JPPIPA 10(8) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Make a Match Assisted Scramble Learning Model for Learning Motivation and Student Learning Outcomes in Atomic Structure Material

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Received: December 29, 2023
Revised: May 21, 2024
Accepted: August 25, 2024
Published: August 31, 2024

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DOI: 10.29303/jppipa.v10i8.6768

Abstract: Abstract and complex learning materials presented with monotonous models can lead to decreased motivation and suboptimal learning outcomes due to student boredom. This study aims to determine the effect of the make-a-match assisted scramble learning model on grade X students' learning motivation and learning outcomes on atomic structure material. The research method was quasi-experimental with a nonequivalent pretest-posttest control group design. The research location at A Sleman High School for the 2023/2024 academic year uses two research samples: class XC as an experimental class and class XG as a control class. The sampling technique used is cluster random sampling. Data were collected using learning motivation questionnaires and test questions. The Mann-Whitney test was applied to analyze the data, revealing significance values of 0.045 and 0.000, both below the 0.05 threshold. The results indicate that the make-a-match assisted scramble learning model significantly enhances learning motivation and outcomes for class X students on atomic structure material.

Keywords: Atomic structure; Learning motivation; Learning outcomes; Make a match; Scramble

Introduction

Education is an effort made and planned consciously to create an effective teaching and learning atmosphere to enable students to understand the material taught by educators (Lince, 2022). The learning process in schools, including the learning models and media used, can be seen as improving the quality of education (Radili, 2013). In general, there are still many teachers who use conventional learning models that emphasize the role of teachers (teacher-centered approach) rather than students (student-centered approach) (Widyanto & Vienlentia, 2022). This model often involves teachers providing knowledge through lectures, giving notes, giving assignments, and having more limited discussions (Mbosisi et al., 2018). According to previous research, it is presented that 40% of the learning time learners need to be more engaged in learning delivered through lecture style (Syaparuddin et al., 2020). Students can remember 70% of the material in the first ten minutes of learning but can only remember 20% of the learning material in the last ten minutes (Kurniawan, 2022). This condition results in learning that does not run optimally, affecting students' motivation, creativity, and behavior, thus potentially reducing student learning outcomes (Latupeirisa et al., 2018). In addition, this learning model tends to be monotonous, so students often feel bored, lack enthusiasm, and are not interested in learning (Apriyanti, 2019).

Choosing a suitable learning model is a way for teachers to maintain students' enthusiasm for learning so as not to feel bored or bored (Umar et al., 2022). Appropriate learning models can improve learning quality and student outcomes (Sumarni et al., 2017). Achieving high and quality learning outcomes in

How to Cite:
Ramadanti, W., & Fikroh, R. A. (2024). Make a Match Assisted Scramble Learning Model for Learning Motivation and Student Learning Outcomes in Atomic Structure Material. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 5749–5758. https://doi.org/10.29303/jppipa.v10i8.6768

students can be realized through a quality learning process (Nasution, 2018). To create a learning process that has optimal quality, it is necessary to have an educator who is competent in using a learning model that is suitable for the situation in the classroom environment (Sani, 2022). If the learning model used is not appropriate, this can reduce the quality of the learning process itself (Rosni, 2021). Thus, improving students' learning outcomes in schools can be achieved by using appropriate learning models implemented by teachers (Nasution, 2018).

Motivation in learning should be the primary focus for teachers in the classroom (Palittin et al., 2019). Motivation significantly affects the learning outcomes of students (Sartika & Rohani, 2021). The motivation that exists in students is the primary driver in the learning process. This internal drive drives individuals to achieve expected goals (Majid, 2017). Highly motivated people will be more eager to participate in learning activities (Sinaga et al., 2017). According to research conducted by Palittin et al. in 2019 at SD Inpres 7, Muting showed a correlation between the level of motivation and students' learning outcomes. Therefore, teachers are expected to have mastery and the ability to apply various learning models precisely to motivate students in the learning process (Sumardi, 2021). Proficiency in applying these learning models affects students' success in the learning process (Umar et al., 2022).

