



## Effectiveness of the Wasaka-Based Scientific Learning Design in Strengthening Students' Performance Character in Physics Education

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### Abstract:

This study examines the effectiveness of a physics learning design that integrates a scientific approach with Wasaka local wisdom to strengthen students' performance character. The Wasaka (*Waja Sampai Kaputing*) philosophy emphasizes perseverance, diligence, and commitment in accomplishing academic tasks. A descriptive-quantitative method was applied to 30 physics education students. Hard work and perseverance were assessed using observation rubrics, while learning outcomes were measured through essay tests. Results revealed a significant improvement in performance character, with hard-work scores increasing from 1.49 to 4.86 and perseverance from 1.42 to 4.86, yielding an average gain of 0.96 (high). Learning outcomes also improved moderately (N-Gain = 0.43–0.55). The findings confirm that the Wasaka-based scientific design effectively enhances students' work character through reflective and inquiry-oriented learning. These results imply that integrating local wisdom within scientific pedagogy provides a meaningful pathway for developing scientific and character-based competence in higher education.

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## Introduction

The development of twenty-first-century education demands not only the attainment of cognitive competencies but also the cultivation of performance-related character traits such as diligence, perseverance, and responsibility. Recent studies have revealed that non-cognitive attributes – including persistence, conscientiousness, and academic perseverance – play a significant role in shaping students' learning outcomes and their continuity in higher education (Rieger et al., 2022; du Plooy et al., 2024; Mtshweni, 2024). For instance, *The Persistence of Students' Academic Effort* examined the contribution of interest and conscientiousness to students' academic engagement and found that both variables exert unique predictive effects on the intensity of their learning effort (Rieger et al., 2022). Similarly, du Plooy et al. (2024) emphasized that personalized learning adaptation can enhance student engagement and motivation, thereby indirectly supporting the development of persistence as a performance character. In addition, analyses of the relationship between sense of belonging and academic persistence indicate that emotional and academic adjustment serve as critical mediating factors in sustaining students' learning efforts (Mtshweni, 2024). Hence, it is highly relevant to design instructional interventions that not only enhance cognitive capabilities but also strengthen students' performance character, enabling them to remain resilient when facing academic challenges.

The scientific approach in science education has been widely investigated and consistently reported as effective in enhancing students' critical thinking skills, scientific process abilities, and experimental motivation (Davis & Burkholder, 2024; Shaikh & Asif, 2022; du Plooy et al., 2024). In the context of physics education, real-world problem-solving models have been associated with higher levels of student persistence compared to traditional learning methods (Davis & Burkholder, 2024). Meanwhile, in online learning environments, studies on persistence and dropout in higher education emphasize that the combination of motivational factors, interaction satisfaction, and course design strongly influences the continuity of students' learning efforts (Shaikh & Asif, 2022). Research on personal adaptation and student engagement also reinforces the notion that learning designs providing opportunities for students to explore scientifically are highly relevant within higher education contexts (du Plooy et al., 2024). Nevertheless, most of these studies have primarily focused on cognitive outcomes or motivational aspects and have not explicitly examined their impact on the development of hard-work and perseverance character within the context of physics learning.

The integration of local wisdom into learning has become an increasingly prominent topic in recent science education literature, serving as a means to enrich learning contexts and strengthen students' character development (Lestari et al., 2024; Febrian et al., 2024; Suciati, 2023; Muhammad et al., 2022). For example, *A Systematic Literature Review about Local Wisdom and Sustainability* discusses the contribution of local wisdom research to science education and finds that the implementation of local values enriches the meaning of learning and strengthens students' character development (Lestari et al., 2024). Likewise, the article *Integrating Local Wisdom in Science Learning* examines opportunities and challenges in embedding cultural elements into science education practices, highlighting barriers such as teacher

resistance, limited resources, and the absence of clear instructional guidelines (Suciati, 2023).

Similarly, the bibliometric study *A Local Wisdom in Science Education Using Bibliometric Mapping* confirms that research trends in local wisdom-based education continue to grow, with the themes of character and assessment becoming increasingly prominent for exploration (Parhan & Dwiputra, 2023; Tiro et al., 2024). In the Indonesian context, studies on local wisdom-based science modules have demonstrated positive effects on students' understanding of scientific concepts and their learning motivation (Sanjayanti et al., 2022; Alwi et al., 2024). Therefore, integrating local values such as hard work and perseverance – as represented by the *Wasaka* philosophy – into the design of physics learning provides a strong theoretical justification. This integration not only contextualizes scientific learning within the students' cultural environment but also serves as a vehicle for nurturing resilience, moral commitment, and a sense of responsibility as essential components of performance character.

