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# The Implementation of Accelerated Learning Model Assisted By Autograph on Students' Adaptive Reasoning Ability and Environmental Literacy

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**Abstract**

This research aimed to assess the impact of implementing the Accelerated Learning model on the adaptive reasoning ability and environmental literacy of students. Employing a quantitative research approach, the study utilized a quasi-experimental post-test only control group design. A total of 180 eighth-grade students from UPT SMP Negeri 3 Bandar Lampung constituted the participants in this study, and a sample of 90 students was chosen using cluster random sampling. The analytical process involved conducting normality and homogeneity tests, and the research hypothesis was assessed using Multivariate Analysis of Variance (MANOVA). The results of the MANOVA test revealed a significance level of 0.000, underscoring a substantial impact of Accelerated Learning assisted by Autograph media on both the adaptive reasoning ability and environmental literacy of students. As such, the study concludes that the integration of the Accelerated Learning model with Autograph media proves effective for enhancing the overall learning process.

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## INTRODUCTION

Ability is very necessary in learning to improve teaching and learning activities so that learning objectives can be achieved (Arifin et al., 2020; Sianipar et al., 2022). Ability is more focused on a person's ability to interpret and restate knowledge into new words in their own way (Aprilia et al., 2021). Through the learning process, students are prepared to be able to face future challenges (Suprianto et al., 2019). Using technology makes it possible to encourage new approaches in teaching and learning so that students can improve their abilities (Ariyana & Putra, 2021; Aulia et al., 2022; Lin et al., 2019; Netriwati et al., 2022). One of the basic principles that can be used as a reference in the development and use of learning technology is the use of learning resources as maximally and as varied as possible (utilizing learning resources) (Salsaibila & Agustian, 2021). The existing body of research and professional literature indicates that emerging educational approaches have the potential to bolster learning outcomes through cognitive, metacognitive, and affective avenues. It is evident that the cognitive and metacognitive dimensions play a pivotal role in advancing learning outcomes when technology is employed. These aspects merit thorough investigation and analysis for a comprehensive understanding of their impact on educational practices (Pierce et al., 2007).

Mathematics serves as a universal scientific discipline with a pivotal role across various fields of study. It plays a crucial role in enhancing cognitive abilities and serves as the foundation for the

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advancement of modern technology (Mashuri, 2019). Certainly, mathematics plays a crucial role as an essential field of knowledge necessary for students to enhance their academic achievements in the future (Harun et al., 2021; Niess, 2005; Utami et al., 2020). Many math teachers are aware of the opportunities of technology, such as software mathematics dynamic (Batubara, 2019), interactive whiteboards, graphic calculators, program graphics, the system of computer algebra and others, to be caused in mathematics learning (Pierce et al., 2007).

The reasoning step is a process that cannot be separated from mathematics learning (Herizal et al., 2022). Therefore, the reasoning abilities that are needed by students are problem solving, communication, connections, reasoning and representation (National Council of Teachers of Mathematics, 2009). It involves the ability to make connections between different mathematical ideas, apply relevant rules and principles, and construct coherent arguments to support problem-solving approaches. Continuous training and the development of adaptive reasoning are essential components for success in the process of learning mathematics. By incorporating adaptive reasoning, the learning experience becomes more meaningful, and the attainment of expected learning objectives is facilitated (Othman, 2022). The ultimate goal for teachers is that students, through adaptive reasoning, acquire the ability to solve mathematical problems efficiently. This not only enables students to grasp mathematical concepts thoroughly but also serves as a foundation for logical thinking in both mathematical and everyday activities, both in the present and future (Muin et al., 2018).

The initial investigation carried out at UPT SMP Negeri 3 Bandar Lampung reveals that students currently exhibit insufficient competence in mathematics, adaptive reasoning, and environmental literacy. The obtained scores indicate a deficiency, as they do not meet the predetermined standards set for these academic areas. Therefore, it is really needed a proper learning to accommodate students' competence improving so the learning results will be better especially adaptive reasoning abilities, one of the approaches involves utilizing the Accelerated Learning model for instruction. Accelerated learning model is a learning model that can accelerate and improve learning by inviting students to directly involve in learning process (Meier, 2002). Increase intelligence and access brain creativity brilliantly correctly so that learning makes the heart happy and satisfied and contribute fully to happiness, intelligence, competence and success (Neviyarni, 2021). The Accelerated Learning model improves students' adaptive reasoning ability and environmental literacy.