The results of an interview with a high school chemistry teacher in Sleman in March 2023 indicate that a commonly used learning model in teaching atomic structure material is a lecture learning model, where teachers thoroughly explain the material. However, this learning model is considered less successful in stimulating the enthusiasm and achievement of students, so teachers often try to bring variety to learning by using quizzes. Despite this, students' enthusiasm and learning achievement are still low. This can be seen from the class achievements and the average score of grade X MIPA 1 students for the 2020/2021 academic year on atomic structure material, which still needs to reach the minimum standard (KKM) set by the school, 75. Learners still need help imagining atomic models, understanding the differences between electrons, protons, and neutrons, distinguishing between mass numbers and atomic numbers, and difficulties in the concepts of isotopes, isobars, and isotons, as well as quantum numbers. This difficulty arises from students' relatively low initial knowledge and skills and monotonous learning models (Riopel et al., 2019) . Most students feel bored because the learning model tends to emphasize the role of the teacher and lack of active interaction with students; this results in a lack of attention, which impacts achieving unsatisfactory overall learning outcomes (Kibitia et al., 2019).

An atomic structure is an abstract and complex matter studying atomic structures related to abstract concepts and calculations (Afrianis & Ningsih, 2022). According to Fauzan et al. (2022), atomic structure material is challenging to observe with the naked eye and difficult to explain in real terms. Therefore, teacher creativity is needed in presenting the material; teachers must design learning models based on the material (Gaydos, 2015). Thus, there needs to be an alternative in updating learning strategies that can be adopted in the learning process on atomic structure material, which is to apply the scramble learning model assisted by make-a-match.

The scramble learning model is a learning model that adopts random games of words, sentences, or paragraphs as one of its techniques, with speed and accuracy of thinking in answering questions as the key to the game (Manalu & Prawijaya, 2023). This model encourages student involvement and active participation in the learning process (Fadilawati & Trisnawati, 2020). Make-a-match is a game where learners must find a suitable pair of cards before a specific time limit (Gosachi & Japa, 2020). Learners are asked to find a suitable pair of cards before a specific deadline (Gosachi & Japa, 2020). Each pair of successfully matched cards in this game will give students points (Wijanarko, 2017). This card will contain questions and answers that students must juxtapose with the appropriate pair of question cards (Diani et al., 2016).

If the scramble learning model with make a match is combined, it will be a fun and fun learning activity. This model will use the syntax of the scramble learning model and make a match as a learning card media (Karepesina et al., 2023). In the make-a-match assisted scramble learning model, students' skills and speed of thinking when answering questions are the keys to the success of this teaching model (Kertiari et al., 2020). Through this model, students are expected to develop creative thinking skills when looking for answers and increase understanding due to the active involvement of students in the learning process (Hafsah, 2017). The application of this game model aims to stimulate students' learning motivation towards the subject matter (Hartanti, 2019).

Sartika and Rohani's research (2021) shows that the scramble learning model with crossword puzzle media has proven effective in increasing students' motivation and cognitive learning outcomes at GPID Christian High School Palu. This model shows more active categories compared to the application of conventional learning models. Research by Ihsan et al. (2021) shows a significant increase in student motivation and learning outcomes in participating in learning by applying the make-a-match type cooperative learning model in social studies subjects. Research by Ari et al. (2019) also shows that the application of the make-a-match learning model has a significant impact on the level of motivation to learn science in grade V students in Cluster II of Tembuku District, Bangli Regency during the 2017/2018 academic year. One solution to these challenges is applying the make-a-match assisted scramble learning model.

Despite existing research on various learning models, there remains a notable gap in the application of innovative methods specifically for teaching abstract and complex subjects like atomic structure (Azizah et al., 2022). Current conventional models often fail to engage students effectively, leading to decreased motivation and less satisfactory learning outcomes (Yasin et al., 2020). This study addresses this gap by introducing the make-a-match assisted scramble learning model, which combines two dynamic learning techniques to enhance student engagement and understanding. Unlike traditional methods, this model integrates interactive and game-based elements, which are designed to stimulate students' interest and participation in learning atomic structure (Nurjamaludin et al., 2021). The novelty of this research lies in its application of these combined techniques to a specific and challenging subject area, potentially offering a new approach to improving both motivation and learning outcomes in chemistry education . The focus of this study is to explore the effect of make-a-match assisted scramble learning models on motivation and learning outcomes, with the hope that it can increase the motivation and learning outcomes of students on atomic structure material because learning while playing is fun so that students easily absorb the material delivered and allows students to be more active (Surur, 2021).

Method

This research is included in the quantitative type research category (Djaali, 2021). This study used a quasi-experimental research method known as a Nonequivalent Pretest Posttest Control Group Design (Sugiyono, 2021), shown in Table 1. There are two groups: an experimental class and a control class.

