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Development of PE teaching materials on variations of fundamental locomotor movements toward elementary school

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ABSTRACT
The aim of this research is to determine the effect of developing basic locomotor movement teaching materials on student learning outcomes in elementary schools. This research uses the Research and Development (R&D) method with the ADDIE instructional design model (Analysis, Design, Development, Implementation, and Evaluation), which aims to develop and test the effectiveness of learning products in the form of basic locomotor movement teaching modules. The research subjects were phase B students, namely fourth grade elementary school students of SD Negeri Kebraon 1 Surabaya. The data collection instrument used is a learning outcomes test to measure students' abilities before and after implementing the developed teaching module. The data analysis technique was carried out using the paired sample t-test to determine differences in student learning outcomes before and after being given treatment. Based on the results of data analysis, it can be concluded that the development of the basic locomotor movement teaching module has had a significant influence on improving student learning outcomes, so that the developed teaching module is declared effective and suitable for use in PE learning in elementary schools.

Keywords: *teaching module; locomotor movement; learning outcomes; elementary school*

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INTRODUCTION

Education is a crucial sector in the development of a nation. The level of a country's progress is often measured by the quality of its education (Schleicher, 2018). Therefore, becoming a developed country by improving the quality of education is the aspiration of every nation. The quality of education is closely linked to the design of learning environments that enable learners to develop their full potential. In this context, physical education has a strategic role in shaping individual personality

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and character through the development of three main domains, namely affective, cognitive, and psychomotor (Casey et al., 2017).

Physical Education (PE) has a strategic role in developing movement competence, physical fitness, and students' character at the elementary school level (Dudley et al., 2017). One of the fundamental competencies that students must master is basic locomotor movement, particularly running, as it serves as the foundation for mastering other sports skills (Robinson et al., 2015). Mastery of fundamental movement skills not only impacts motor abilities but also plays a role in children's cognitive, affective, and social development (Barnett et al., 2016).

The reality in the field shows that PE learning in elementary schools is still often monotonous, centered on repetitive activities, and lacks movement variation (Casey et al., 2017). This condition causes students to easily feel bored, less enthusiastic, and not fully engaged in the learning process. The lack of variation in teaching materials also affects students' low learning interest, which ultimately may influence the low achievement of fundamental movement learning outcomes (Lonsdale et al., 2013). In fact, movement variation has been proven to increase motor stimulation, provide richer learning experiences, and enhance students' intrinsic motivation (Beni et al., 2017).

To overcome these problems, the development of PE teaching materials containing variations of basic locomotor movements becomes a relevant solution. Teaching materials developed based on movement variation principles enable students to gain learning experiences that are more interesting, challenging, and appropriate to their stage of motor development (Logan et al., 2012). In addition, structured teaching materials based on students' needs can improve learning effectiveness, facilitate teachers in delivering the material, and encourage active student engagement during the learning process (Ward et al., 2015)

Basic movements can be classified into three main groups, namely locomotor, non-locomotor, and manipulative. These three groups of movements form the building blocks of more complex physical activities such as sports and games. More specifically, motor skills are divided into three types, namely (1) locomotor skills such as walking, running, and jumping; (2) object control skills such as throwing, catching, and kicking; and (3) balance and stability skills (Khotimah et al., 2024) . Among these three types, basic locomotor movement, particularly running, is a fundamental skill involving body displacement from one place to another and serves as the foundation for mastering more complex motor skills (Hulteen et al., 2018).

On the other hand, research related to the development of PE teaching materials, particularly in variations of basic running movements, is still limited and rarely examines simultaneously the relationship between teaching material development, learning outcomes, and students' learning interest. In fact, learning interest is one of the important indicators of learning success, especially in elementary school children who are highly influenced by enjoyable movement experiences (Vasconcellos et al., 2020). Therefore, innovation in teaching materials is needed not only to improve mastery of movement skills but also to foster students' learning interest, so that PE learning becomes more effective and meaningful (Holfelder & Schott, 2014).