Learning media are valuable in helping students grasp concepts more effectively, presenting data in an engaging and trustworthy manner, simplifying the interpretation of information, and condensing complex data efficiently (Arsyad, 2010). Learning media is a tool or equipment processes that enable learners and educators to carry out learning activities (Zuhdan, 2011). The using of media is highly recommended in learning mathematics. One of the software that can maximize students' learning is Autograph. Autograph can visualize graphic in 2D and 3D, this media is developed in PC Desktop (Butler, 2020). The integration of Autograph in schools has the potential to enhance students' comprehension of mathematics lessons (Sari, 2020; Triana et al., 2019). Incorporating this interactive software into teaching methods could improve the overall effectiveness and quality of instruction. Given the nature of mathematics classes, which require significant interaction, reasoning, and observation, it is evident that tools like Autograph can be beneficial in facilitating more engaging and effective learning experiences (Tarmizi et al., 2008).

Previous research on Accelerated Learning has been carried out. Previous similar research shows that Accelerated Learning can improve students' adaptive reasoning abilities (Bafadal, 2004; Kilpatrick et al., 2002; Putra & Linda Sari, 2016). Adaptive reasoning ability is positively related to environmental literacy, because individuals who are able to adapt to environmental changes tend to be more sensitive to environmental problems. They can recognize and respond to environmental challenges with innovative and sustainable solutions. So this model also has an influence on environmental literacy (Chu et al., 2007; Desfandi, 2015; Siddiq et al., 2020). However, no previous researcher has simultaneously examined the influence of this model with two variables at once. And also no one has used the Autograph software learning media. Therefore, this research aims to see the influence of students' adaptive reasoning abilities, environmental literacy and mathematics using Accelerated Learning and Autograph.

## METHODS

The study employed an experimental method, specifically utilizing a quasi-experimental design. Two classes were randomly selected, with one designated as the experimental group (comprising experiment class 1 and experiment class 2) and the other as the control group. The population for this research comprised six classes at the eighth grade in UPT SMP Negeri 3 Bandar Lampung, totaling 180 students. The population details are presented in Table 1.

**Table 1.** Total population

| Class | Total |
|---|---|
| 8.4 | 30 |
| 8.5 | 30 |
| 8.6 | 30 |
| 8.7 | 30 |
| 8.8 | 30 |
| 8.9 | 30 |
| **Total** | **180** |

Table 1 reveals that there were a total of 180 students involved in the study. To select participants, the researcher utilized cluster random sampling, a method that involves choosing groups (clusters) rather than individual students (Maksum, 2012). The sample size was determined to be 90 students. The application of cluster random sampling entailed randomly selecting two classes in each draw, subsequently assigning them distinct roles as the experimental class and the control class in the research design. This approach allows for a representative subset of students to be chosen, ensuring a balanced representation in both the experimental and control groups.

## RESULT AND DISCUSSION

### Analysis Data

In this research, two primary instruments were employed: an adaptive reasoning ability test and an environmental literacy test, administered to the students. Initial stages involved a review and analysis of the test results from both instruments before proceeding to assess students' adaptive reasoning ability and environmental literacy. Based on the outcomes of this preliminary analysis, the subject of Statistics was identified as relevant for the research sample. The instrument trials were carried out with ninth-grade students at UPT SMP Negeri 3 Bandar Lampung, involving a total of 30 students as respondents. This process was designed to ensure the suitability and reliability of the instruments before their full implementation within the research sample.

### Prerequisite Test Analysis

After administering assessments to Experimental Class 1, Experimental Class 2, and the Control Class, scores were acquired for the instruments used in the evaluations. Subsequently, the gathered data underwent analysis to extract descriptive information and central tendencies for both variables. The findings were then presented in Table 2, which depicts observational data concerning the adaptive reasoning ability of both the Experimental and Control Classes. This table serves as a visual representation of the assessment results, offering insights into the central tendencies and descriptive statistics that characterize the adaptive reasoning abilities of the respective classes in the study.

**Table 2.** Description data of adaptive reasoning ability

| Class | N | Xmax | Xmin | Central Tendency | | |
|---|---|---|---|---|---|---|
| | | | | Mean | Median | Modus |
| Experimental Class 1 | 30 | 100 | 80 | 89 | 88 | 88 |
| Experimental Class 2 | 30 | 100 | 76 | 86,6 | 86 | 88 |
| Control Class | 30 | 80 | 56 | 66,8 | 68 | 70 |

Based on the information presented in Table 2, it is evident that both experimental classes, namely Experimental Class 1 and Experimental Class 2, outperformed the control class in terms of scores. This is evident in the average scores for adaptive reasoning ability. While the xmax scores for Experimental Class 1 and Experimental Class 2 are identical, it's worth noting that the xmin score for Experimental Class 1 is higher than that of Experimental Class 2.

