Journal of Technology and Mathematics Learning
Volume 1, Issue 1, 1-11, Juni 2024
https://afeksi.id/journal3/index.php/jtml

Implementation of Contextual *Project-Based Learning* on Student Learning Outcomes Reviewed from Learning Independence

Nida Nuria[1], Robia Astuti[2], Binti Anisaul Khasanah[3*]
[1,2,3*] Mathematics Education, Faculty of Teacher Training and Education, Muhammadiyah University of Pringsewu
[1]nida@gmail.com, [2]robiaastuti@umpri.ac.id, [3*]*bintianisaul@umpri.ac.id*
*Correspondent author

Received: Maret, 2024 | Revised: April 2024 | Accepted: Mei 2024 | Published: Juni 2024

Abstract
In mathematics learning, students' understanding of the material on linear equations in one variable is still lacking, so that their learning outcomes are low. This study aims to determine the differences in average learning outcomes using the contextual *Project Based Learning (PjBL) learning model in terms of learning independence.* The population in this study were students of class VII MTs N 2 Pringsewu with samples of class VII A and class VII B, through the sampling technique, namely the *cluster random sampling technique* . This research method uses a quantitative method with data collection techniques, namely test and questionnaire techniques, then analyzed using two-way ANOVA with unequal cells . The results of the study showed that; (1) Learning using the contextual-based *PjBL learning model* has higher mathematics learning outcomes compared to learning using the STAD cooperative learning model. (2) Students with high learning independence have higher mathematics learning outcomes compared to students who have moderate or low learning independence, and students who have moderate learning independence have higher mathematics learning outcomes compared to students who have low learning independence. (3) In each learning (using the contextual-based *PjBL learning model* or using the STAD cooperative learning model), students with high learning independence have higher learning outcomes compared to students with medium or low learning independence and students with medium learning independence have higher learning outcomes compared to students with low learning independence. In each learning independence (high, medium and low), the application of learning using the contextual-based *PjBL learning model* provides higher mathematics learning outcomes compared to learning using the STAD cooperative learning model .
Keywords: Mathematics Learning Outcomes; Learning Independence; Learning Model; Contextual-Based PjBL

Introduction

Education is an investment in long-term human resources that has strategic value for the sustainable development of human civilization in the world. Schools are a means of supporting sustainable development. Starting from the 2022/2023 academic year, several schools have implemented the Independent Curriculum which emphasizes student-centered learning, including in mathematics subjects. Mathematics is an important field to train critical, systematic, logical, creative thinking,

and working well together (Khasanah, & Ayu, 2017) . Mathematics is also a major subject and is very important in people's lives (Husna, 2022) . However, many students have the perception that mathematics is quite difficult to learn (Siregar, 2017) . Mathematics related to numbers, calculations, formulas and abstract images is considered a difficult subject. Students feel bored with learning activities that involve sitting and calculating formulas and numbers.

Based on the results of interviews with subject teachers, information was obtained that the teacher explained the material then students were given example questions after that they were given exercises in the form of questions similar to the examples and discussed together so that data on student learning outcomes for the material on linear equations of one variable on daily tests tended to be low, namely 77% of students did not achieve the Minimum Completion Criteria (KKM) and only 23% of students achieved the KKM. This is thought to be because students tend not to be interested in learning mathematics and consider mathematics to be abstract and difficult to understand. Based on the results of interviews with subject teachers, it was also found that most students had difficulty in working on linear equations with one variable, especially in operating the variables in the equation. In addition, students enjoy doing project-based learning by producing contextual products that are easy to find in real life. This can be seen when working on handicrafts and skills in arts and culture subjects. The students were very enthusiastic and produced good products.