Based on the explanations from experts and the discussion in the background of the problem, the researcher developed PE teaching materials on variations of basic locomotor running movements and examined their effect on elementary school students' learning outcomes. It is expected that the results of this study will provide practical contributions for teachers in improving the quality of PE learning and theoretical contributions to the development of physical education science in Indonesia.

Based on the foregoing, the development of PE teaching materials on variations of basic locomotor running movements represents a strategic step that addresses both the improvement of

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motor learning outcomes and the fostering of sustained student interest and engagement in physical education.

METHOD

Research Design

This study employed a research and development (R&D) method. According to (Sumarni, 2019), development planning and research is a systematic study of how to design a product, develop/produce the design, and evaluate the product's performance with the aim of obtaining empirical data that can serve as the basis for creating products, tools, and models that can be used in learning or non-learning contexts (see also Borg & Gall, 1983; Creswell, 2014). This study aims to produce, validate, and test the effectiveness of a learning product systematically based on empirical data from learning practices.

Development research is cyclical in nature and oriented toward solving learning problems through processes of needs identification, design, development, trial, implementation, and continuous evaluation in order to produce products that are valid, practical, and effective. The focus of this study is the development of teaching materials on variations of basic locomotor movements in Physical Education (PE) learning in Elementary School to improve the quality of the learning process and student learning outcomes. Product development was carried out using the ADDIE instructional design model, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation, which are interrelated as a structured framework to ensure that the developed teaching materials are aligned with student characteristics, curriculum, and learning needs in the field.

Research Subjects

The sampling technique used in this study was non-probability sampling with the type of saturated sampling (total sampling), in which all members of the population were used as research samples. The selection of this technique was based on the characteristics of development research, which focuses on testing the feasibility, practicality, and effectiveness of learning products, as well as the relatively small population size of 24 students. By involving all students in one intact learning group, this study is expected to provide a comprehensive description of the implementation of PE teaching materials on variations of basic locomotor movements, including student responses, level of practicality of use, and improvements in learning outcomes obtained.

Data Collection Instruments

Research instruments are tools used to collect data systematically and objectively in order to obtain information in accordance with the research objectives. In this study on the development of PE teaching materials on variations of basic locomotor movements toward elementary school students' learning outcomes, the research instruments were designed and developed based on the stages of the ADDIE model, namely analysis, design, development, implementation, and evaluation. The instruments used in this study included a needs analysis questionnaire, expert validation sheets, practicality questionnaires, student response questionnaires, and learning outcome tests.

Data Analysis

Data analysis is an important procedure in research that functions to break down and examine data into component parts in order to identify the characteristics and structure of the data (Arifin, 2019). This process includes techniques or strategies used in processing, interpreting, and presenting data so that it can provide meaning in accordance with the research objectives. In this study, there were two calculations, namely prerequisite testing, which was the normality test, and hypothesis testing, which was the t-test. The normality test aims to determine whether the research data are normally distributed as a requirement for parametric statistical analysis. The test was conducted using

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the Kolmogorov–Smirnov test with the assistance of SPSS. The data are considered normally distributed if the significance value (p-value) > 0.05, and not normally distributed if the p-value < 0.05.

The research data were obtained from the results of pretests and posttests administered to the same group of students before and after the use of PE teaching materials on variations of basic locomotor movements. The pretest was used to determine students' initial abilities, while the posttest was used to determine improvements in learning outcomes. Data analysis was conducted using a paired sample t-test with the assistance of SPSS to determine differences in learning outcomes before and after the treatment, which was subsequently used to assess the effectiveness of the teaching materials. In addition, effect size was calculated using Cohen's d to convey the practical significance of the findings beyond statistical significance alone.