Table 1. Research Design of Experimental Class and Control Class

Class	Pretest	Treatment	Posttest
Experimental class	O_{E1}	X_1	O_{E2}
Control Class	O_{K1}	X_2	O_{K2}

Information:
O_{E1} : experimental group pretest
O_{K1} : pretest control group
X_1 : experimental classroom treatment (make a match assisted scramble learning model)
X_2 : control class treatment (discovery learning learning model)
O_{E2} : posttest experimental group
O_{K2} : posttest control group

Based on Table 1, the research design shows that both classes are given pretest and posttest (Handayani & Muhammadi, 2023). The experimental class received treatment using a scramble-assisted learning model to make a match, while the control class was treated as a discovery learning model.

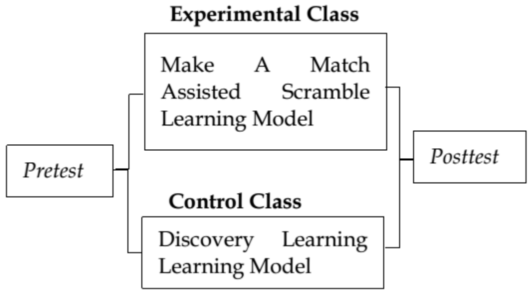

Figure 1. Research flowchart

This study was conducted in the first semester of the 2023/2024 academic year at A Sleman High School, Yogyakarta. The population in this study is all students of grade X semester of A Sleman High School for the 2023/2024 academic year, which amounts to 36 students and is divided into seven classes, namely XA, XB, XC, XD, XE, XF, and XG. The sampling technique is cluster random sampling (Firmansyah & Dede, 2022). Among these classes, two classes out of seven classes were used as research samples, namely class XC as an experimental class and XG as a control class. This study consisted of eight meetings, four in the experimental and four in the control classes.

Data collection regarding student learning motivation was obtained through a student learning motivation questionnaire instrument after treatment (Halimatus, 2020). The questionnaire sheet instrument is tested for validity by expert lecturers, and then empirical tests are carried out to test the validity and reliability of the instrument. The questionnaire instrument contains 28 statements with criteria, namely always (SL), often (SR), sometimes (KD), rarely (J), and never (TP) (Madri et al., 2020).

Data on students' cognitive learning outcomes were obtained from test questions (Lubis et al., 2019). The multiple-choice test questions will be tested on the pretest and posttest (Sizi et al., 2021). The pretest is the initial test of students before treatment, while the posttest is the final test to determine students' final knowledge after treatment (Nurulhidayah et al., 2020). Question items are tested for validity by expert lecturers, and then empirical tests are carried out to test validity and reliability (Rizal et al., 2020). The question instrument consists of 35 multiple-choice questions.

Data analysis techniques for learning motivation and cognitive learning outcomes of learners using hypothesis tests that have previously been tested prerequisites by conducting normality tests using the Kolmogorov-Smirnov method and homogeneity tests using statistical Levene tests (Putri et al., 2018). If the requirements are met, then the statistical test with the T-test, while if one of the conditions is not met, a nonparametric statistical test is carried out, namely the Mann-Whitney test (Hakim, 2017).

Results and Discussion

Learning Motivation

Learning motivation is an internal and external drive in learners learning to do something to achieve goals (Rahman, 2022). Student learning motivation is obtained through the distribution of learning motivation questionnaires to experimental classes and control classes after students receive the treatment given (Kholifah, 2016). A descriptive analysis of students' learning motivation levels in the experimental and control groups (Ari & Wibawa, 2019) can be seen in the following Table 2 and Table 3.

Based on Table 2 and Table 3, it can be seen that the average learning motivation score of students in the experimental class is 103.67, with the highest score reaching 140 and the lowest score at 28. The same thing can also be seen in the average learning motivation score of students in the control class, which is also 91.92, with the highest score of 140 and the lowest score of 28.

Table 2. Descriptive Test Results Statistics of Learning Motivation of Experimental Class Students (Descriptive Statistics)

	N	Min	Max	Mean	Std. Deviation
Experimental Class	36	28	140	103.67	20.779
Valid N (listwise)	36				

Table 3. Descriptive Test Results of Learning Motivation Statistics of Control Class Students (Descriptive Statistics)

	N	Min	Max	Mean	Std. Deviation
Control Class	36	28	140	91.92	28.606
Valid N (listwise)	36				

Before a statistical analysis of student learning motivation, prerequisite steps such as normality and homogeneity tests must be carried out first (Herlina, 2019). According to Budyaningsih et al. (2023), a dataset can be considered to have a normal distribution if its significance value exceeds 0.05 (sig. > 0.05) (Ayuningsih & Muna, 2023). Then, the population is considered homogeneous if the significance value is more significant than 0.05 (Usmadi, 2020). The normality test results and homogeneity of student learning motivation can be seen in Table 4 and Table 5.