There are several factors that collectively influence the success of mastering learning materials, including students, teachers, learning methods used, and the learning environment (Astuti, 2017) . One of the external factors that influences learning outcomes is the learning model. Based on the results of interviews with mathematics teachers of class VII MTs Negeri 2 Pringsewu in the 2023/2024 academic year by implementing the independent curriculum, information was obtained that teachers in learning use the *Student Team Achievement Division* (STAD) cooperative learning model. The teacher divides the groups randomly, continues with the delivery of the material, then gives group assignments in the form of questions and ends with individual assignments and discussion of questions. However, it is not uncommon to find many groups that are passive or do not do group assignments. In addition, on several occasions when doing exercises and assignments, students tend to rely on their smart friends and copy their friends' work. In fact, students are often found chatting, playing around, and even sleeping during learning. In fact, learning initiatives have a significant impact on mathematics learning outcomes (Yanti, et al., 2020) . This is partly because the learning model used has not been adjusted to the characteristics of the students. Grade VII students of MTs Negeri 2 Pringsewu have characteristics that enjoy making projects related to life. So one of the learning models that can be applied is the *project based learning* (*PjBL*) learning model. Project-based learning can increase students' learning independence (Anjarsari, et al., 2021) . Learning independence plays an important role in the success of achieving learning goals (Hidayat, et al., 2020) . Learning independence also has a positive influence on mathematics learning outcomes (Bungsu, et al., 2019) .

PjBL is a model that combines experience with knowledge during learning through project activities (Hosnan, 2014) . In addition, according to Ardianti, et al., (2017) , *PjBL* is an activity related to the design and implementation of projects in the product manufacturing process. *The PjBL model* will be a guide for students to be active during learning which has an impact

on learning outcomes. Made, et al., (2022) , revealed that using the *PjBL learning model* can help students improve their activeness and learning outcomes in machine tool and production courses. Juwanti, et al., (2020) also stated that in online learning, *PjBL* can increase students' creativity and ability to utilize technology as a medium to communicate their work to create products. In addition, Luma, et al., (2022) also revealed that the average score of physics learning outcomes of students who were given treatment using the *PjBL learning model* with a contextual approach was higher than the average Physics learning outcomes when they had not been given treatment. From the three studies, there has been no application of the contextual-based *PjBL learning model* for junior high school mathematics subjects. Thus, researchers are interested in implementing a contextual-based *PjBL learning model* in the subject of mathematics for grade VII on the material of linear equations of one variable that is in accordance with student characteristics with the hope of improving learning outcomes.

Research Methods

This research is a type of quantitative research in the form of a quasi-experiment. The population in this study were all students of class VII MTs N 2 Pringsewu consisting of 238 students grouped into 7 classes. The sampling technique used *cluster random sampling* obtained class VII A consisting of 34 students as the experimental class and class VII B consisting of 34 students as the control class. The variables used in this study consisted of one dependent variable, namely mathematics learning outcomes and two independent variables, namely learning models and student independence.

There are two techniques used to collect data in this study, namely questionnaires and tests. Learning independence is measured using a student learning independence questionnaire adopted from Ariyanti, (2019) with 23 questions describing learning independence. The questionnaire in this study is a closed questionnaire with 4 alternative choices of agreement responses based on a Likert scale by eliminating the doubtful option. Then, it is categorized with criteria sourced from Ambiyar, et al., (2020) as follows:

Table 1. Categories of Student Learning Independence

Score	Category
$74\% < S \leq 100\%$	Tall
$50\% < S \leq 74\%$	Currently
$0\% < S \leq 50\%$	Low

The instrument used to determine students' mathematics learning outcomes is a mathematics learning outcome test consisting of 19 multiple-choice questions developed by researchers through content validity testing by experts in terms of material and language aspects. In addition, the Mathematics learning outcome test instrument also went through a trial stage by paying attention to the level of difficulty, differentiating power, distractors and reliability.

The material used in this study is a linear equation of one variable. The hypothesis test used in this study is a two-way ANOVA test with unequal cells with a 2x3 factorial design. The hypotheses in this study are as follows:

1. H_{0A} = There is no difference in the effects between learning models on students' mathematics learning outcomes.
   H_{1A} = There are differences in the effects of learning models on students' mathematics learning outcomes.
2. H_{0B} = There is no difference in the effect of learning independence on students' mathematics learning outcomes.
   H_{1B} = There is a difference in the effect of learning independence on students' mathematics learning outcomes.
3. H_{0AB} = There is no interaction between learning models and students' independence in learning mathematics
   H_{1AB} = There is an interaction between the learning model and students' independence in learning mathematics.