RESEARCH RESULTS AND DISCUSSION

Data are considered normally distributed if the significance value (Sig.) is greater than 0.05. Based on the table above, both the pretest and posttest scores have significance values exceeding 0.05 in the Kolmogorov–Smirnov and Shapiro–Wilk tests. Therefore, the data are normally distributed. This result indicates that the assumption of normality required for parametric statistical analysis has been fulfilled. Consequently, further analysis using parametric tests, such as the paired sample t-test, can be appropriately conducted to examine the effect of the implemented teaching module.

Table 1. Test of Normality

Variable	Kolmogorov-Smirnov (Sig.)	Shapiro-Wilk (Sig.)	Description
Pretest	0,200	0,337	Normal
Posttest	0,200	0,059	Normal

Based on the results of the normality test in the Tests of Normality table, it is known that the pretest and posttest data have significance values (Sig.) greater than 0.05 in both the Kolmogorov–Smirnov and Shapiro–Wilk tests. The significance value for the pretest is 0.200 and for the posttest is 0.200 in the Kolmogorov–Smirnov test, while in the Shapiro–Wilk test the significance values are 0.337 for the pretest and 0.059 for the posttest.

Thus, it can be concluded that the pretest and posttest data are normally distributed, thereby meeting the requirements for parametric statistical analysis. Therefore, the students' learning outcome data on the fundamental locomotor movement teaching materials are declared to be normally distributed and fulfill the assumptions necessary to conduct parametric statistical analysis in testing the effect of the teaching materials on students' learning outcomes. Data are considered homogeneous if the significance value (Sig.) is greater than 0.05. Based on the table above, the significance value of 0.291 exceeds 0.05, indicating that the variance of locomotor learning outcome scores is equal or homogeneous. This result shows that the assumption of homogeneity of variance has been met, allowing the data to be analyzed further using parametric statistical tests such as the t-test.

Table 2. Test of Homogenity

Variable	Levene Statistic	df1	df2	Sig.	Description
Locomotor Learning Outcomes	1,142	1	46	0,291	Homogeneous

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Based on the Test of Homogeneity of Variances table above, the Levene Statistic value is 1.142 with a significance value (Sig.) of 0.291. Since the significance value of 0.291 > 0.05, it can be concluded that the students' learning outcome data on the fundamental locomotor movement material have equal or homogeneous variances. This indicates that the research sample comes from a population with relatively similar characteristics, and therefore the data meet the basic assumption required to conduct parametric statistical analysis using the t-test. The table above presents the results of the paired samples t-test comparing pretest and posttest scores. The mean difference of 4.708 indicates that posttest scores are higher than pretest scores. The 95% confidence interval (3.619–5.797) does not include zero, which indicates a consistent improvement in students' learning outcomes.

The calculated t-value of 8.944 with 23 degrees of freedom (df) and a significance value of 0.000 ($p < 0.05$) demonstrates that there is a statistically significant difference between pretest and posttest scores. Therefore, it can be concluded that the developed locomotor teaching module has a significant effect on improving students' learning outcomes.

Table 3. Paired Sample 2 Test

No	Variables Compared	Mean Difference	Std. Deviation	Std. Error Mean	95% CI Lower	95% CI Upper	t Count	df	Sig. (2-tailed)
1	Pretest – Posttest	4,708	2,579	0,526	3,619	5,797	8,944	23	0,000

Based on the results of the Paired Samples Test, it is known that there is an improvement in students' learning outcomes after the implementation of the developed fundamental locomotor movement teaching module. The mean difference between the pretest and posttest scores is 4.708, indicating that the posttest scores are higher than the pretest scores. A standard deviation of 2.579 and a standard error of 0.526 indicate that the learning outcome data are relatively homogeneous and that the measurements conducted are sufficiently stable. The 95% confidence interval ranges from 3.619 to 5.797, demonstrating that the improvement in learning outcomes occurred consistently among the majority of students.