Although there is a growing body of literature supporting the combination of scientific approaches and local wisdom in science education, empirical research that specifically evaluates the effectiveness of integrating *Wasaka* values – embodying hard work and perseverance – within higher-level physics learning (particularly among pre-service physics teachers) remains scarce. Several studies have examined local wisdom-based learning at the elementary and secondary levels or within modular contexts, and found that such modules enhance students' conceptual understanding skills (Ramdani & Syukur, 2024; Febrian et al., 2024; Alwi et al., 2024; Muhammad et al., 2022). However, few have directly investigated its impact on the performance character of pre-service physics teachers in experimental classroom settings. Therefore, this study develops a *Wasaka*-based Scientific Learning Design in physics education – emphasizing the values of hard work and perseverance – and aims to examine its effectiveness through quantitative measurements, including character observation and learning outcome analysis using the N-gain test. With this focus, the study seeks to bridge the empirical gap between science education research and character education studies grounded in local cultural values

## Research Method

This study aims to evaluate the effectiveness of the *Wasaka*-based Scientific Learning Design in Physics Education in strengthening students' performance character while simultaneously improving learning outcomes on the topic of *Electric Current and Circuits*. The learning design integrates the stages of the scientific approach with the local values of *Wasaka* (*Waja Sampai Kaputing*), which represent the spirit of hard work, perseverance, and responsibility in completing tasks thoroughly. Through sequential learning phases – *Visualize & Explore*, *Activate Inquiry*, *Construct & Connect*, *Transform Insight*, and *Apply & Transfer* – students are guided not only to understand physics concepts conceptually but also to demonstrate persistence, consistency, and determination throughout the scientific inquiry process.

The study employed a descriptive-comparative quantitative approach with a repeated-measures design, as observations were conducted during each learning session to capture the dynamics of students' character development and learning

progress. The research subjects consisted of 30 students enrolled in the Physics Education Study Program, Faculty of Teacher Training and Education, at a university in South Kalimantan, Indonesia. The participants were divided into two stages: a limited trial involving nine students to assess the feasibility of the learning syntax and the clarity of the instruments, and a wider trial involving twenty-one students to examine the model's effectiveness in a more representative setting. The learning implementation took place over three sessions, each focusing on a different subtopic of *Electric Current and Circuits*, and was facilitated by the same lecturer to maintain instructional consistency.

Research data were collected using two main instruments: a performance character observation sheet and an open-ended essay test. The observation sheet was developed with reference to the moral character framework (Lickona, 1992), whose continuing relevance is affirmed by recent empirical insights (e.g., Munawarsyah et al., 2024). It also draws on the grit construct proposed by Duckworth et al. (2007), further substantiated by contemporary studies (Datu et al., 2023; Harpaz et al., 2024). In addition, the design incorporates Zimmerman's (2002) principles of self-regulated learning, supported by up-to-date evidence of their effectiveness (Theobald, 2021; Luo & Zhou, 2024).

The two primary character traits observed were hard work and perseverance, each represented by five indicators with two operational behavioral statements, resulting in a total of twenty observation items. The indicators of hard work included: (1) effort in completing tasks despite difficulties, (2) seeking alternative solutions to overcome obstacles, (3) consistency in completing tasks independently, (4) maintaining focus during learning, and (5) utilizing various learning resources. Meanwhile, the indicators of perseverance included: (1) completing tasks thoroughly without giving up, (2) consistently following experimental procedures, (3) repeating processes to achieve better results, (4) remaining focused on completing tasks even when they require extended time, and (5) maintaining concentration without being easily distracted when facing learning challenges.

Each statement was assessed using a five-point Likert scale, with the following categories: 1 = strongly not observed, 2 = not observed, 3 = moderately observed, 4 = observed, and 5 = strongly observed. The observations were conducted by two trained observers who attended every learning session to ensure data reliability. The content validity of the instrument was examined through expert judgment by three specialists – two physics education lecturers and one educational evaluation expert – while its reliability was calculated using Cronbach's Alpha coefficient, yielding a value above 0.80, which indicates high internal consistency.

