



Professional Development Program on Innovative Teaching Methods for Beginner Science Teachers

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Abstract: Professional Development Programs (PDPs) play a crucial role in enhancing the teaching skills of beginner science teachers, particularly in the area of Innovative Teaching Methods. This research aims to analyze the implementation of a professional development program on innovative teaching methods for beginner teachers based on their age and teaching experience. The research applies a qualitative descriptive method. The research sample consists of science teachers who attend the teacher professional program at one of the state universities in Semarang, Indonesia. Data were collected using questionnaires and tests. The research results show that higher age only sometimes indicates better teaching experience. Longer teaching experience also does not determine better mastery of skills in modifying learning methods at the end of the training. The initial mastery of teaching methods, motivation towards achieving targets, and expectations of the development program have a more significant influence on the achievement of mastery in innovative modification skills of science learning methods. This research contributes to understanding professional development programs by demonstrating that personal factors are more critical in improving beginner teachers' innovative teaching methods than age or teaching experience alone.

Keywords: beginner teachers, modification skills, teaching methods, training model

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INTRODUCTION

Natural Science is one of the essential components in the education curriculum aimed at developing students' understanding of natural phenomena and scientific processes. Science learning involves the effort to comprehend science concepts through internalization within students themselves, and subsequently, the mastery of these concepts is applied to solve the problems they encounter (Alhassan et al., 2024; Chiu, 2024; Fakhriyah et al., 2022; Lin et al., 2024). Employing innovative teaching methods is an essential pedagogical skill that every teacher should strive to master (Bahodirovich & Romilovich, 2021; Khanshan & Yousefi, 2020; Moore, 2014). The knowledge and application of diverse learning techniques empower teachers to select the most suitable approach to meet their students' learning objectives and individual needs (Caena & Redecker, 2019; Engeness, 2021). Furthermore, the capacity to adapt and modify instructional strategies based on context and student requirements is crucial for effective teaching.

The effectiveness of any educational innovation heavily depends on the pivotal role played by teachers (Chaharbashloo et al., 2020; Huong, 2020). While it is widely accepted that teachers are the most influential factor in driving educational change, their role in learning reform or innovation can be evaluated from different perspectives. Traditional top-down approaches often attribute the lack of success in many innovative projects to teachers' failure to implement the proposed changes in alignment with the developers' intentions. In such approaches, learning developers assume they know how learning should be transformed and how teachers should adapt their instructional practices, ultimately altering classroom behavior (Rapanta et al., 2021).

In the process of science learning, teachers need to have the ability to identify students' prior knowledge and utilize appropriate strategies and teaching methods (Capobianco et al., 2018; Chan & Yung, 2018; Fauzi et al., 2019) that align with the characteristics of the science content being taught. However, in practice, many science teachers need help delivering innovative and motivating instruction that engages students in the learning process. One of the reasons is that teachers often only possess knowledge of conventional and monotonous teaching methods, resulting in less engaging and challenging lessons for students. Consequently, this can reduce students' interest and motivation in science learning. To ensure a strong internalization of science concepts within students, teachers need to modify their teaching methods to improve them to align with the characteristics of the content and accommodate various learning styles of students in the learning process. There is no single best teaching method in science education. The teacher should consider the suitability of the

chosen method with the characteristics of the content, students, the learning environment, and the availability of resources (Hanif, 2020; Suryawati & Osman, 2017). Therefore, teachers are expected to develop continuously by innovating teaching methods suitable for their students' characteristics and the available support.

The training program for teachers, especially beginners, needs to be implemented to assist science teachers in understanding knowledge and mastering pedagogical skills. This article specifically focuses on implementing a professional training program for teachers to modify innovative learning methods in science education that are aligned with the characteristics of science material content. Several factors considered in the teacher training program include age and teaching experience. Is it true that the age of a teacher indicates better experience? This question serves as a discussion trigger that should be answered through research that is appropriate to the context. While teaching experience is often related to age, other factors such as the duration of teaching experience, opportunities for professional development, and willingness to continuously learn and innovate also play a significant role in acquiring effective teaching experience. Therefore, every teacher's experience in teaching can vary. Hence, the research problem in this study is: (1) Does age contribute to the competence in modifying learning methods? (2) Does teaching experience contribute to the competence in modifying learning methods?