The prerequisite tests for ANOVA are the normality test using the *Liliefors method* and the homogeneity test using the *Bartlett test* . Then, an in-depth analysis is continued using the *Scheffe' method* if there is a difference in effect **.**

Results and Discussions

PjBL learning model is aimed at the material of one variable linear equations by producing a product in the form of a project, namely a story board with the following stages;

1. Determining project questions (*start with essential project*)
   Learning begins with essential questions, namely questions that give students the task of carrying out an activity. These questions are structured around real-world relevant topics and begin with a thorough investigation.
2. Developing contextual project planning (*design contextual project*)
   Planning is done collaboratively by teachers and students. Planning includes dividing the groups that have been prepared by the teacher, determining the rules for working on the project, integrating various materials, knowing and preparing materials and tools that can be used to help complete the project. In addition, the projects selected are also contextual projects that are in accordance with everyday life.
3. Create a *schedule*
   In completing the project, teachers and students work together to create a schedule of activities. One of their tasks is to create a project completion schedule, set a project end date, encourage students to plan something new, and ask students to provide an explanation (reason) for how they choose the time. Teachers can track learning progress and complete projects outside the classroom through an agreed schedule that must be mutually agreed upon.
4. Monitoring the students and progress *of* project
   During the project, the teacher is responsible for monitoring the students' activities. Monitoring is done in a way that facilitates the students throughout the process. In other words , the teacher acts as a mentor for the activity. In addition, the teacher also provides input and assistance to students when they have difficulties while working on the project.
5. Assess *the* outcome
   Assessment is conducted to help teachers measure the achievement of competency standards, assess student progress, and provide feedback on the level of understanding

that has been achieved. At this stage, students present their work in the form of storyboard products in front of the class. Then, the teacher gives appreciation to the students' work and gives several questions related to the project to measure students' understanding of the material through the project. Here are examples of products produced by students;

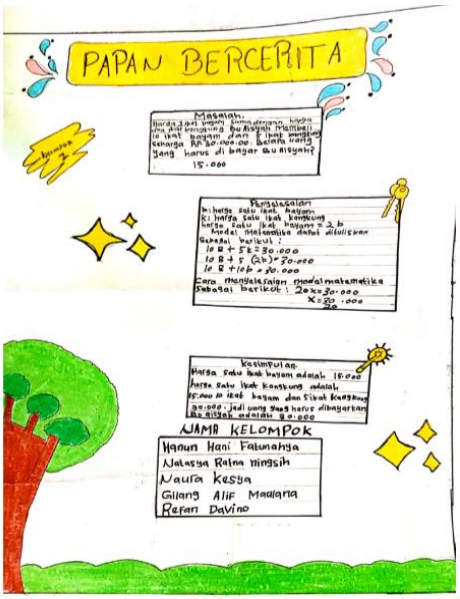

Figure 1. Student Project Results

6. Evaluation of Experience (*evaluation the experience*)

When the learning process is complete, the teacher and students reflect by conveying their emotions and experiences during the process of completing the project. In addition, the teacher also provides a mathematics learning outcome test to measure students' individual understanding of the material on linear equations of one variable.

Before the learning began, the researcher took data on learning independence in the experimental class and the control class. The results of the categorization of student learning independence questionnaire data are as follows:

Table 2. Data from the Distribution of Student Learning Independence Questionnaire Results

Class	Number of Shiva	Number of Students in Each Category of Learning Independence		
		Tall	Currently	Low
Experiment	34	18	11	5
Control	34	13	14	7

Learning independence is one of the internal factors that affect learning outcomes. Learning independence has a positive influence on mathematics learning outcomes (Dewi, et al., 2020) . Siagian, et al., (2020) also revealed that the significant influence of learning independence between learning independence and mathematics learning outcomes. In addition, Suhandi, & Kurniasri, (2017) also stated that students' learning independence can be improved through contextual learning models .

The prerequisite results of the ANOVA test show that each sample group comes from a population with a normal and homogeneous distribution in each paired group. Table 3 below shows a summary of the calculation results of the two-way ANOVA test with unequal cells .

Table 3. Summary of Two-Way Analysis of Variance

Source	JK	Dk	RK	F_{obs}	F_a	Test Decision
Learning (A)	6832,56	1	6832,56	17,53	3,996	H_{0A}rejected
Independence Study (B)	27097,63	2	13548,82	34,75	3.145	H_{0B}rejected
Interaction(AB)	1080,72	2	540,36	1,385	3,145	H_{0AB}accepted
Error	24175,21	62	389,93			
Total	**59186.12**	**67**				

Based on Table 3, it can be concluded that: a) There is a difference in the average mathematics learning outcomes between students taught with the contextual-based *PjBL learning model* and students taught with the STAD cooperative learning model ; b) There is a difference in the average between students who have high, medium and low learning independence; c) there is no significant relationship between the learning model and learning independence on mathematics learning outcomes.