In addition to character data, this study also collected students' cognitive learning outcomes through an essay test consisting of five open-ended questions. These questions required students to explain the fundamental concepts and principles of electric circuits, establish relationships among variables (current, voltage, and resistance), and apply Ohm's Law and circuit principles in real-life contexts. One question specifically assessed scientific process skills – students' ability to design a simple experiment to investigate the relationship among electric current, voltage, and resistance using basic laboratory tools. The responses were evaluated using an analytic rubric encompassing three criteria: (1) accuracy of physics concepts, (2) logical

reasoning steps, and (3) quality of experimental design or scientific argumentation. The scoring rubric was verified by two experts in introductory physics to ensure clarity of criteria and objectivity in scoring.

The collected data were analyzed using a descriptive and comparative quantitative approach. Character observation scores were calculated as the mean value for each indicator and categorized into four achievement levels: very low (1.00–1.80), low (1.81–2.60), high (2.61–4.20), and very high (4.21–5.00). Changes in scores from the first to the third session were analyzed to identify the trend of character improvement. Meanwhile, the essay test results were analyzed based on the mean final scores and the comparative increase between sessions. These numerical findings were then complemented by descriptive qualitative analysis, which portrayed students' observable behaviors during the learning process, such as perseverance in repeating experiments, persistence in solving problems, and initiative in utilizing additional learning resources. Overall, the research method was designed to capture two dimensions of learning effectiveness: character and cognitive. The observations conducted over three learning sessions provided a concrete picture of how the scientific approach, when synergized with *Wasaka* values, can foster persistence, diligence, and scientific thinking among pre-service physics teachers.

## Results and Discussion

The results of this study are presented to illustrate the effectiveness of the *Wasaka*-based Scientific Learning Design in physics education, which was implemented over three learning sessions. The effectiveness was evaluated through two main indicators: the development of students' hard work and perseverance—observed directly during the learning process—and their cognitive learning outcomes, measured through essay tests administered after the instructional sessions. Data from both aspects were analyzed descriptively and qualitatively to explore how the integration of *Wasaka* values—emphasizing perseverance and commitment to completing tasks—contributed to the formation of students' performance character as well as their understanding of dynamic electricity concepts. The presentation of results begins with an overview of students' character development, as displayed in Table 1 to 4, followed by an analysis of learning outcomes and an integrative discussion of both dimensions within the framework of constructivist learning theory and character education.

**Table 1. Mean Scores of Students' Hard Work Character Observations during the Limited Trial Phase**

No.	Indicators of Hard Work	O1	O2	O3	O4	Gain Score
1	Effort in completing tasks despite difficulties	1.58	4.81	4.83	4.86	<b>0.96</b>
2	Seeking alternative solutions when facing obstacles	1.50	4.69	4.86	4.89	<b>0.97</b>
3	Consistency in completing tasks independently	1.39	4.67	4.67	4.78	<b>0.94</b>
4	Focus during the learning process	1.36	4.81	4.58	4.83	<b>0.95</b>
5	Utilizing various learning resources to support concept understanding	1.64	4.42	4.78	4.92	<b>0.98</b>
<b>Overall Mean</b>		<b>1.49</b>	<b>4.68</b>	<b>4.74</b>	<b>4.86</b>	<b>0.96</b>

**Note:** O1 = Initial Observation, O2–O3 = Intermediate Observations, O4 = Final Observation.

**Table 2. Mean Scores of Students' Perseverance Character Observations during the Limited Trial Phase**

No.	Indicators of Perseverance	O1	O2	O3	O4	Gain Score
1	Completing tasks thoroughly without giving up midway	1.81	4.72	4.75	4.86	0.96
2	Consistency in following experimental or practical procedures	1.31	4.72	4.83	4.81	0.95
3	Repeating processes to achieve better results	1.25	4.69	4.72	4.86	0.96
4	Remaining focused on completing tasks even when they require extended time	1.44	4.69	4.75	4.89	0.97
5	Maintaining focus without being easily distracted when facing learning challenges	1.31	4.64	4.75	4.89	0.97
<b>Overall Mean</b>		<b>1.42</b>	<b>4.69</b>	<b>4.76</b>	<b>4.86</b>	<b>0.96</b>