Improving teachers' ability to apply and modify teaching methods suitable for science subjects and students' prior knowledge will positively impact the effectiveness and enjoyment of science education. This will contribute to enhancing students' understanding and interest in science, as well as improving their learning achievement in science subjects. This research aims to analyze the implementation of a professionalism development program focused on enhancing innovative teaching methods among beginner teachers, considering their age and teaching experience.

METHODS

The research applied a qualitative descriptive method by formulating a problem to guide the research in exploring the observed situation comprehensively, extensively, and in-depth (Alam, 2021). The research sample consists of science teachers who attend the teacher professional program of the Indonesian Ministry of Education at one of the state universities in Semarang, Indonesia. The total sample consisted of 25 teachers, but only 21 teachers completed all stages of the training and research until the end. Data were collected using questionnaires and tests. Questionnaires were used to collect data on the teacher's age and teaching experience. The test consisted of a pretest to measure teacher comprehension of innovative science teaching methods implementation and a post-test to measure teacher comprehension of innovative science teaching method modification. The research process began with distributing a questionnaire to prospective training participants, which revealed that the prospective participants were teachers at the beginner level and would progress toward becoming experienced teachers. The training on the competence of modifying innovative science teaching methods using the E-ROGIM model. The flow or syntax of the training model is presented in Figure 1.

The reflection activity involved distributing the reflection journal form (Google Form) and guiding participants to reflect on the teaching methods they have mastered, facilitating the formation of groups (maximum of 3 people per group), allowing participants to analyze the strengths and weaknesses of various teaching methods they have mastered, guiding the presentation of reflection results, and facilitating discussions as an evaluation in the reflection stage. The orientation activity involved guiding participants in analyzing science learning objectives in the selected or prepared lesson plan documents, guiding the review of science teaching methods used in the designated or ready lesson plans, guiding to determine areas for modifying innovative science teaching methods, and concluding with coaching presentations and discussions in this stage.

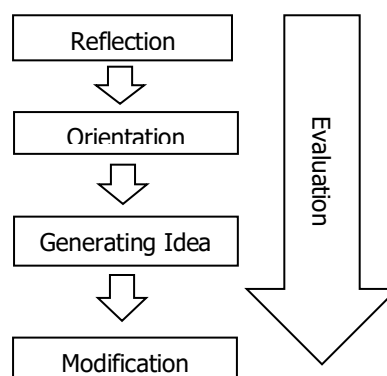


Figure 1. The E-ROGIM Model in Modifying Innovative Science Teaching Methods

The idea generation activity involved guiding participants in accessing reputable scientific literature sources on various innovative science teaching methods, analyzing scientific journals on various innovative science teaching methods, exploring case studies or best practices, collecting and analyzing different information on innovative science teaching methods, using guiding data or evidence to determine ideas for modifying innovative science teaching methods, and concluding with coaching presentations and discussions in this stage. The modification activity involved guiding participants in designing modifications to innovative science teaching methods, providing feedback on the design of modifications to innovative science teaching methods, and concluding with coaching presentations and discussions in this stage. The evaluation activity involved guiding the presentation of the final design modifications. The evaluation activity was conducted from the reflection, orientation, idea generation, and modification stages and up to the evaluation stage by providing feedback for improvement at each step. The research data on the age and teaching experience of science teachers who participated in a training program used a questionnaire as the data collection instrument. The effectiveness of modifying learning methods after the training was assessed through a post-test and a product assessment questionnaire. To analyze the data, correlations were examined between age and competence in modifying learning methods and between teaching experience and competence in modifying learning methods, using Pearson correlation tests. Subsequently, the results of the correlation tests were analyzed descriptively and qualitatively.

RESULT AND DISCUSSION

This study analyses the implementation of a professional development program to train beginner teachers in modifying innovative teaching methods. The training activities were conducted for two weeks with 32 sessions (1 session equals 50 minutes). The training was conducted online using synchronous methods through the Zoom meeting application asynchronously by accessing a Google Classroom-based Learning Management System (LMS). The research questions related to the correlation of age and teaching experience with the competence in modifying learning methods are used to guide the investigation, and the study aims to provide valuable insights into the program's effectiveness in promoting innovative teaching practices. Preliminary findings from the research shed light on the notion that higher age or more extended teaching experience does not necessarily correlate with better teaching performance. The study examines various factors, including the initial mastery of teaching methods, motivation towards achieving targets, and the expectations of the development program, to determine their influence on the acquisition of innovative modification skills in science learning methods, according to the results of the data analysis from questionnaires and tests presented in [Table 1](#).