The results of the hypothesis test show that the *PjBL learning model* and learning independence have a significant impact on mathematics learning outcomes. Then a further post-ANOVA test was carried out using *the Scheffe' method* to compare the means between rows and columns. This aims to determine the learning model and category of learning independence that provide higher learning outcomes. Table 4 shows the marginal average.

Table 4. Marginal Average of Research Results

Learning model	Learning Independence			Marginal Mean
	Tall	Currently	Low	
Contextual *PjBL* Model	86.31	64.04	31.58	71.06
STAD Cooperative Model	68.81	30.14	17.57	42.34
Marginal Mean	78.97	45.06	28.66	

First Hypothesis

The results of the hypothesis test in Table 3 show that H_{0A}it is rejected, which means that there is a difference in the effect between learning models on students' mathematics learning outcomes . Therefore, a further post-ANOVA test was carried out on the mean test between rows in the following Table 5:

Table 5. Summary of Multiple Comparison Tests Between Rows

H_0	F_{obs}	1 $F_{0,05:1;62}$	Test Decision
μ_1=μ_2	35,961	3,996	H_0rejected

Table 5 shows that the average mathematics learning outcomes of students taught using the contextual-based *PjBL learning model* are different from those of students taught using the STAD cooperative learning model. As in Table 4, it is known that the implementation of the contextual-based *PjBL learning model* on the PLSV material has a positive impact on student learning outcomes. In learning using the contextual-based *PjBL learning model* , a marginal average of 71.06 was obtained . While in learning using the STAD cooperative learning model, a marginal average of 42.34 was obtained . From these data, it can be concluded that learning using contextual-based *PjBL learning* achieves higher learning outcomes compared to using the STAD cooperative learning model. This means that the contextual-based *PjBL* learning model can improve learning outcomes. This is because in classes that use contextual-based *PjBL learning models* , many students are enthusiastic during learning because they are given the opportunity to explore the material as deeply as possible to work on projects. In addition, students have a sense of responsibility so that they are more enthusiastic and more active in the learning process to complete projects that they often encounter in everyday life. In addition, students also train their brave souls by presenting the results of their project work in front of the class. This is in accordance with the results of research conducted by Made, et al., (2022) which shows that using the *PjBL model* can help students improve their activeness and learning outcomes . There is also research conducted by Setiawan, & Sudana, (2018) which states that contextual learning can improve students' mathematics learning outcomes.

Second Hypothesis

The results of the hypothesis test in Table 3 show that H_{0B}it is rejected, which means that there is a difference in the effect of learning independence on students' mathematics learning outcomes . Therefore, a comparative test of the average between columns is carried out, which can be seen in the following table:

Table 6. Summary of Multiple Comparison Tests Between Columns

H_0	F_{obs}	2 $F_{0,05:1;62}$	Test Decision
$\mu_{.1}=\mu_{.2}$	40,813	6.29	H_0rejected
$\mu_{.1}=\mu_{.3}$	85,714	6.29	H_0rejected
$\mu_{.2}=\mu_{.3}$	8,264	6.29	H_0rejected

Based on Table 6, it is found that H_0it is rejected, which means that all three have different average learning outcomes. As for Table 4 , it is known that student learning independence has an impact on student learning outcomes. In students who have high learning independence, the marginal average is 78.97 , while in students who have moderate learning independence, the marginal average is 45.06. As for students who have low learning independence, the marginal average is 28.06 . From these data, it can be concluded that the learning outcomes of students with high learning independence are better than those with moderate and low learning independence, while the learning outcomes of students with high learning independence are better than those with low learning independence. This is because students who have high learning independence tend to have a high willingness to learn and will complete their tasks well without being told and not depending on others, so that they

will provide higher learning outcomes. Students who have moderate learning independence have a willingness to learn that is still mediocre, only doing assignments given by the teacher so that their learning outcomes are still classified as moderate or low. Likewise, students who have low learning independence with a low willingness to learn and still depend on others when given assignments so that their learning outcomes tend to be low. This is in line with what was stated by Winata, et al., (2021) that learning independence has an influence on learning achievement and Riyanti, et al., (2021) found that the level of student learning independence is positively correlated with their mathematics learning outcomes. Conversely, a lower level of learning independence is negatively correlated with students' mathematics learning outcomes.

