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Educational Robotics Workshop for Developing Wasaka Character

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Abstract

The community service activity was carried out as an effort to enhance the competence of physics teachers in Hulu Sungai Selatan Regency in designing contextual, innovative, and culturally rooted learning. The partner of this activity was the MGMP (*Musyawarah Guru Mata Pelajaran*) of physics, consisting of 22 teachers. This activity adopted the Participatory Action Research (PAR) method, involving teachers as active participants throughout the process. The program was conducted through several stages, namely socialization, training, robotics practice, mentoring, and evaluation. This approach ensured that the solutions developed were relevant and aligned with the needs and capacities of the teachers. The medium used was ArtecRobo, which supports the application of technology-based learning. The results of the activity indicated an improvement in teachers' understanding of integrating the Wasaka character—reflecting resilience and consistency—into physics learning through authentic experiences of assembling and programming robots. Teachers not only gained technical skills but also directly experienced how robotics can foster perseverance, collaboration, and problem-solving abilities. Participant responses were positive, with 87% of teachers stating the activity was highly beneficial and 80% reporting that they were motivated to implement it in their classrooms. The implication of this activity is the need for continuous mentoring and the provision of robotics facilities in schools so that the integration of Wasaka character can be optimized and support the achievement of 21st-century skills.

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INTRODUCTION

Efforts to improve the quality of science education, particularly physics, are not only determined by mastery of subject matter, but also by the extent to which learning is able to equip students with relevant life skills (Ariyanti et al., 2022; Hartini et al., 2023; Wati

et al., 2023, 2024; Yanti et al., 2023). Physics, as a science that explains natural phenomena, should be connected to the social, cultural, and environmental realities surrounding students (Murniati et al., 2024). This connection is crucial for making learning meaningful and applicable in real life.

In practice, however, physics learning in schools still tends to emphasize the transmission of concepts and the completion of procedural exercises, a pattern commonly reported in science education research (Asyafaah et al., 2024; Miriam et al., 2023; Wicaksono et al., 2024). Such teacher-centered approaches often limit opportunities for students to engage in higher-order cognitive processes, learners are primarily trained to memorize formulas and follow algorithmic steps rather than analyze situations, interpret phenomena, or construct solutions independently (Anjiana et al., 2024; Dewi et al., 2024; Widyaningtyas et al., 2024). Consequently, this instructional orientation contributes to the underdevelopment of students' problem-solving and critical-thinking skills, which are essential competencies for meaningful physics understanding. These findings underscore the urgent need to design physics learning that is more contextual, inquiry-driven, and connected to students' real-life experiences. The community service partners in this activity were physics teachers in Hulu Sungai Selatan Regency, who are members of the MGMP of Physics. This forum, which consists of 22 teachers, serves as an important platform for enhancing teacher professionalism and advancing teaching practices. South Kalimantan itself is rich in local wisdom, one of which is the Wasaka value (Waja Sampai Kaputing), which means resilient, steadfast, and persistent until the end (Wati et al., 2021).

The Wasaka character reflects the spirit of struggle and consistency of the Banua community in facing various life challenges(Wati et al., 2019). These values are highly relevant to physics learning, as the process of understanding scientific concepts and solving problems requires sustained effort, accuracy, and resilience in reasoning (Misbah et al., 2018). Integrating the Wasaka character enables physics learning not only to transfer scientific concepts but also to cultivate cultural values that strengthen students' local identity while fostering adaptive scientific attitudes.

The theoretical foundation shows that the integration of local wisdom in education plays an important role in increasing the relevance and meaningfulness of learning (Dewantara et al., 2024, 2025; Mahmudah et al., 2023). Culture-based education studies highlight that connecting learning content with local values helps build cultural literacy, increases motivation, and allows students to perceive how scientific knowledge interacts with their socio-cultural environment. In physics education, local wisdom offers authentic contexts that make abstract concepts more concrete and relatable through real-life phenomena. This aligns with contextual teaching and learning (CTL) and problem-solving–based learning, both emphasizing the linkage between academic knowledge and everyday life.