Table 1. Comparison of Ages and Experience to the Results of Pretest and Post-test Scores

Gender (Male= M/Female= F)	Ages (year)	Experience (year)	Pretest (Beginner Level) Score	Post-test (Experienced Level) Score
F	26	4	80	80
F	28	4	80	70
F	27	4	80	70
F	27	4	80	80
F	27	5	70	60
F	27	5	70	60
M	28	5	80	70
M	29	5	70	50
F	28	5	70	60
F	28	5	70	50
F	29	5	80	90
F	28	5	80	80
F	28	6	70	60
F	30	6	70	80
F	29	6	70	70
F	29	6	70	70
F	29	6	70	60
F	29	6	80	70
F	29	6	70	60
F	30	7	70	60
F	30	7	80	70

Based on the data in Table 1, it is only sometimes valid that the age of a teacher indicates better experience. Although teaching experience is usually related to age, other factors such as the length of teaching experience (Pianta et al., 2016), opportunities for professional development (Kyndt et al., 2016), and the willingness to continue learning and innovating also play a crucial role in acquiring good teaching experience (Al-Azawi et al., 2016). Teachers actively seeking professional development stay updated with the latest teaching methods and educational trends. Furthermore, those open to innovation and continuous learning are better equipped to adapt to diverse student needs and changing classroom dynamics. Some younger teachers have extensive teaching experience because they have been teaching for many years or have been involved in various educational projects. On the other hand, some older teachers have limited teaching experience because they are just starting their teaching careers or have limited opportunities for professional development. When evaluating a teacher's experience, it is essential to look beyond just their age (Goldie, 2016; Le et al., 2018). Factors such as dedication, commitment to professional development, reflection on teaching practices, and efforts to continuously improve teaching quality should also be considered (Darling-Hammond, 2017; Andriani et al., 2018). Good teaching experience is more closely related to a teacher's efforts to continually enhance their skills and knowledge in the field of education (Toropova et al., 2021; Yadav et al., 2016). Subsequently, to determine whether age and teaching experience contribute to competence in modifying learning methods, a Pearson correlation test using software SPSS 22 was conducted. The results are presented in Table 2 and Table 3.

Table 2. Pearson Correlation Test Results between Age Factor and Competence in Modifying Learning Methods

Correlation Test		Ages	Competence in Modifying Learning Methods
Ages	Pearson Correlation	1	-.057
	Sig. (2-tailed)		.805
	N	21	21
Competence in Modifying Learning Methods	Pearson Correlation	-.057	1
	Sig. (2-tailed)	.805	
	N	21	21

Table 3. Pearson Correlation Test Results between Teaching Experience and Competence in Modifying Learning Methods

Correlations Test		Teaching Experience	Competence in Modifying Learning Methods
Teaching Experience	Pearson Correlation	1	-.227
	Sig. (2-tailed)		.322
	N	21	21
Competence in Modifying Learning Methods	Pearson Correlation	-.227	1
	Sig. (2-tailed)	.322	
	N	21	21

Based on the Pearson correlation test results in Table 2, a correlation value of $r = 0.057$ was obtained between age and competence in modifying learning methods. When comparing this result with the critical value of r (adjusted according to the df ($N-2$, 0.05) criteria, where 'N' represents the sample size), the critical value or r table = df (19-2, 0.05) = 0.4329. These results show that the r calculated (0.057) is less than the r table (0.4329). Therefore, it can be interpreted that there is no negative relationship between age and competence in modifying learning methods. Based on Table 2, the significance value (2-tailed) is 0.805, greater than 0.05. This indicates that there is no significant relationship between the variables of age and competence in modifying learning methods. Based on the interpretation of the correlation test results, it can be concluded that there is no relationship between teachers' age and the skill of modifying learning methods. The skill of modifying learning methods is not solely dependent on the age of the teachers but instead on various factors such as experience, training, professional development, adaptability, and willingness to embrace new ideas. While it is true that older or more experienced teachers may have accumulated a wealth of knowledge and expertise over the years, more is needed to guarantee their ability to modify learning methods effectively. On the other hand, younger teachers can bring new perspectives, enthusiasm, and a willingness to explore innovative teaching approaches. The primary determinant of a teacher's skill in modifying learning methods is their dedication to continuous professional growth and development. Teachers who possess information literacy and problem-solving skills