Third Hypothesis

The results of the hypothesis test in Table 3 show thatH_{0AB} accepted, which means there is no difference in effect between the learning model and independent learning . This means that the learning model and learning independence have their respective influences or effects on learning outcomes. It can be said that the contextual-based *PjBL learning model and* learning independence have no relationship with each other, namely the influence of the learning model on student learning outcomes does not depend on the category of learning independence possessed by students and vice versa, the influence of learning independence does not depend on the model used. So it can be concluded that there is no interaction between the model and learning independence. This is in line with research by Nurdin, et al., (2017) which shows that there is no difference in learning outcomes between the Think Pair Share model *and learning* independence on learning outcomes and Lami, et al., (2023) learning models and mathematical dispositions do not have an interactive impact on critical thinking skills. Meanwhile, Suhendri, (2015) also found that there was no relationship between the problem solving learning method and learning independence on learning outcomes.

Conclusion and Suggestions

The conclusion of this study was obtained from field data, hypotheses and discussions supported by data analysis. So the conclusion of the study is: 1) The application of learning using the contextual-based *PjBL learning model* provides higher mathematics learning outcomes compared to learning using the STAD cooperative learning model; 2) Students with high learning independence have higher mathematics learning outcomes than students with medium and low learning independence, and students with medium learning independence have higher mathematics learning outcomes than students with low learning independence; 3) In each learning (using the contextual-based *PjBL learning model* or using the STAD cooperative learning model) students with high learning independence have higher learning outcomes than students with medium and low learning independence and students with medium learning independence have higher learning outcomes than students with low learning independence, in each learning independence (high, medium and low), the application of learning using the contextual-based *PjBL learning model* provides higher mathematics learning outcomes compared to learning using the STAD cooperative learning model .

The author also suggests further research , such as providing sufficient time for students to learn independently through discussion and problem solving, and keeping the classroom environment comfortable so that teacher-student interactions are more even.

References

Ambiyar, A., Aziz, I., & Melisa, M. (2020). Differences in Student Learning Independence During the Pandemic at SMAN 1 Lembah Melintang and SMAN 1 Lembah Gumanti. *Cendekia Journal: Journal of Mathematics Education, 2* (4), 1246–1258. https://doi.org/: https://doi.org/10.31004/cendekia.v4i2.367

Anjarsari, W., Suchie, S., & Komaludin, D. (2021). Implementation of Project Based Learning-Based Online Learning to Improve Student Learning Independence. *PRISMA , 2* (10), 255–263.

Ardianti, SD, Pratiwi, IA, and Kanzunnudin, M. (2017). Implementation of Project Based Learning (PjBL) with Science Edutainment Approach to Student Creativity. *Journal of Edukatika Reflection , 2* (7), 145–150. https://doi.org/https://doi.org/10.24176/re.v7i2.1225

Ariyanti, I. (2019). Validity and reliability test of mathematics learning independence questionnaire instrument. *THETA: Journal of Mathematics Education, 1* (2), 53-57.

Astuti, R. (2017). Analysis of students' learning obstacles in studying combinatorial material. *e-DuMath JOURNAL , 1* (3). https://doi.org/https://doi.org/10.52657/je.v3i1.284

Bungsu, TK, Vilardi, M., Akbar, P., & Bernard, M. (2019). The influence of learning independence on mathematics learning outcomes at SMKN 1 Cihampelas. *Journal on Education , 1* (2), 382-389. https://doi.org/https://doi.org/10.31004/joe.v1i2.78

Dewi, N., Asifa, SN, & Zanthy, LS (2020). The influence of learning independence on mathematics learning outcomes. *PYTHAGORAS: Journal of Mathematics Education Study Program , 2* (9), 48–54. https://doi.org/https://doi.org/10.33373/pythagoras.v9i1.2293

Hidayat, DR, Rohaya, A., Nadine, F., & Ramadhan, H. (2020). Student Learning Independence in Online Learning During the COVID-19 Pandemic. *Perspective of Educational Science , 2* (34), 147–154. https://doi.org/https://doi.org/10.21009/PIP.342.9

Hosnan.. (2014). *Scientific and Contextual Approaches in 21st Century Learning*. Ghalia Indonesia.