The statistical test results show a calculated t-value of 8.944 with 23 degrees of freedom (df) and a significance value (Sig. 2-tailed) of 0.000 ($p < 0.05$). Therefore, it can be concluded that the development of the fundamental locomotor movement teaching module has a significant effect on improving students' learning outcomes. Thus, the developed teaching module is declared effective for use in Physical Education (PE) learning at the elementary school level.

DISCUSSION

The results of this study, from a theoretical perspective, are consistent with motor learning theory proposed by (Schmidt et al., 2018), which states that practice variability can enhance movement adaptability and strengthen the formation of motor programs in learners. The developed fundamental locomotor movement teaching module incorporates variations of movement activities, thereby providing students with opportunities to explore movements in various situations. This allows students to gain richer and more meaningful learning experiences, which positively impact the improvement of fundamental movement skills.

In addition, motor development theory proposed (David & Ozmun, 2011) emphasizes that

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elementary school age is a fundamental phase in the development of basic movement skills, including locomotor movements. Learning designed in accordance with children's motor development stages will be more effective in improving movement skill mastery. The teaching module developed in this study has been adjusted to the characteristics and abilities of elementary school students, thereby supporting an optimal learning process.

From a constructivist perspective, learning that emphasizes students' active involvement through direct experience helps them construct knowledge and skills independently. The varied movement activities included in the fundamental locomotor movement teaching module encourage students to be active, participate, and interact during Physical Education (PE) lessons. This active engagement impacts not only the psychomotor domain, but also the cognitive and affective domains, such as understanding movement concepts, developing self-confidence, and fostering cooperation among students.

Furthermore, the results of this study are also in line with the view of (Cennamo & Kalk, 2005), who state that the use of structured and systematic instructional materials can enhance learning effectiveness. The developed teaching module includes clear learning objectives, well-directed activity steps, and appropriate evaluation components, thereby facilitating teachers in managing instruction and assisting students in achieving the expected competencies.

Based on the research findings and theoretical review, it can be concluded that the development of the fundamental locomotor movement teaching module has a strong theoretical foundation and has proven effective in improving elementary school students' learning outcomes. This module not only enhances mastery of fundamental movement skills, but also contributes to creating PE learning that is more engaging, meaningful, and aligned with modern educational principles. Therefore, the developed fundamental locomotor movement teaching module is feasible to be used as an alternative instructional material in PE learning to optimally support the achievement of learning objectives.

Based on the results of data analysis using the Paired Samples Test, it was found that the development of the fundamental locomotor movement teaching module has a significant effect on improving elementary school students' learning outcomes. This is indicated by a meaningful difference between pretest and posttest scores after the implementation of the teaching module, where posttest scores were consistently higher than pretest scores. The mean difference of 4.708 demonstrates a substantial improvement in learning outcomes after students participated in PE learning using the developed module.

The standard deviation of 2.579 and the standard error of 0.526 indicate that the students' learning outcome data are relatively homogeneous and that the measurements conducted are sufficiently stable. This condition suggests that the improvement in learning outcomes was not experienced by only a small number of students, but occurred evenly among the majority of students. The 95% confidence interval ranging from 3.619 to 5.797 further strengthens that the improvement in learning outcomes occurred consistently and is statistically reliable. The t-test result showing a calculated t-value of 8.944 with a significance value of 0.000 ($p < 0.05$) confirms that the improvement in learning outcomes is a direct impact of the implementation of the developed teaching module.

The findings of this study are consistent with empirical studies indicating that learning interventions focused on strengthening fundamental movement skills significantly improve elementary school students' motor competence. Research conducted by. (Logan et al., 2012) shows that interventions focusing on fundamental motor skills consistently improve children's locomotor abilities and physical activity levels. This reinforces the finding that the developed fundamental

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locomotor movement teaching module significantly improves learning outcomes.