**Table 3. Mean Scores of Students' Hard Work Character Observations during the Limited Extensive Phase**

No.	Indicators of Hard Work	O1	O2	O3	O4	Gain Score
1	Effort in completing tasks despite difficulties	1.61	4.71	4.86	4.93	0.98
2	Seeking alternative solutions when facing obstacles	1.56	4.56	4.61	4.73	0.92
3	Consistency in completing tasks independently	1.55	4.35	4.56	4.73	0.92
4	Focus during the learning process	1.60	4.54	4.64	4.77	0.93
5	Utilizing various learning resources to support concept understanding	1.58	4.64	4.71	4.81	0.94
<b>Overall Mean</b>		<b>1.58</b>	<b>4.56</b>	<b>4.68</b>	<b>4.79</b>	<b>0.94</b>

**Table 4. Mean Scores of Students' Perseverance Character Observations during the Extensive Trial Phase**

No.	Indicators of Perseverance	O1	O2	O3	O4	Gain Score
1	Completing tasks thoroughly without giving up midway	1.49	4.77	4.85	4.89	0.97
2	Consistency in following experimental or practical procedures	1.56	4.52	4.61	4.75	0.93
3	Repeating processes to achieve better results	1.61	4.48	4.58	4.65	0.90
4	Remaining focused on completing tasks even when they require extended time	1.49	4.37	4.54	4.71	0.92
5	Maintaining focus without being easily distracted when facing learning challenges	1.57	4.64	4.69	4.83	0.95
<b>Overall Mean</b>		<b>1.49</b>	<b>4.77</b>	<b>4.85</b>	<b>4.89</b>	<b>0.97</b>

The observations of students' hard work and perseverance during both the limited and extensive trial phases revealed a highly significant increase in scores over time. Observations were conducted four times, comprising an initial measurement before the intervention (O1) and three subsequent observations throughout the learning implementation (O2–O4). Overall, the improvement was consistent across all indicators for both hard work and perseverance. This finding indicates that the implementation of the *Wasaka*-based scientific learning design in physics education had a positive impact on students' engagement and attitudes throughout the learning process.

In the limited trial involving nine students, the average score of the hard work character increased sharply from 1.49 at the initial stage to 4.86 in the fourth session, with a gain score of 0.96. A similar improvement was observed in the perseverance

character, which rose from an initial mean of 1.42 to 4.86, yielding the same gain score of 0.96. Almost all indicators showed relatively uniform increases, with the highest gains recorded in the indicators of *utilizing various learning resources to support conceptual understanding* (gain = 0.98) and *remaining focused without being easily distracted when facing learning challenges* (gain = 0.97). These data indicate that although students initially demonstrated low levels of character performance, by the end of the learning sessions nearly all indicators had reached the “very high” category.

Meanwhile, in the extensive trial involving twenty-one students, the results exhibited an almost identical pattern, though with slightly more moderate variations. The average score for the hard work character increased from 1.58 in the initial observation to 4.79 in the fourth session, with a gain score of 0.94. The indicator *effort in completing tasks despite difficulties* showed the highest improvement (gain = 0.98), followed by *utilizing various learning resources* (gain = 0.94). For the perseverance character, the initial mean score of 1.54 rose to 4.77 by the fourth session, yielding a gain score of 0.93. The indicator *completing tasks thoroughly without giving up midway* recorded the greatest improvement (gain = 0.97), whereas *repeating processes to achieve better results* showed the smallest increase (gain = 0.90), though it still fell within the high category.

When compared as a whole, both the limited and extensive trials demonstrated a relatively consistent pattern of improvement. Students in both stages of the study showed progressive development in their hard work and perseverance, moving from low to very high categories within three learning sessions. This improvement was evident not only in the overall mean scores but also across all observed indicators, indicating that repeated learning through the scientific approach combined with *Wasaka* values successfully fostered more persistent, focused, and independent behavioral patterns over time. These observations provide a strong basis to conclude that the developed learning design has the potential to be effective in internalizing performance character among pre-service physics teachers.

To complement the observations of students’ hard work and perseverance, this study also measured students’ cognitive aspects through a learning achievement test (LAT) on the topic of Dynamic Electricity. The test was administered before and after the learning sessions to evaluate the effectiveness of the *Wasaka*-based scientific learning design in improving conceptual understanding. The learning outcome data were presented in descriptive statistical form, including the mean, standard deviation, maximum–minimum scores, and the N-gain calculation as an indicator of improvement. A summary of the students’ learning outcomes is presented in Table 5 and Figure 1.