actively seek new ideas, engage in reflective practices, participate in relevant workshops or training programs, and stay updated with current educational research are more likely to be skilled at adapting and modifying their teaching methods to meet the evolving needs of their students (Belay, 2016; Malik, 2018; Vodă et al., 2022). Furthermore, a teacher's competencies to modify learning methods also depend on the context. Teachers who understand the characteristics of students from diverse backgrounds, varying preconceptions, and different learning styles will be more proficient in adapting their methods to meet the individual needs of students (Alannasir, 2020; Bernard et al., 2017; Retnawati et al., 2016). Finally, it is important to recognize that a teacher's age alone does not determine their skills in modifying learning methods. Instead, it is a combination of factors such as experience, professional development, adaptability, and a genuine commitment to student learning. The knowledge and experience gained from these factors contribute to their competence in creatively modifying their teaching methods.

Based on the Pearson correlation test results in Table 3, a correlation value of $r = 0.227$ was obtained between teaching experience and competence in modifying learning methods. When comparing this result with the critical value of r or $r_{table} = df (19-2, 0.05) = 0.4329$. These results show that the r calculated (0.227) is less than the r_{table} (0.4329). Therefore, it can be interpreted that there is no negative relationship between teaching experience and competence in modifying learning methods. Based on Table 3, the significance value (2-tailed) is found to be 0.322, which is greater than 0.05. This indicates that there is no significant relationship between the variables of teaching experience and competence in modifying learning methods. Based on the interpretation of the correlation test results, it can be concluded that there is no relationship between teaching experience and the skill of modifying learning methods.

We acknowledge that teaching experience can provide valuable insights, knowledge, and skills, but it does not guarantee an individual's ability to modify learning methods effectively. Based on the analysis of responses in open-ended questionnaires provides an overview that teachers with less experience may have the motivation and initial awareness to become highly skilled in modifying learning methods. Beginner teachers can bring fresh perspectives and innovative ideas and are more open to experimenting with different or varied teaching methods (Bawaneh et al., 2020; Kinchin & Gravett, 2020; Supena et al., 2021). They may also be more familiar with the latest educational research and technology advancements, which can enhance their ability to effectively and innovatively modify learning methods. On the other hand, experienced teachers may have developed a level of comfort and expertise with specific teaching methods, making them resistant to change or less inclined to modify their approach. However, this only applies to some experienced teachers, as many actively seek opportunities for professional growth and continuously update their pedagogical practices.

Although it has been discussed previously, based on the analysis of research data, we can emphasize that the skill of modifying learning methods is influenced by various factors, including a teacher's willingness to learn and adapt, their openness to new ideas, their ability to reflect on their teaching practices, and their commitment to professional development. These qualities can be developed and nurtured at any stage of a teacher's career, regardless of their experience level. Ultimately, the skill of modifying learning methods is not solely determined by teaching experience. It is a multifaceted ability that is influenced by a teacher's mindset, ongoing professional development, receptiveness to new ideas, and dedication to meeting the diverse needs of their students. There is increasing awareness of the need for Professional Development Programs in Innovative Teaching Methods for Beginning Science Teachers. We discussed these initiatives and concluded that more than traditional teaching methods are needed to prepare students for the demands of the rapidly changing modern world. The program equips novice science teachers with the skills and knowledge to implement innovative pedagogical approaches that foster critical thinking, problem-solving, and a deeper understanding of scientific concepts, and is an essential step toward improving science education and ensuring that students are ready to meet the challenges of the 21st century (Bower et al., 2017; Häkkinen et al., 2017; Soulé & Warrick, 2015). The results of the training activities have been obtained and presented previously. However, there are interesting things related to the mastery of skills for modifying innovative teaching methods of post-training beginner science teachers based on age and teaching experience, which we can criticize as a discussion.

The program's core components revolve around a comprehensive curriculum, expert instructors, and hands-on training. The curriculum is designed to align with national standards, emphasizing innovative teaching methods such as inquiry-based learning and effective integration of technology in the classroom. Experienced science educators and mentors have provided guidance and training to novice teacher participants currently taking the in-service Teacher Education Program for 32 meeting hours. Training program through the E-ROGIM method to provide insight and practice in modifying innovative learning methods. This program is implemented through workshops, classroom observations, and peer collaboration, and novice science teachers will learn this innovative method and gain the confidence to apply it effectively. The research results show that older age only sometimes indicates better teaching experience. Older age only sometimes means better teaching experience in natural science learning competencies and the ability to modify methods in science learning. First, a practical teaching experience depends on several factors, including continuous learning and development opportunities.