Table 4. Results of the Normality Test of Learners' Learning Motivation

	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Results of the Learning Motivation Questionnaire	Experimental Class	.133	36	.105	.902	36	.004
	Control Class	.090	36	. 200*	.954	36	.144

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 5. Results of the Homogeneity Test of Learners' Learning Motivation

		Levene Statistic	df1	df2	Sig.
Results of the Learning Motivation Questionnaire	Based on Mean	3.379	1	70	.070

Based on Table 4, the significance value for both classes is more than 0.05 (Sig. > 0.05), which shows that the learning motivation data of learners in the experimental class and control classes show a normal distribution (Shamdas et al., 2024). Based on the homogeneity test in Table 5, the significance value exceeds 0.05 (Sig. > 0.05), so it is concluded that the learning motivation data of learners in the experimental and control classes show the same level of homogeneity (Santi, 2023).

Student learning motivation data is categorized as ordinal data, so the statistical analysis used is the Mann-Whitney, a nonparametric statistical test (Ismail, 2018). Haryana et al. (2023) show that nonparametric statistics are used to analyze ordinal data. The results of the Mann-Whitney test can be seen in Table 6.

Based on Table 6, the value of Asymp. Sig (2-tailed) 0.045 or less than 0.05, then H0 rejected means that there is an effect of using the make-a-match assisted scramble learning model on student learning motivation based on the results of the questionnaire. This is in line with the research of Adnyani et al. (2020) that there is a significant influence on the use of the question card-assisted scramble learning model on the motivation to learn science of grade V students of Cluster XIII of Buleleng District. Research by Manalu et al. (2023) also states that the scramble learning model can increase student and learning motivation in theme 1, subtheme 1 in grade V SD Negeri 106453 Suka Damai.

Table 6. Mann Whitney Test Analysis Results of Student Learning Motivation

	Results of the Learning Motivation Questionnaire
Mann-Whitney U	470.000
Wilcoxon W	1136.000
Z	-2.006
Asymp. Sig. (2-tailed)	.045

a. Grouping Variable: Class

Cognitive Learning Outcomes of Learners

Learning outcomes are the results that students have achieved after carrying out learning activities. Data on students' cognitive learning outcomes were obtained based on pretest and posttest results (Sumarni et al., 2017). A pretest is given before treatment to determine the initial ability of students (Yulita & Prayitno, 2023). In contrast, a posttest is given after treatment to measure the final ability of students in experimental and control classes (Setyaningsih et al., 2020). Descriptive statistics of cognitive learning outcomes of experimental and control class learners can be seen in Table 7.

Table 7. Descriptive Test Results of Learners' Cognitive Learning Outcomes

	N	Min	Max	Mean	Std. Deviation
Pretest Experiment	36	20	69	42.69	10.607
Posttest Experiment	36	40	92	73.83	13.481
Pretest Control	36	29	80	48.33	13.920
Posttest Control	36	40	77	59.33	9.920
Valid N (listwise)	36				

Based on Table 7, the average pretest result score in the experimental class was 42.69, while the average pretest result score in the control class was 48.33. The average score of posttest results in the experimental class in the experimental class was 73.83, while the average score of posttest results in the control class was 59.33.

The pretest and posttest scores obtained are then tested hypothetically to determine whether there are differences in cognitive learning outcomes between experimental classes using the make-a-match assisted scramble learning model and control classes using discovery learning models based on test results. Before testing the hypothesis, a prerequisite test is carried out, namely the normality and homogeneity test (Sianturi, 2022). The results of normality and homogeneity of learners' cognitive learning outcomes can be seen in Table 8.