Research by (Robinson et al., 2015) emphasizes that motor competence is directly related to health development and long-term physical activity participation. The increase in posttest scores in this study indicates that students not only experienced short-term performance improvement, but also potentially gained long-term benefits in physical development and physical fitness. Thus, the results of this study strengthen the argument that the development of a movement-variation-based teaching module has broad implications for student development.

The results of this study are also consistent with the findings of (Holfelder & Schott, 2014), who state that there is a significant relationship between fundamental motor skill mastery and students' physical activity levels. When students possess good motor competence, they tend to be more confident and active in participating in PE lessons. This condition aligns with the evenly distributed improvement in learning outcomes among most students in this study, as indicated by the relatively low standard deviation.

A meta-analysis conducted by (Lonsdale et al., 2013) shows that systematically and structurally designed physical education interventions are able to increase moderate-to-vigorous physical activity as well as student learning outcomes. The teaching module developed in this study includes clearly structured objectives, learning steps, and evaluation components, thereby supporting students' intrinsic motivation. The movement variations contained in the fundamental locomotor movement teaching module provide a more engaging and less monotonous learning experience, positively impacting students' active participation during lessons. Thus, the statistical test results showing high significance ($p < 0.05$) further reinforce that the improvement in learning outcomes is not only quantitative in nature, but also supported by improved learning quality.

These findings are also supported by a meta-analysis conducted by (Lubans et al., 2010), which states that school-based interventions emphasizing the improvement of fundamental movement skills significantly increase students' physical activity participation. This indicates that the improvement in fundamental locomotor movement learning outcomes found in this study has the potential to positively influence students' long-term physical activity habits.

(Goodway & Robinson, 2015) found that instructional programs focusing on the development of fundamental movement skills in elementary schools significantly improve locomotor competence compared to conventional learning. These results are consistent with the increase in posttest scores in this study, demonstrating the effectiveness of the developed teaching module.

Research by (Aziz, 2023) also reported that physical education learning designed with a systematic and activity-variation-based approach can enhance students' intrinsic motivation and active engagement. This supports the finding that the teaching module containing variations of running-based fundamental locomotor movements impacts not only the psychomotor domain, but also students' affective aspects.

A study by (Barabanov et al., 2026) indicates that the quality of teacher instruction and clear instructional structure in physical education significantly contribute to improving student learning outcomes. The teaching module developed in this study includes specific learning objectives and systematic activity steps, thereby supporting the overall effectiveness of the instructional process. Note: Barabanov et al. is cited as 2026 because it is an online-first/ahead-of-print publication; authors should verify and update the year upon formal publication.

Research by (Bardid et al., 2017) emphasizes that the development of fundamental motor skills at the elementary school age is a key factor in building more complex movement competencies in the future. Therefore, the significant improvement in learning outcomes in this study reinforces the importance of structured intervention through a fundamental locomotor movement teaching module.

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CONCLUSION

The results of the study indicate that the development of PE modules and teaching materials based on variations of fundamental locomotor movements has a significant effect on improving elementary school students' learning outcomes. The implementation of teaching materials that are systematically organized, aligned with students' characteristics and needs, and enriched with varied fundamental movement activities is able to enhance students' understanding and movement skills evenly.

These findings confirm that innovation in PE teaching materials based on variations of fundamental locomotor movements is not only effective in improving learning outcomes, but also serves as a solution to the monotonous nature of PE instruction that has often occurred. Therefore, such teaching materials are appropriate for supporting the optimal achievement of PE learning objectives. Nevertheless, this study has several limitations that should be acknowledged. The research was conducted in a single school (SD Negeri Kebraon 1 Surabaya) with a relatively small sample size of 24 students, which limits the generalizability of the findings to broader populations. The use of a single-group pretest-posttest design also means that alternative explanations for the observed improvements cannot be entirely ruled out. Future research is recommended to employ larger and more diverse samples across multiple schools, and to consider control group designs to further confirm the effectiveness of the developed teaching materials.

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