**Table 3.** Description data of environmental literacy

| Class | N | Xmax | Xmin | Central Tendency | | |
|---|---|---|---|---|---|---|
| | | | | Mean | Median | Modus |
| Experimental Class 1 | 30 | 100 | 87,5 | 92,9 | 92,7 | 91,6 |
| Experimental Class 2 | 30 | 97,9 | 89,5 | 93,4 | 93,7 | 91,6 |
| Control Class | 30 | 91,6 | 68,7 | 78,7 | 77 | 75 |

According to table 3 above, it shows that experimental classes have bigger scores that control class has. It can be seen from the average scores of each class on environmental literacy. As for the analysis of the prerequisite tests are:

## Normality Test

This test used to find out whether a sample comes from a population with a normal distribution or not (Machali, 2015). The findings presented in Table 4 outline the outcomes derived from conducting a normality test on adaptive reasoning ability.

**Table 4.** The result of normality test on adaptive reasoning ability

| | | Kolmogorov-Smirnov | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | Class | Statistic | df | Sig. | Statistic | df | Sig. |
| Adaptive Reasoning | Experiment 1 | ,126 | 30 | ,200* | ,939 | 30 | ,086 |
| | Experiment 2 | ,163 | 30 | ,083 | ,939 | 30 | ,084 |
| | Control | ,119 | 30 | ,200* | ,967 | 30 | ,459 |

The results obtained from the normality test, conducted on adaptive reasoning ability using the Kolmogorov-Smirnov test at a significance level of 5% (0.05), indicate that data is considered normally distributed if the p-value is greater than or equal to 0.05. Specifically, the Kolmogorov-Smirnov significance values for all classes are 0.200, 0.083, and 0.200, respectively. These findings suggest that the data for each class demonstrates characteristics consistent with a normal distribution. The obtained p-values exceeding the significance level further support the assumption of normality in the adaptive reasoning ability data for each class.

**Table 5.** Findings from the normality test regarding environmental literacy

| | | Kolmogorov-Smirnov | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | Class | Statistic | df | Sig. | Statistic | df | Sig. |
| Environmental Literacy | Experiment 1 | ,139 | 30 | ,142 | ,938 | 30 | ,080 |
| | Experiment 2 | ,216 | 30 | ,156 | ,898 | 30 | ,083 |
| | Control | ,159 | 30 | ,052 | ,956 | 30 | ,237 |

Based on the results of the normality test on environmental literacy by using Kolmogorov-Smirnov with significance level 5% or 0,05. The criteria of the normality test is if p-value ≥ 0,05, so data is normally distributed. The result shows that significancy Kolmogorov-Smirnov is higher than 0,05 for all classes. It means that the data of each class is normally distributed.

## Homogeneity Test

This test is conducted to determine if a dataset or a sample extracted from a population exhibits uniform variance (Budiyono, 2009). Homogeneity test used in this research was Bartlett Test.

Bartlett test can be used to examine a data from two groups or more. The criteria is if $X^2_{count} \leq X^2_{table}$, so $H_0$ accepted it means the data is homogeneous (Rinaldi et al., 2020). The following table is the result of the calculation of homogeneity test with significance level 5%.

**Table 6.** Homogeneity test results for adaptive reasoning ability

| | | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| Adaptive Reasoning Ability | Based on Mean | 1,501 | 1 | 58 | ,226 |
| | Based on Median | 1,273 | 1 | 58 | ,264 |
| | Based on Median and with adjusted df | 1,273 | 1 | 57,982 | ,264 |
| | Based on trimmed mean | 1,545 | 1 | 58 | ,219 |

According to the table above, it is evident that the results of adaptive reasoning ability exhibit data with the same variance, indicating homogeneity. Based on the Mean row, the obtained significance level is 0.226. Therefore, it can be concluded that the data in this research is homogeneous, signifying no significant differences among the three groups in terms of adaptive reasoning ability. This outcome suggests a consistent distribution of data across the groups regarding adaptive reasoning ability, providing a robust foundation for further analysis related to the impact of the utilized learning model.