**Table 5. Descriptive Statistics of Students’ Learning Outcomes on the Dynamic Electricity Topic**

Trial Stage	N	Mean (Pre)	SD (Pre)	Min.-Max. (Pre)	Mean (Post)	SD (Post)	Min.-Max. (Post)
Limited Trial	9	10.0	3.0	6.3 – 13.7	59.7	15.0	40.1 – 83.5
Extensive Trial	21	8.0	3.8	2.7 – 14.9	47.5	18.8	17.4 – 91.6

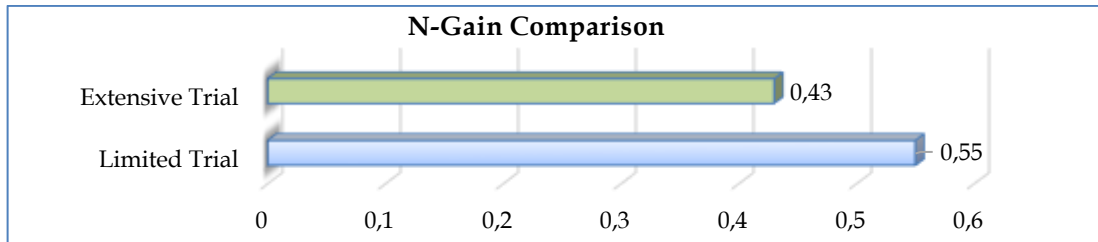


Figure 1. Comparison of Gain Scores Between the Limited and Extensive Trials

Based on Table 5 and Figure 1, the average learning outcome score of students in the limited trial phase showed a substantial increase – from an initial mean score of 10.0 to 59.7 after the learning sessions – with an N-gain score of 0.55, categorized as moderate. The score range also displayed considerable variation, from 40.1 to 83.5, with a standard deviation of 15.0, indicating individual differences in achievement levels even though the overall trend of improvement remained consistent. At this stage, all students experienced score increases, although there were still variations in the rate of conceptual understanding among individuals.

In the extensive trial, the pattern of improvement in learning outcomes also appeared consistent, although the magnitude was slightly lower than that observed in the limited trial phase. The students' average pretest score of 8.0 increased to 47.5 after the intervention, resulting in an N-gain score of 0.43, which also falls within the moderate category. The maximum score increased to 91.6, indicating that some students achieved a high level of conceptual mastery, while the minimum score of 17.4 reflected a remaining variation in levels of conceptual understanding among students. The relatively large standard deviation (18.8) further illustrates the greater diversity of student abilities compared to the limited trial group.

Overall, the results of both trial stages indicated that the implementation of the *Wasaka*-based scientific learning design in physics led to a substantial improvement in students' learning outcomes, with the average N-gain score falling within the moderate category. Although the improvement observed in the limited trial was higher than that in the extensive trial, both stages demonstrated a consistent and positive upward trend. This finding suggests that the developed learning model effectively supported students in gaining a deeper and more structured understanding of dynamic electricity concepts, while also demonstrating its consistent effectiveness in larger groups. These results reinforce the earlier findings on the development of hard work and perseverance, which similarly showed progressive enhancement over time. Hence, both character and cognitive aspects provide empirical evidence that the *Wasaka*-based learning approach fosters a more active, meaningful, and performance-oriented learning process for pre-service physics teachers.

The N-gain scores of 0.55 in the limited trial and 0.43 in the extensive trial indicate that the developed learning design was not only effective in internalizing the values of hard work and perseverance but also capable of improving students' conceptual understanding of physics at a moderate level. These findings are noteworthy because the instructional process was not exclusively directed toward cognitive achievement; rather, it simultaneously accommodated character development as an integral component of learning. In other words, allocating learning activities to strengthen hard work and perseverance did not reduce students' academic

achievement; instead, it appeared to enhance their engagement and persistence throughout the learning process. This interpretation is consistent with the findings of [Duckworth et al. \(2007\)](#), [Neroni et al., \(2022\)](#), [Harpaz et al. \(2024\)](#), and [Yanling et al. \(2024\)](#), who reported that grit, persistence, and sustained effort are positively associated with academic success and long-term learning achievement. Therefore, the cognitive gains observed in this study may be viewed as a logical consequence of the strengthened performance character cultivated through the learning process.