The Wasaka character, as one of the core cultural values of the Banua community, can therefore serve as a value framework that instills persistence, diligence, and courage in students as they engage with scientific tasks (Annisa et al., 2020). This value can be embedded into physics learning strategies through the design of problem-solving activities, experiments, and contextual discussions that require resilience and sustained effort in constructing solutions (Wati & Misbah, 2021). This value can be embedded into physics learning strategies through the design of problem-solving activities, experiments, and contextual discussions that require resilience and sustained effort in constructing solutions.

Preliminary data collected by the community service team in February 2025 through a questionnaire showed that 93.33% of partner teachers had not yet integrated the Wasaka

character into physics learning. This indicates a substantial gap between the richness of local cultural potential and the conventional, concept-oriented teaching practices still predominating in classrooms. If this gap persists, students may struggle to recognize the relevance of science to real life, experience limited opportunities to develop critical thinking, and fail to cultivate innovative capacities needed for future challenges. These conditions may further affect students' competitiveness in navigating an increasingly dynamic modern world that demands strong 21st-century skills.

The resulting problem formulation is therefore: how can the skills of physics teachers in Hulu Sungai Selatan Regency be improved in integrating the Wasaka character into physics learning to address real-life problems faced by students? The main objective of this program is to strengthen the professional and socio-community capacities of partner teachers, with a key expected outcome being the enhancement of their ability to integrate Wasaka-based values into physics instruction. Through this integration, teachers are expected to design physics lessons that move beyond mere conceptual transmission toward meaningful, contextual learning that fosters students' critical thinking and problem-solving abilities.

The novelty of this program lies in its approach to embedding the Wasaka character (a distinctive local cultural value) into physics education. Unlike conventional teacher training programs that predominantly emphasize pedagogical mastery, this initiative foregrounds socio-cultural empowerment and the cultivation of community-rooted practices. Integrating Wasaka creates a culturally grounded learning model that makes physics education more relevant, inspiring, and contextual. Furthermore, the strengthening of MGMP (Teacher Working Groups) management supports long-term sustainability, ensuring that the program yields institutional rather than solely individual benefits. This innovation presents a replicable model for other regions and enriches the broader discourse on culturally grounded physics learning and 21st-century skill development.

METHODS

A solution to the issue of teachers not yet integrating learning that addresses students' real-life problems is the organization of a Workshop on the Application of Creative Problem Solving through Educational Robotics to Foster Wasaka Character. The rationale behind this program is closely aligned with the expected outcomes, particularly the enhancement of teachers' socio-community empowerment through improved skills, knowledge, and cultural pedagogical capacity. Educational robotics provides a rich, hands-on learning environment that does not merely engage students in technical tasks but also promotes the development of character and values (Asri, 2018; Ayuningtyas et al., 2025; Syahmani et al., 2025). The processes of assembling and troubleshooting robotic components require diligence, patience, and consistency—values that resonate with the Wasaka spirit of resilience, perseverance, and determination. When students encounter circuit failures or programming errors, they learn to persist, refine their strategies, and maintain commitment to achieving functional outcomes. Through these authentic experiences, the Wasaka character is internalized not only conceptually but also through lived practice.

Moreover, integrating educational robotics within the Creative Problem-Solving framework facilitates collaboration, communication, and cooperative decision-making. Working in teams to identify problems, propose solutions, and distribute tasks fosters a culture of gotong royong, which aligns with local cultural values while simultaneously strengthening 21st-century competencies. The use of robotics in this context thus becomes a culturally responsive pedagogical approach that unites STEM learning,

creative problem solving, and character formation. By grounding the development of scientific and technological skills in local cultural values, this program supports the broader objective of cultivating a resilient, adaptive young generation imbued with the Wasaka character. This theoretical and contextual foundation provides the justification for integrating CPS-based educational robotics into physics education and serves as the conceptual basis for the workshop implemented in this program. The stages of community service are shown in Figure 1.