Table 8. Normality Test Results of Learners' Cognitive Learning Outcomes

Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest Experiment	.099	36	.200*	.980	36	.751
Posttest Experiment	.149	36	.043	.919	36	.012
Pretest Control	.114	36	.200*	.948	36	.089
Posttest Control	.166	36	.014	.958	36	.190

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 9. Homogeneity Test Results Pretest Learning Outcomes of Learners

		Levene Statistic	df1	df2	Sig.
Student Learning Outcomes	Based on Mean	3.084	1	70	.083

Table 10. Homogeneity Test Results of Posttest Learning Outcomes of Learners

		Levene Statistic	df1	df2	Sig.
Student Learning Outcomes	Based on Mean	2.360	1	70	.129

Based on Table 8, the significance value of the control class experimental class pretest is more than 0.05, so the pretest data are typically distributed (Raisah et al., 2023). A normality test was also performed on posttest data. Based on the normality test, the experimental and control class posttest data were 0.043 and 0.014, respectively. The value of both data shows less than 0.05, so the data is not normally distributed. According to Sugiyono (2021), the reasons data is not normally distributed are ordered data, extreme data, and other causes. The test results in this study are not generally distributed because there are outliers or extreme data that have a value very far from other data. The second prerequisite test is the homogeneity test (Adisha & Rohaeti, 2024). Based on Tables 9 and 10, the pretest-posttest homogeneity test obtained significance values of 0.083 and 0.129, respectively, meaning more than 0.05 (Sig. > 0.05). This shows that the experimental and control test scores have the same or homogeneous variance. After the prerequisite test is met, the next step is to test the hypothesis (Abdullah et al., 2021). The statistical hypothesis test used against learners' cognitive learning outcomes data is a nonparametric Mann-Whitney test because the pretest and posttest data of the experimental and control classes are generally not distributed (Nadliyah et al., 2019). The results of the Mann-Whitney test can be seen in Table 11.

Table 11. Results of the Mann-Whitney Test Analysis of Learners' Cognitive Learning Outcomes

	Student Learning Outcomes
Mann-Whitney U	243.000
Wilcoxon W	909.000
Z	-4.573
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Class

Based on Table 11, the value of sig. (2-tailed) 0.000, which means less than 0.05, then H0 is rejected, meaning that there is a significant effect of the make-a-match assisted scramble learning model on the cognitive learning outcomes of students on atomic structure material based on test results. This study's results align with Kertiari's research (2020), which states that the scramble-type cooperative learning model assisted by image card media influences science learning outcomes. Based on research by Ma'rifah et al. (2020) also stated that there is an influence on student learning outcomes on the use of the make-a-match type cooperative learning model.

This study divided the learning process between an experimental class that used a scramble-assisted learning model make-a-match and a control class that applied a discovery learning model. Although both involve learners actively, the fundamental difference lies in using random card games in the learning process in experimental classes. The use of card games was seen as very engaging and enjoyable by the students in the experimental class (Sundaram & Ramesh, 2022). This is consistent with Hidi's explanation that a supportive environment can enhance the appeal of the learning process (Tanti et al., 2020). As a result, the experimental class showed higher levels of motivation, characterized by more active participation and better cooperation than the control class (Alphrazy & Octavia, 2023).

In addition, differences in implementation schedules are also an important consideration. The experimental class was held in the morning, while the control class was conducted in the afternoon. This difference allows for variations in learning motivation that students' physical condition can influence (Arisanty & Riyah, 2019). Learners in the control class tended to face motivational challenges due to fatigue or daytime sleepiness. In contrast, learners in the experimental class were potentially more physically refreshed and mentally prepared to learn in the morning.

Although the learning process in both classes went smoothly, some obstacles were also identified (Der Valk & Broekman, 1999). These disruptive obstacles include limited learning duration, noise interference from outside the classroom, pauses between class hours, and allowed extracurricular activities. However, what stands out is that the number of students who received dispensation permission for extracurricular activities was higher in the control class. This is most likely to cause low learning outcomes in the control class, which has students who are absent more in the class (Tanggaard, 2011).

Based on the data, analysis, and observation, the learners in the experimental class showed higher scores than those in the control class. This shows that the make-a-match assisted scramble learning model affects learners' motivation and cognitive learning outcomes on atomic structure material.

Conclusion

Based on the results of research and discussion, the make-a-match assisted scramble learning model significantly enhances the learning motivation and outcomes of class X students on atomic structure material. This is evidenced by the significance values from the Mann-Whitney test, which are below the 0.05 threshold.

Acknowledgments

The researcher would like to thank the Chemistry Education study program, Faculty of Tarbiyah and Teacher Training, and A Sleman High School for supporting and facilitating the place in data collection for this research.

Author Contributions

All authors contributed to writing this article.

Funding

No external funding.

Conflicts of Interest

No conflict interest.

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