The findings of this study demonstrate that the implementation of the *Wasaka*-based scientific learning design in physics education had a significant effect on strengthening students' performance character, particularly in the dimensions of hard work and perseverance. Both character traits showed a consistent increase from the initial to the final observations, in both the limited and extensive trial phases. In parallel, students' learning outcomes also improved, ranging from moderate to high categories. These results indicate that the developed learning design not only enhanced conceptual understanding but also cultivated persistent and self-directed learning dispositions among pre-service physics teachers. This finding is consistent with the results of previous studies by [Fachrurradhi et al \(2025\)](#) and [Sudarto et al \(2025\)](#), which emphasized that the integration of local wisdom values into learning design has been empirically proven to strengthen students' moral understanding, social responsibility, and learning engagement through reflective and contextual activities. Such integration ultimately cultivates perseverance and resilience in completing tasks and overcoming academic challenges.

Theoretically, this effectiveness can be explained through the principles of constructivism, which underlie the scientific approach. From a constructivist perspective, students play an active role in constructing their understanding through exploration, experimentation, and reflection ([Wiyono et al., 2025](#); [Le & Nguyen, 2024](#)). The learning process that emphasizes observation, experimentation, and independent analysis fosters perseverance, a sense of responsibility, and academic self-regulation. This finding is supported by [Urdanivia Alarcon et al. \(2023\)](#) and [Avcı & Kırbaşlar, \(2023\)](#), who revealed that inquiry-based science education strategies enhance students' learning motivation and self-regulation skills. In addition, [Maison et al. \(2021\)](#) and [Hong et al., \(2021\)](#) found that the implementation of inquiry models in physics learning contributes to the improvement of scientific attitudes and learning resilience. Therefore, this learning design possesses a strong theoretical foundation and aligns well with recent empirical findings.

The improvement in students' hard work and perseverance observed in this study did not occur by chance; rather, it was closely associated with the alignment between the instructional phases embedded in the *Wasaka*-Based Scientific Learning Design and the targeted performance character traits. From the perspective of self-regulated learning, character development is not achieved through the verbal transmission of values alone, but through active engagement in learning experiences that require planning, decision-making, monitoring progress, and reflecting on outcomes ([Zimmerman's 2002](#); [Theobald, 2021](#); [Luo & Zhou, 2024](#)). During the Visualize and Explore phase, students were exposed to contextual physics phenomena that stimulated attention, concentration, and curiosity toward the problems being investigated. In the Activate Inquiry phase, students formulated research questions,

developed hypotheses, identified variables, and designed investigation procedures independently, thereby fostering effortful engagement and hard work. Subsequently, the Construct & Connect phase required students to conduct experiments, collect and analyze data, and relate their findings to relevant physics concepts. This process frequently required repeated measurements, procedural revisions, and reevaluation of results, providing authentic experiences that nurtured perseverance and resilience. In the Transform Insight phase, students defended their scientific arguments through discussion and presentation, while the Apply and Transfer phase encouraged them to apply their understanding to new situations and reflect upon their learning experiences. Accordingly, each instructional phase within the Wasaka-Based Scientific Learning Design systematically provided opportunities for the development of hard work and perseverance as essential dimensions of performance character.

The integration of *Wasaka* (Waja Sampai Kaputing) local wisdom values serves as a key distinguishing element of this learning design compared to conventional scientific models. Local values such as perseverance, hard work, and commitment to task completion provide a moral and cultural context that is highly relevant to students in the Banua region. [Ramadania \(2019\)](#) and [Ramadhan & Wahab \(2019\)](#) collectively highlight the strong pedagogical potential of Banjar local wisdom in character formation. Their studies show that cultural values—such as diligence, mutual cooperation, loyalty to social responsibilities, and traditional practices like the *teprung tawar* ceremony—serve as contextual foundations that effectively foster students' resilience, discipline, and respectful engagement in the learning process. Thus, the integration of *Wasaka* values into the scientific approach not only cultivates students' scientific spirit but also reinforces their cultural roots and personal responsibility. This finding is further supported by [Syahfitri & Muntahanah \(2024\)](#) and [\(Prayogi et al., 2023\)](#), who stated that integrating local wisdom into digital science modules effectively enhances students' critical thinking disposition and learning responsibility.