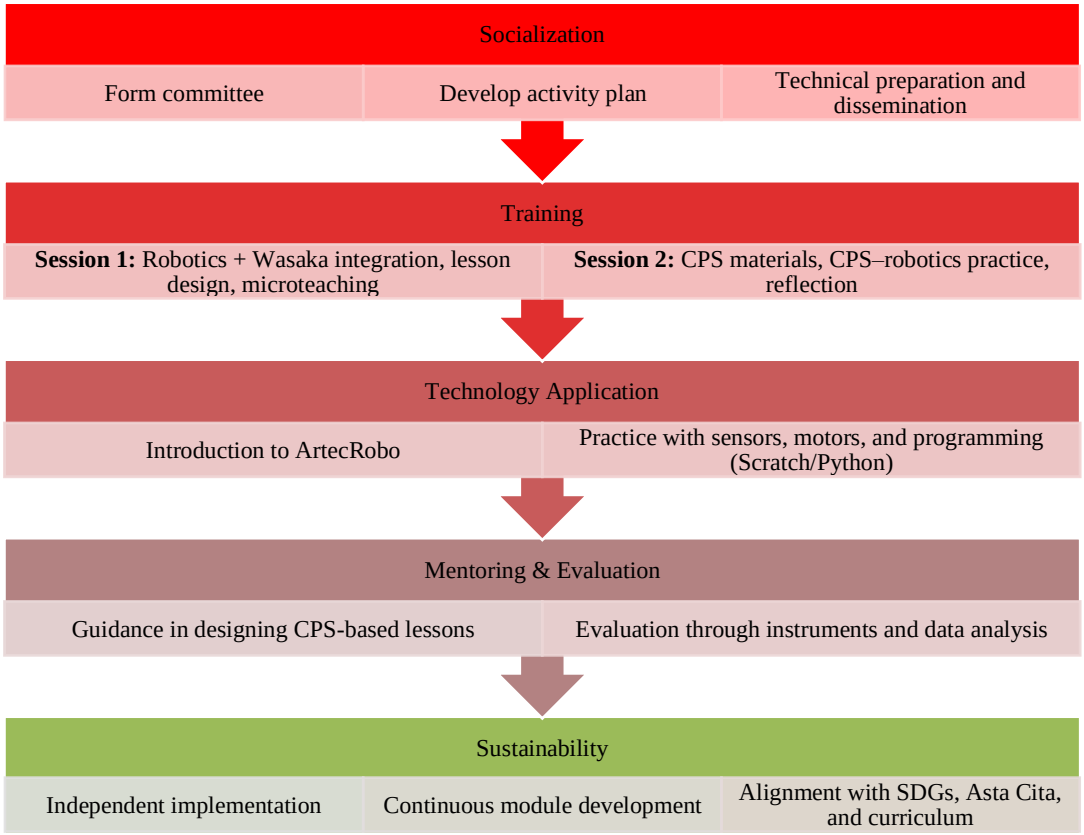

Figure 1 Stage of community service

As seen in Figure 1, the first stage was socialization, beginning with the formation of the committee, the design of the activity plan, participant recruitment, and various technical preparations. The event rundown was designed by incorporating feedback from the partners to align with field needs. Participants consisted of teachers who are members of the partner MGMP, coordinated directly by the MGMP Chair. At this stage, students who were members of the community service team also played an active role in disseminating information and ensuring the success of participant recruitment.

The second stage was the training, which formed the core of the community service activity. The entire team—consisting of the chair, faculty members, students, and field assistants—actively participated in facilitating the implementation. The partners acted as training participants who were guided to understand and apply physics learning through educational robotics. The training was conducted in two sessions. The first session focused on the implementation of educational robotics to instill the Wasaka character, with materials covering the design of robotics-based learning and microteaching simulations. The second session concentrated on the development of CPS-based learning

materials and hands-on practice of integrating CPS with robotics in the classroom, as well as group reflection and evaluation.