**Table 7.** Findings of the homogeneity test regarding environmental literacy

| | | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| Environmental Literacy | Based on Mean | 1,376 | 1 | 58 | ,246 |
| | Based on Median | ,871 | 1 | 58 | ,354 |
| | Based on Median and with adjusted df | ,871 | 1 | 52,169 | ,355 |
| | Based on trimmed mean | 1,337 | 1 | 58 | ,252 |

The data analysis derived from the presented table reveals a consistent pattern of variances in the environmental literacy results, indicating homogeneity among the three groups. The significance level, specifically noted in the Mean row, is determined to be 0.245. Consequently, it can be inferred that the data in this study is homogenous, pointing towards an absence of statistically significant differences among the three groups concerning environmental literacy. This implies that the environmental literacy outcomes are comparable across all groups involved in the study, emphasizing a uniformity in the levels of environmental literacy among the different cohorts under investigation.

## Hypothesis Testing

Once it is established that the outcomes in this study exhibit normal distribution and homogeneity, the next step involves conducting a hypothesis test using the MANOVA Test (Multivariate Analysis of Variance). MANOVA is defined as a statistical technique employed to assess the simultaneous significance of mean differences among groups across two or more dependent variables (Sutrisno & Wulandari, 2018). The initial examination entails performing a Multivariate Test with the assistance of SPSS.

**Table 8.** Output multivariate test

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| Intercept | Pillai's Trace | ,998 | 27501,223[b] | 2,000 | 86,000 | ,000 |
| | Wilks' Lambda | ,002 | 27501,223[b] | 2,000 | 86,000 | ,000 |

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| Learning Model | Hotelling's Trace | 639,563 | 27501,223[b] | 2,000 | 86,000 | ,000 |
| | Roy's Largest Root | 639,563 | 27501,223[b] | 2,000 | 86,000 | ,000 |
| | Pillai's Trace | ,874 | 33,741 | 4,000 | 174,000 | ,000 |
| | Wilks' Lambda | ,151 | 67,625[b] | 4,000 | 172,000 | ,000 |
| | Hotelling's Trace | 5,455 | 115,918 | 4,000 | 170,000 | ,000 |
| | Roy's Largest Root | 5,425 | 235,978[c] | 2,000 | 87,000 | ,000 |

a. Design: Intercept + LearningModel
b. Exact statistic
c. The statistic is an upper bound on F the yields a lower bound on the significance level.

According to Table 8, it can be seen that adaptive reasoning ability on Learning Model row and Effect column from Multivariate test with Wilks' Lambda obtained significance level is 0,000. It means it gained significance level > 0,05. Because of the significance level on the test was significant. Furthermore, it can be concluded that $H_{0A}$ rejected and $H_{1A}$ accepted. It means there is an effect of Accelerated Learning model on students' adaptive reasoning ability.

Also from table 8 it can be seen that environmental literacy on Learning Model row and Effect column from Multivariate test with Wilks' Lambda obtained significance level is 0,000. It means it gained significance level > 0,05. Because of the significance level on the test was significant. Furthermore, it can be concluded that $H_{0B}$ rejected and $H_{1B}$ accepted. It means there is an effect of Accelerated Learning model on students' environmental literacy. The effect of learning model on each test that tested, can be known through Tests of Between-Subjects Effects that can be seen in the following table.

**Table 9.** Analysis of Between-Subjects Effects

| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Corrected Model | Adaptive Reasoning Ability | 8850,489[a] | 2 | 4425,244 | 140,067 | ,000 |
| | Environmental Literacy | 4196,666[b] | 2 | 2098,333 | 132,568 | ,000 |
| Intercept | Adaptive Reasoning Ability | 587900,844 | 1 | 587900,844 | 18608,067 | ,000 |
| | Environmental Literacy | 703363,441 | 1 | 703363,441 | 44436,923 | ,000 |
| Learning Model | Adaptive Reasoning Ability | 8850,489 | 2 | 4425,244 | 140,067 | ,000 |
| | Environmental Literacy | 4196,666 | 2 | 2098,333 | 132,568 | ,000 |
| Error | Adaptive Reasoning Ability | 2748,667 | 87 | 31,594 | | |
| | Environmental Literacy | 1377,067 | 87 | 15,828 | | |
| Total | Adaptive Reasoning Ability | 599500,000 | 90 | | | |
| | Environmental Literacy | 708937,174 | 90 | | | |
| Corrected Total | Adaptive Reasoning Ability | 11599,156 | 89 | | | |
| | Environmental Literacy | 5573,733 | 89 | | | |

a. R Squared = ,763 (Adjusted R Squared = ,758)
b. R Squared = ,462 (Adjusted R Squared = ,747)

According to Tests of Between-Subjects Effects on the table above, can be concluded that:

a. $H_{0A}: \alpha_1 = \alpha_2 = \alpha_3$ rejected due to significance level 0,00 < 0,05, so it can be said that there is an effect of Accelerated Learning model assisted by Autograph on adaptive reasoning ability.
b. $H_{0B}: \beta_1 = \beta_2 = \beta_3$ rejected due to significance level 0,00 < 0,05, so it can be said that there is an effect of Accelerated Learning assisted by Autograph on environmental literacy.