Furthermore, the effectiveness of integrating Wasaka values into physics learning can be explained through the epistemological compatibility between the Wasaka philosophy and the nature of physics itself. Physics is not merely a collection of concepts, laws, and mathematical equations; it is fundamentally a scientific process that involves observation, experimentation, data analysis, hypothesis testing, and evidence-based reasoning. In practice, these processes frequently confront students with challenges such as measurement errors, discrepancies between predictions and experimental results, and difficulties in interpreting empirical data. Consequently, success in physics learning requires strong dispositions of hard work, persistence, and sustained effort. In this context, the Wasaka philosophy, which embodies the values of perseverance, determination, and commitment to completing tasks thoroughly, is inherently aligned with the demands of scientific inquiry in physics. Therefore, the integration of Wasaka values into physics learning should not be viewed merely as the addition of local cultural elements into the curriculum; rather, it represents a philosophically, pedagogically, and epistemologically coherent integration between local wisdom and the scientific practices that characterize physics learning.

In addition to character formation, the results of this study also revealed a positive correlation between performance character and learning outcomes. Students who demonstrated higher levels of hard work and perseverance tended to achieve

better learning results, particularly in scientific process skills. This phenomenon aligns with the grit theory proposed by [Duckworth et al. \(2007\)](#) and further reinforced by [Yanling et al. \(2024\)](#), which emphasize that perseverance of effort plays a crucial role in long-term academic achievement. Similarly, [Harpaz et al. \(2024\)](#) and [Neroni et al., \(2022\)](#) found that academic grit serves as a consistent predictor of students' academic performance across disciplines. Therefore, the improvement in learning outcomes observed in this study can be viewed as a manifestation of strengthened performance character that is closely integrated with active and reflective learning processes.

Compared with previous studies, the present research offers a distinctive contribution. Most earlier studies on local wisdom-based learning primarily focused on improving conceptual understanding, scientific literacy, science process skills, or learning motivation through culturally contextualized teaching materials, modules, or instructional media. In contrast, this study integrated Wasaka values directly into the syntax of scientific learning activities implemented throughout the instructional process. Consequently, the primary contribution of this study lies not merely in the use of local wisdom as a contextual learning resource, but in the development of a learning design that systematically connects local cultural values, scientific inquiry processes, and the cultivation of students' performance character. This finding strengthens the argument that local wisdom can function not only as a means of contextualizing learning but also as a pedagogical mechanism for fostering hard work and perseverance, which are essential competencies for physics learning and twenty-first-century education. Moreover, this study differs from previous local wisdom-based learning research by positioning Wasaka values not only as contextual content but also as an integral mechanism for character formation embedded within the learning process itself.

Although the results of this study demonstrate a high level of effectiveness, several areas for further enhancement remain. The duration of implementation should be extended to allow a deeper and more sustainable process of character internalization. The use of reflective instruments, such as learning journals or peer review, is recommended to help students become more aware of their own character development. This effort aligns with the recommendations of [Hidayat et al. \(2022\)](#) and [Kiersch & Gullekson \(2021\)](#), who emphasized the importance of self-reflection in the internalization of character values in higher education. Future research should also broaden the application of this model to secondary schools or other areas of physics to examine the consistency of its effectiveness across different educational levels and cultural contexts.

## Conclusion

The study concludes that the Wasaka-based scientific learning design is proven effective in enhancing the performance character of pre-service physics teachers, particularly in the aspects of hard work and perseverance. These character traits consistently improved throughout three learning sessions, both in the limited and wider trials, with an average gain score categorized as high. The findings also revealed a moderate-to-high improvement in students' learning outcomes in the topic of electric current, confirming that the integration of scientific inquiry with Wasaka values – such

as sincerity, persistence, and consistency – can internalize scientific character while simultaneously strengthening conceptual understanding.

The results carry significant implications for physics education practice and higher education curriculum design. First, physics lecturers may employ this model as a pedagogical strategy to foster students' character holistically – covering cognitive, affective, and psychomotor domains. This model is particularly relevant for conceptual and experimental physics topics that require scientific investigation. Second, higher education institutions may adopt the Wasaka-based approach as a policy framework to promote value-based learning grounded in local wisdom as part of the *Pancasila Student Profile* initiative, ensuring character development is embedded in the academic process.

In addition, this study opens opportunities for further research. Future investigations may test the model's effectiveness across a larger sample and longer duration while incorporating reflective assessment tools such as self-assessment or learning journals to capture deeper character internalization. Theoretically, these findings reaffirm that learning which balances scientific inquiry and local wisdom can serve as a strategic framework for 21st-century education – nurturing critical and creative thinking while reinforcing the cultural and moral values that shape national identity.

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