The third stage was the application of technology, in which the community service team provided a web-based learning resource to ensure that the benefits of the activity would not end with the training alone. The technology used was *ArtecRobo*, an educational robotics kit for STEM learning equipped with light sensors, sound sensors, infrared photoreflectors, DC motors, and LEDs. This kit enables students to design interactive robots. Moreover, ArtecRobo is compatible with Scratch 3.0 and Python, which allows students to learn programming logic from basic to advanced levels. Through this technological application, teachers gained hands-on experience in utilizing robotic devices as a medium for contextual, creative, and digitally relevant learning.

The fourth stage was mentoring and evaluation, which served to strengthen the sustainability of the training outcomes. Teachers were guided in designing CPS-based lessons by drawing upon real-world problems from society, thereby making learning more contextual and relevant. The evaluation process was conducted using instruments distributed to participants to assess the extent to which the program's objectives were achieved. The results were analyzed by calculating average scores, with the program deemed successful if it achieved at least a "good" category.

The final stage was program sustainability. At this stage, teachers were expected to be able to independently implement CPS-based teaching modules through educational robotics in physics classrooms. The teaching modules that had been designed and practiced during the program could serve as ongoing references, enabling teachers to update and further develop them in line with contemporary demands, the SDGs, *Asta Cita*, and the current curriculum. Thus, this program not only enhanced teachers' skills in the short term but also created a long-term impact by fostering a culture of CPS-and robotics-based learning to cultivate the Wasaka character among students.

RESULTS AND DISCUSSION

The implementation of the community service activity in the form of the *Workshop on the Application of Educational Robotics to Foster Wasaka Character* was carried out in accordance with the planned methodology. Overall, the activity ran smoothly and received positive responses from the partners, including both physics teachers and the MGMP Madrasah Aliyah of Hulu Sungai Selatan Regency.

The first stage was the socialization, conducted on July 21, 2025, at MAN 2 Hulu Sungai Selatan. The activity was attended by the MGMP chairperson, teacher representatives, and the community service implementation team. At this stage, discussions were held regarding the objectives of the activity, the urgency of integrating Wasaka character into physics learning, and the design of the upcoming workshop. The partner teachers showed high enthusiasm, as this activity was considered a breakthrough in teacher competency development, particularly in aspects of problem-solving-based learning, which had not been widely implemented. The socialization also served as a platform to gather input from the partners regarding technical implementation, ensuring that the event's rundown would be better aligned with field needs.

The second stage was the implementation of the workshop, held on August 7, 2025, at SMAN 1 Kandangan. The workshop was attended by 15 physics teachers who are members of the MGMP, with full support from the host school. The activity began with a presentation on the Wasaka values (*Waja Sampai Kaputing*), which emphasize resilience, perseverance, and consistency in facing challenges. The participants noted that integrating this local cultural value provided them with a new perspective in designing meaningful physics learning—not only focusing on cognitive aspects but also fostering

students' character development. A presentation on educational robotics is shown in Figure 2.

Figure 2 Presentation on educational robotics

The main session of the workshop focused on hands-on practice with educational robotics. Teacher participants were introduced to the ArtecRobo kit as a STEM-based learning medium. They were then divided into small groups to assemble simple robots, test sensor functions, and perform basic programming. This process provided teachers with direct experience of how assembling robots can foster accuracy, perseverance, and resilience—qualities that align with the Wasaka character. Direct practice in the field of robotics is shown in Figure 3.

Figure 3 Hands-on practice in robotics

Several groups encountered technical difficulties, such as circuits not functioning or programs not running as expected. However, these challenges became valuable learning moments, as teachers practiced critical thinking, troubleshooting, and collaborative problem-solving within their groups.

In addition, during group discussions, participants realized that teamwork in addressing robotics-related technical issues directly reflected the principle of *gotong royong*, which is an integral part of local culture. This finding highlights that the application of robotics not only sharpens technical abilities but also fosters social aspects and character values within the learning process. The robotics practice session is shown in Figure 4.