Younger teachers are more open to change and have easier access to the latest educational resources (Buchanan et al., 2013; Elliott, 2015). They are more likely to adopt innovative learning methods because they are familiar with the latest technology and approaches in education. Teaching experience itself only sometimes guarantees better competence. A teacher who has been teaching for many years may experience stagnation in teaching methods, holding on to old practices that may no longer be effective. They may lose their passion for learning new things or feel that their experience guarantees their competence without needing to adapt to new educational developments. It is essential to understand that experience in teaching is not just about the number of years spent in the classroom but also about continuous reflection and improvement. Good teachers, both younger and older, reflect on their practice, seek input from colleagues deeply, and continually strive to improve their competence. Productive teaching experience comes with age awareness and commitment to professional development (Yoo & Carter, 2017).

Differences in science learning competencies and ability to modify science learning methods are related more to individual approaches and commitment to professional development than to age. Teachers, regardless of their age, need to have a high enthusiasm for learning, openness to innovation in science learning, and a willingness to invest in their development. The resources, training, and support provided by schools and governments can also influence teachers' ability to become competent in science instruction and to modify their methods as needed. Thus, the opportunity to learn and innovate is a more determining factor than age in influencing teacher competence in science learning (Bower et al., 2017). More extended teaching experience only sometimes determines better mastery of skills in modifying natural sciences learning methods at the end of the training. Teachers with more extended experience may have developed routines in their teaching methods. They may have become accustomed to specific ways of presenting material, making them less flexible in trying new methods. They may feel that the approach they have used for years is compelling enough and, therefore, feel free to modify it. Long experience in teaching can create an excessive sense of complacency. Teachers teaching for decades may have reached the peak of their skills and no longer need to learn or adapt to educational changes. This can hinder their willingness to continue learning and follow the latest developments in science learning (Coman et al., 2020).

Teachers with more extended experience may have difficulty letting go of old teaching methods that may no longer be effective. They may feel emotionally attached to these methods, especially if they have become a hallmark of their identity as teachers. This can make it difficult for them to adopt new methods that may be better suited to students' needs. It is important to remember that mastery of the skills of modifying science learning methods depends on experience and the teacher's commitment to professional development. Both experienced and young teachers need to have a high enthusiasm for learning and a willingness to improve their skills continuously. Support from schools and educational resources can also help teachers, regardless of their experience, modify science learning methods according to recent educational developments (Rapanta et al., 2020). In other words, experience is a factor that needs to be accompanied by an open attitude towards continuous learning so that teachers can continue to modify science learning methods better. Initial mastery of strong teaching methods can provide a solid foundation for teachers to develop innovative modification skills for science learning methods. Teachers who understand the basics of pedagogy and have effective teaching techniques from the start will find it easier to adapt to new methods (Kivunja, 2014). They may better understand the principles of teaching and learning so that they can relate new methods to their previous knowledge and experience. This gives them an edge in mastering the skills of innovative modification of science learning methods.

We concluded that initial mastery of teaching methods, motivation to achieve targets, and expectations for development programs have a greater influence on mastery of innovative modification skills in science learning methods. High motivation to achieve learning targets strongly encourages teachers to develop innovative modification skills (Andriani et al., 2018). Teachers who are determined to see positive developments in student learning outcomes will be more likely to seek out new and more effective ways to teach. They may be more open to change and willing to take risks when trying different learning methods. This motivation can be a strong driver in mastering innovative modification skills in science learning methods. High expectations for development programs also play an essential role in achieving mastery of innovative modification skills in science learning methods. Teachers who enter the program with positive expectations are motivated to learn and believe the program will significantly benefit them and their students. They are more likely to actively participate and take advantage of the opportunities provided by the program. This positive expectation helps them be more open to learning and change, which can increase their mastery of the skills of innovative modification of science learning methods (Suryawati & Osman, 2017). In addition to the above factors, openness to continuous learning is very important. Teachers willing to continue learning, explore new methods, and respond to changes in student needs will be more likely to successfully master the skills of innovative modification of science learning methods. The willingness to adapt to developments in education and technology and openness to continuous improvement is the key to becoming an effective teacher in teaching science with innovative methods.

