sub-material as an element's periodicity. The average value of student skills in cycle 4 is 79,89 while the average value of student attitudes is 84,65. The third stage in cycle 4 is the see activity . At the see stage , the LSLC community conveyed several advantages in cycle 4, including student activity which had greatly increased compared to the previous cycle, students were also very enthusiastic in answering the model teacher's questions and presenting the results of group discussions to conclude the learning outcomes at the end of cycle 5. In this cycle, there is 1 student who is constrained by the network during group discussions, but the student immediately joins using a group friend device that is next to him.

5. Cycle 5

The first stage in the activity of cycle 5 is the plan stage. In the activity plan cycle 5, the model teacher together with the LSLC community discussed the learning design in cycle 5. According to the LSLC community, the learning design designed by the model teacher can already be applied to the do cycle 5. The second stage in cycle 5 is do activity. The activity in cycle 5 discusses the electron configuration sub-material according to the theory of quantum mechanics. The average value of student skills in cycle 5 is 85,78 while the average value of student attitudes is 83,54. The third stage in cycle 5 is the see activity. According to the LSLC community, the activities in cycle 5 have increased compared to the previous cycle where students were seen to be very active in conducting group discussions. In addition, students also seemed enthusiastic and fought over when presenting the results of group discussions and responding to the results of other group discussions and even students asked for additional questions from the model teacher. According to Hosnan., et al (2018), the application of LSLC can improve students' communication and argumentation skills in learning activities.

6. Cycle 6

The first stage in cycle 6 is a plan activity. In the activity plan cycle 6, the model teacher together with the LSLC community discussed the technical aspects of the do cycle 6 activities where the do cycle 6 activities were carried out fully offline in the XE 3 classroom. According to the LSLC community, the do cycle 6 activities no longer use the zoom meeting application considering all students are in the classroom during the learning takes place. The design of learning devices designed by the model teacher can also be accepted by the LSLC community so that the design can be directly implemented at the do stage of cycle 5. The second stage in cycle 6 is do activity. The sub-material discussed in cycle 6 is the understanding and importance of nanotechnology and the concept of atomic structure in the discussion of nanomaterials. The average value of student skills in cycle 6 is 90,11 while the average value of student attitudes is 91.81. The third stage in cycle 6 is the see activity. According to the LSLC community, cycle 6 activities took place in an orderly and conducive manner even though all students were in the classroom. Based on the results obtained in each learning cycle, it shows that learning activities with the LSLC-based PBL model show an increase in the percentage of student activity in each cycle. In this last cycle, the LSLC community gave a lot of good responses to the learning carried out for 6 cycles.

The difference in the value of students knowledge, skills, and attitudes between the experimental class and the control class was influenced by the different treatment between the two classes. In accordance with the results of hypothesis testing in data analysis, H1 in this study is acceptable where there is an effect of the application of the LSLC-based PBL model on the learning outcomes of students knowledge, skills and attitudes in the experimental class Based on the results obtained in this study, the application of the LSLC-based PBL model can increase student activity during learning which is followed by increasing student learning outcomes in aspects of knowledge, skills and attitudes. Therefore, learning activities with the LSLC-based PBL model in class XE 3 SMAN 9 Padang can be said to be successful.

The success of learning activities with the LSLC-based PBL model in this study is also supported by several previous studies including the research of Darmawanti (2019) with the title of applying the Problem Based Learning learning model to the learning outcomes of high school students in class X chemical bonding material. The results showed that the Problem Based Learning learning model had a good impact on class X SMAN Leihitu with the percentage of student learning outcomes in the knowledge aspect 88%, attitude aspect 80%, and skill aspect 84%.

Defista & Andromeda (2022) research entitled the effect of the LSLC-based Guided Inquiry Learning learning model on student learning outcomes at SMAN 1 Padang on chemical equilibrium material also shows that the LSLC-based GIL model is effective in improving student learning outcomes as evidenced by an increase from pretest scores to the student's posttest score with an N-Gain value of 0,68.