Husna, N. (2022). (2022). Implementation of Problem Based Learning Model in Efforts to Improve Student Activity and Learning Outcomes in Mathematical Logic Material for Class X TO 3 SMKN 3 Bengkulu Selatan Semester II Academic Year 2021/2022. *Raflesia Journal of Mathematics Education, 3* (7), 1-12.

Juwanti, AE, Salsabila, UH, Putri, CJ, Nurany, ALD, & Cholifah, FN (2020). Project-Based

Learning (PjBL) for Islamic Religious Education During Online Learning. *Al-Ilmi Islamic Education Journal* , *2* (3). https://doi.org/https://doi.org/10.32529/al-ilmi.v3i2.752

Khasanah, BA, & Ayu, ID (2017). Students' critical thinking skills through the application of the brain based learning model. *Exponent, 2* (7), 46–53. https://doi.org/https://doi.org/10.47637/eksponen.v7i2.148

Lami, NA, Pamungkas, MD, & Franita, Y. (2023). Moodle-Based Flipped Classroom Model on Critical Thinking Skills Reviewed from Mathematical Disposition. *Pedagogy: Journal of Mathematics Education, 2* (8), 77-91. https://doi.org/https://doi.org/10.30605/pedagogy.v8i2.3053

Luma, S.L., Makahinda, T., & Umboh, S.I. (2022). Implementation of Project Based Learning Model with Contextual Approach. *Charm Sains: Journal of Physics Education* , *2* (3), 68-73. https://doi.org/https://doi.org/10.53682/charmsains.v3i2.176

Made, AM, Ambiyar, A., Riyanda, AR, Sagala, MK, & Adi, NH (2022). Implementation of Project Based Learning (PjBL) Model in Efforts to Improve Learning Outcomes of Mechanical Engineering Students. *Edukatif: Journal of Educational Sciences* , *4* (4), 5162–5169. https://doi.org/https://doi.org/10.31004/edukatif.v4i4.3128

Nurdin, EA, Apriyanto, B., Ikhsan, FA, & Kurniawan, FA (2017). The influence of the think pair and share learning model reviewed from the perspective of learning independence on students' social studies learning outcomes. *Journal of Economic Education: Scientific Journal of Educational Sciences, Economics and Social Sciences* , *2* (11), 1–7. https://doi.org/https://doi.org/10.19184/jpe.v11i2.5729

Riyanti, Y., Wahyudi, W., & Suhartono, S. (2021). The effect of learning independence on elementary school students' mathematics learning outcomes. *Edukatif: Journal of Educational Sciences* , *4* (3), 1309-1317. https://doi.org/https://doi.org/10.31004/edukatif.v3i4.554

Setiawan, P., & Sudana, IDN (2018). Application of Contextual Learning Model to Improve Mathematics Learning Outcomes. *Scientific Journal of Teacher Professional Education, 2* (1), 164-173.

Siagian, H., Pangaribuan, JJ, & Silaban, PJ (2020). The effect of learning independence on students' Mathematics learning outcomes in elementary schools. *Basicedu Journal, 4* (4), 1363-1369. https://doi.org/https://doi.org/10.30743/mes.v2i1.117

Siregar, NR (2017). Students' Perceptions in Mathematics Lessons: A Preliminary Study on Students Who Enjoy Games. *Proceedings of the 10th National Scientific Meeting of the Indonesian Developmental Psychology Association* , 1.

Suhandi, A., & Kurniasri, D. (2017). Increasing student independence through contextual learning models in grade IV of elementary school. *Gentala Journal of Elementary Education,*

1 (4), 125-137. https://doi.org/https://doi.org/10.22437/gentala.v4i1.6972

Suhendri, H. (2015). The influence of problem solving learning methods on mathematics learning outcomes viewed from learning independence. *Formative: Scientific Journal of Mathematics and Natural Sciences Education, 2* (3). https://doi.org/http://dx.doi.org/10.30998/formatif.v3i2.117

Winata, R., Friantini, RN, & Astuti, R. (2021). Learning independence and learning discipline towards student achievement in online lectures. *e-DuMath JOURNAL, 1* (7), 18–26. https://doi.org/https://doi.org/10.52657/je.v7i1.1343

Yanti, H., Zaenuri, Z., & Walid, W. (2020). Student Learning Independence in Mathematics Subjects During the Covid-19 Pandemic. *Proceedings of the National Postgraduate Seminar (PROSNAMPAS)* , 146–149.