Figure 4 Robotics practical session

The implementation of community service in the form of a Workshop on the Application of Educational Robotics to Foster Wasaka Character, held with the Physics MGMP of Madrasah Aliyah in Hulu Sungai Selatan Regency, was successfully carried out in accordance with the planned stages. The results showed an increase in teachers' understanding of physics learning supported by robotics media, along with the integration of Wasaka values (Waja Sampai Kaputing). Teachers not only gained technical skills in assembling and programming robots but also directly experienced how this process cultivates perseverance, collaboration, and problem-solving abilities. The integration of Wasaka values proved to be more effective when delivered through authentic experiences rather than theoretical explanations. In addition, group activities in robotics practice strengthened 21st-century skills such as communication, collaboration, and teamwork, all of which align with Wasaka character. The participants' response was very positive, with the majority of teachers stating that the workshop was beneficial and motivated them to implement it in their classrooms.

Observations revealed that most participants showed improved understanding of how to integrate Wasaka values through robotics media. They were also able to design initial drafts of physics learning scenarios utilizing robotics as a medium. These drafts were then reviewed in feedback sessions, where the community service team provided suggestions to make the designs more applicable and aligned with the curriculum. The third stage, mentoring and preliminary evaluation, was also carried out briefly after the workshop. Teachers were asked to fill in evaluation questionnaires regarding the achievement of workshop objectives. The results showed that 87% of participants considered the program highly beneficial and provided new learning experiences. Furthermore, 80% stated that they were motivated to integrate robotics and Wasaka values into their physics teaching. The main challenges identified were limited practice time and the availability of robotics kits in schools, which serve as important notes for program sustainability.

Discussion of the results indicated that the workshop significantly contributed to improving teachers' skills. The application of educational robotics proved relevant for building critical thinking, problem-solving, and collaboration, while simultaneously integrating Wasaka values as local cultural heritage. The success of this activity aligns with the theory of contextual teaching and learning (CTL), which emphasizes linking academic learning to real-life experiences and socio-cultural contexts. Moreover, this approach strengthens the implementation of character education based on local wisdom as emphasized in the Merdeka Belajar (Freedom to Learn) policy.

Thus, it can be concluded that this program not only enhanced teachers' pedagogical capacities but also enriched their understanding of integrating science, technology, and culture. However, for more sustainable impact, further support is needed in the form of

robotics equipment provision in schools and continuous mentoring to develop teaching modules based on Wasaka values.

The Workshop on the Application of Educational Robotics to Foster Wasaka Character, carried out with the Physics MGMP of Madrasah Aliyah in Hulu Sungai Selatan Regency, demonstrated significant achievements in pedagogical, social, and cultural aspects. The analysis of this program was based on observations, joint reflections with participants, and evaluations through questionnaires and interviews. Before the workshop, most partner teachers (93.33%) had never integrated Wasaka values into physics teaching and were still accustomed to using lecture-based methods and procedural exercises. Through two training sessions, teachers were guided to design teaching materials supported by educational robotics. The evaluation results showed increased teacher awareness of the importance of contextual learning that connects physics with real-life phenomena. Teachers were able to develop robotic-based learning scenarios, such as using light sensors and DC motors to explain energy, motion, and waves—indicating a paradigm shift from rote learning toward experiential learning.

Hands-on practice in robot assembly became an essential experience for teachers to understand how Wasaka character could be cultivated in students. The process required perseverance, patience, and the ability to troubleshoot. When errors occurred in circuits or programming, participants learned not to give up but to keep trying until successful. This aligns with the principle of *Waja Sampai Kaputing*, a core value of Banua society. Therefore, this program proved that Wasaka character is more effectively taught through authentic experiences involving real challenges, rather than through lectures or theoretical value explanations.