Mahesa & Yerimadesi (2022) research entitled the effect of applying the LSLC-based Guided Discovery Learning model to student learning outcomes at SMAN 15 Padang also shows a significant influence on student learning outcomes in electrolysis material, where student learning outcomes in classes that apply the GDL model based on LSLC was significantly higher than the class that did not apply the LSLC-based GDL model.

4. Conclusion

Based on the results of research and data processing that has been carried out, it can be concluded that the application of the Problem Based Learning (PBL) model based on Lesson Study for Learning Community (LSLC) on the atomic structure-nanomaterial has a significant influence in improving learning outcomes both in terms of knowledge, skills, as well as the attitudes of the tenth graders of SMAN 9 Padang.

Confession

References

Asmara, L. Y. (2021). Differences Of Cognitive Learning Outcomes With The Addie Learning Model Based On Lesson Study Holistic Learning Strategy And Addie Model At SMA N 7 Rejang Lebong. *Journal Of Bioeduscientific, 2(1)*.

Darmawati, S. (2019). Application of Problem-Based Learning Models on Learning Outcomes of High School Students in Class X Chemical Bonds. *Journal of Muara Pendidikan , 4(1),* 200-207.

Defista, C., Andromeda, A., & Sovia, E. (2022). The Influence of Guided Inquiry Learning Model Based on Lesson Study for Learning Community on Chemical Equilibrium Material on Student Learning Outcomes of SMAN 1 Padang. *IJIS Edu: Indonesian Journal of Integrated Science Education , 4 (1),* 40-44.

Hope, E. (2017). The Principal's Vision as a Driver of Education Quality. *JMKSP (Journal of Management, Leadership, and Education Supervision), 1(2),* 133-145.

Haryanto, Z. (2013). The Effectiveness of Lesson Study Models in the Implementation of Constructivism Learning in SMA/MA in West Kutai Regency, East Kalimantan Province in 2012. *Media Communications FPIPS , 12(1)*.

Harisandy, R. (2015). Increasing Students' Learning Outcomes In Low Voltage Power Control Subjects Through Group Investigation (Gi) Type Cooperative Model. *Journal of Electrical Engineering Education , 5(3).*

Hosnan, H., Hobri, H., & Dafik, D. (2018). Algebraic learning through caring community based on lesson study for learning community.

ISWARI, NND (2016). The Effect of Problem Based Learning Model Based on Science Literacy on Chemistry Learning Achievement Subject Redox Reactions in Class X Students of SMAN 1 Lingsar Academic Year 2015/2016 (Doctoral Dissertation, University of Mataram).

Junaid, R., & Baharuddin, MR (2020). Improving teacher pedagogic competence through PKM lesson study. *To Maega: Journal of Community Service , 3 (2),* 122-129.

Pertiwi, NM, & Lukitasari, M. (2019, December). Analysis And Description Of The Use Of Mind Mapping Through Lesson Study For Learning Community (Lslc) On Human Reproductive System Materials. *In Proceedings Of The National Seminar On Symbiosis. 4.*

Mahesa, A., & Yerimadesi, Y. (2022). The Influence of the Application of the LSLC-Based GDL Model on Student Learning Outcomes at SMA Negeri 15 Padang. *Tambusai Journal of Education, 6(1),* 1055-1059.

Sugiyono. (2016). Educational Research Methods . Bandung : ALFABETA

Syaifuddin, M., Ummam, AW, Bangkit, SM, Sodiq, AR, & Zakiah, IN (2022). Extension on the Application of Digital Literacy for Students in Facing Online Learning. *Altifani Journal of Research and Community Service, 2(1),* 1-6.

Widana, IW, & Muliani, NPL (2020). Test requirements analysis.

Yunitasari, R., & Hanifah, U. (2020). The effect of online learning on students' interest in learning during the covid 19 period. *Educational: Journal of Educational Sciences, 2(3),* 232-243.

Yusuf, M. (2013). Methods of Quantitative, Qualitative and Combined Research . Padang: UNP Press.