Based on the results of data analysis, obtained three hypothesis tested that is mentioned in a discussion below:

1. The First Hypothesis

As the result of MANOVA test, the hypothesis is $H_{0AB}$ is rejected since the significance level 0,00 < 0,05 which is more than significance 0,05. The utilization of Accelerated Learning with the assistance of Autograph appears to have a discernible impact on students' adaptive reasoning ability

and environmental literacy. The focus of the Accelerated Learning model is directed towards outcomes rather than the methodologies employed (Meier, 2002). The method used is a method that can speed up and maintain the learning process. Accelerated Learning is a model that uses learning methods according to the way the brain functions, thus resulting in better absorption of information and understanding, so that ultimately the learning process becomes easier. Apart from that, when learning takes place, groups are formed, so that students can share information with each other and work together to find information and solve the problems given.

2. The Second Hypothesis

Based on the calculation result, got $H_{0A}$ rejected with significance level > 0,05, it is 0,00 that shows there is an effect of the implementation of Accelerated Learning assisted by Autograph on adaptive reasoning ability.

3. The Third Hypothesis

Based on the calculation result, got $H_{0B}$ rejected with significance level > 0,05, it is 0,00 that shows there is an effect of the implementation of Accelerated Learning assisted by Autograph on environmental literacy.

Previous research by (Putra & Linda Sari, 2016) shows that the use of the Accelerated Learning learning model significantly increases adaptive reasoning abilities compared to the use of ordinary learning models as a whole. Likewise, research by (Mulyadi & Amalia, 2019). found an increase in learning outcomes when using Autograph as a learning tool. Nevertheless, research by (Siddiq et al., 2020) shows that the implementation of Accelerated Learning has a positive effect on increasing environmental literacy, especially in the knowledge aspect, but not significantly in the students' attitudes and cognitive aspects. It is important to note that this research is in line with previous research findings, where the implementation of Accelerated Learning showed a positive impact on increasing environmental literacy. Therefore, the results of this research support and strengthen previous findings, confirming that learning models that utilize the Accelerated Learning approach can be an effective strategy in increasing students' understanding and awareness of environmental issues.

The use of Autograph software in schools has proven to be effective in enhancing students' grasp of mathematical concepts. Research suggests that employing Autograph contributes to improved understanding of mathematics, increased learning motivation, enhanced problem-solving skills, and better communication abilities among students (Manalu et al., 2018; Triana et al., 2019; Sari et al., 2020). Previous studies highlight that learning mathematics with Autograph, particularly when using a contextual approach, significantly boosts students' understanding and motivation compared to traditional teaching methods (Husna et al., 2020). Furthermore, the integration of Autograph as a tool in problem-based learning has demonstrated effectiveness in elevating students' proficiency in solving mathematical problems.

The seamless integration of Autograph as a sophisticated tool within the framework of problem-based learning has consistently demonstrated remarkable effectiveness in not only enhancing but also significantly elevating students' proficiency levels in comprehensively tackling and resolving intricate mathematical problems. Through its dynamic features and interactive functionalities, Autograph not only cultivates a deeper understanding of mathematical concepts but also empowers students with the analytical skills and confidence needed to navigate complex problem-solving scenarios with precision and ingenuity (Manalu et al., 2018). This amalgamation of innovative technology and pedagogical methodology serves as a testament to the transformative impact that well-integrated educational tools can have on fostering a more profound and applied mastery of mathematical principles among students.

## CONCLUSION

The result of the MANOVA test indicates increasing adaptive reasoning ability and environmental literacy after applying Accelerated Learning assisted by Autograph. It can be seen in the score obtained was 0,000 with significance level 0,05, it shows that Sig. < 0,05 so that $H_{0AB}$ rejected and $H_{1AB}$ accepted. According to the data analysis and the discussion, the findings suggest that implementing Accelerated Learning with the assistance of Autograph has a significant impact on both adaptive reasoning ability and environmental literacy. The recommendation to use Accelerated

Learning and Autograph in future research indicates that this combination may be a focal point for further exploration and in-depth investigation. It also points towards the potential development of more innovative teaching methods.

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