Furthermore, robot assembly and programming were conducted in groups, allowing teachers to directly experience how collaboration, communication, and teamwork could be developed. Participants shared roles, engaged in discussions, and worked together to find solutions. These values not only align with 21st-century skills but also reflect the communal culture of Banua society. This became an important lesson for teachers that physics is not merely a transfer of abstract concepts but also a medium for fostering students' social skills.

The use of digital technology in physics learning also became a vital aspect of the program. The application of ArtecRobo, compatible with Scratch 3.0 and Python, introduced teachers to programming logic while linking it to physics concepts. Participants responded positively, noting that robotics technology made learning more engaging, interactive, and relevant to the digital era. Moreover, the development of a web-based learning resource ensured the sustainability of the program, as teachers now have continuous access to resources and teaching modules beyond the training sessions. The program also had socio-cultural impacts, particularly in strengthening local identity. Integrating Wasaka values into physics learning reaffirmed that science cannot be separated from cultural context. Participants expressed that this approach made learning more meaningful and relevant since students were encouraged to connect science with familiar local wisdom. This is consistent with studies in culturally responsive teaching, which highlight that linking knowledge with cultural background increases learning motivation, builds cultural literacy, and strengthens student identity. Thus, the workshop not only enhanced teachers' pedagogical skills but also contributed to preserving Banua cultural values in a modern context.

Evaluation results showed that most teachers rated the workshop as good to very good. They felt more confident in designing lessons, understood how to integrate Wasaka values, and expressed commitment to applying the teaching modules produced. The main challenges noted were limited time and robotics laboratory facilities in schools, meaning

full implementation still requires additional support. However, the availability of modules, mentoring, and online learning resources could serve as solutions to minimize these obstacles.

Overall, this workshop effectively enhanced teachers' pedagogical competence, cultivated Wasaka character through authentic robotics practice, supported the achievement of 21st-century skills, and connected science with local culture—making physics learning more contextual and meaningful. With continued development, this approach has the potential to strengthen student identity, improve competitiveness, and nurture a resilient, adaptive young generation ready to face future challenges.

To ensure the sustainability of this program, follow-up activities are essential so that the improvements in teachers' skills continue to develop beyond the initial workshop. Periodic mentoring, peer-sharing forums, and classroom implementation monitoring can help maintain the momentum of integrating educational robotics with Wasaka character. In the long term, the program has the potential to create a continuous impact by fostering a community of practice among physics teachers who consistently collaborate, innovate, and embed local cultural values in STEM learning. Over time, such sustained efforts are expected to strengthen students' character development and problem-solving abilities in real-life contexts.

CONCLUSION

The implementation of the community service program in the form of a workshop on the application of educational robotics to foster Wasaka Character, held in collaboration with the MGMP Physics in Hulu Sungai Selatan Regency, was successfully carried out according to the planned stages. The results indicated an increase in teachers' understanding of physics learning supported by educational robotics, along with the integration of Wasaka values (Waja Sampai Kaputing). Teachers not only gained technical skills in assembling and programming robots but also directly experienced how these processes cultivated perseverance, collaboration, and problem-solving abilities.

The integration of Wasaka values proved to be more effective when delivered through authentic experiences rather than mere theoretical explanations. Furthermore, group activities in robotics practice reinforced 21st-century skills such as communication, teamwork, and mutual cooperation, all of which align with Wasaka character. The participants' responses were highly positive, with the majority of teachers stating that the program was beneficial and that they were motivated to implement it in their classrooms.

Future research is recommended to examine the long-term impact of integrating educational robotics and Wasaka character on students' learning outcomes, classroom engagement, and character development across different school contexts. Longitudinal studies and comparative designs could provide deeper insights into the sustainability and broader applicability of this culturally grounded robotics-based learning model.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

All authors played active roles and were involved in every stage of preparing this article, starting from conceptualizing the idea, collecting data, implementing the activities, and analyzing the results to writing the manuscript. The authors also jointly carried out revisions and approved the final version of the article for publication.

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