In reality, achieving mastery of innovative modification skills in science learning methods often results from a combination of the factors above. Teachers with a strong foundation in teaching methods are driven by the motivation to achieve targets and have positive expectations for development programs. They are more likely to be continuous learners. They will explore new learning methods to meet their learning goals. With openness to continuous learning, they can better master the skills of innovative modification of science learning methods. Sustainability and collaboration are also vital aspects of these discussions. Building partnerships with educational institutions, government agencies, and NGOs is critical to ensuring long-term program sustainability. Additionally, building a community of practice among participants will encourage knowledge exchange and continuous improvement, creating a supportive ecosystem for novice science teachers as they embark on their innovative teaching journey (Jho et al., 2016). In short, this Professional Development Program represents a promising pathway to improving science education in Indonesia by empowering educators with the tools and techniques needed to inspire and engage the next generation of scientists and critical thinkers. To ensure the sustainability of the science teacher training program, it is essential to implement various significant initiatives. First, there needs to be a commitment from the government and educational institutions to provide consistent resources and support. This includes sufficient budget allocation for teacher training, provision of up-to-date teaching materials, and adequate facilities for training. With strong support from the government and educational institutions, science teacher training programs can be more easily maintained and improved over time.

Second, collaboration with various stakeholders in education is crucial. This involves cooperation between the government, educational institutions, teacher organizations, and the community. Science teacher training programs can utilize broader knowledge and resources by involving various parties. In addition, the program can be adapted to better suit concrete needs in the field. Lastly, a science teacher training program must be sustainable because it is not just short. After completing the main program, teachers must have access to ongoing training, workshops, seminars, and educational resources. This helps teachers to continuously improve their skills as time goes by. Thus, teachers' learning continues after the completion of primary training but continues throughout their careers as science educators. With commitment, collaboration, and a sustainable approach, the science teacher training program can become a strong foundation for improving the quality of science education in Indonesia on an ongoing basis. This will support the development of competent and skilled teachers in teaching science, which will provide great benefits for Indonesian students. Based on the results of this research, recommendations need to be made in the future; the first is to develop individual-based programs. Professional development programs for innovative teaching methods need to be formulated considering teachers' characteristics, such as level of experience and age. The individually customizable program will help novice and experienced teachers focus on learning aspects that suit their needs (Caspersen & Raaen, 2014). For example, novice teachers may need more coaching related to basic teaching skills, while more experienced teachers may focus more on innovative modifications in instructional methods.

Second, improve skills in modifying learning methods. Focus development programs on skills in modifying learning methods. This includes ensuring that teachers have sufficient knowledge and skills to adapt their learning approaches in line with the latest developments in education. Resources and training related to educational innovation need to be provided consistently to help teachers master these skills, regardless of their age or level of experience (Johnson et al., 2016). Third, encourage positive motivation and hope. Motivating teachers to achieve higher learning targets and having positive expectations for development programs is critical. This can be achieved through recognition of achievements, rewards, and constructive assessment. Development programs can also support teachers in planning realistic and meaningful learning goals (Darling-Hammond et al., 2014). Motivating teachers and providing positive expectations will encourage active participation and better mastery of innovative modification skills in science learning methods.

CONCLUSION

Designing literal reading materials based on Islamic values and Lampung local wisdom is needed for students in the English education department. Based on the results of a questionnaire that has been given to 40 students of the English education department, it can be classified into three categories: 1) necessity, which includes the reading strategies that students must master; 2) lack, which encompasses the difficulties faced by the students when reading English text; 3) need, which refers to the information or teaching materials that students need to master in the literal reading course. The steps that have been used in this study comprise four steps, namely, a) define, b) design, c) develop, and d) disseminate. Moreover, the students' response to literal reading materials based on Islamic values and Lampung local wisdom that has been conducted to 40 students expressed 0% disagreed, 4,72% less agreed, 42,11% agreed, and 53,17% strongly agreed. The average score is 3.36 and, if converted on a table with a scale of 4, includes into a very good category. Therefore, literal reading materials based on Islamic values and Lampung local wisdom are worth applying to students. For other

researchers, similar reading materials can be further developed using different approaches to increase students' insights.

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