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Development of a STEAM-based adaptive curriculum integrating civic and character competencies for inclusive elementary education

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Abstract

The growing number of students with special needs in inclusive elementary schools necessitates the development of adaptive and flexible curricula that can accommodate diverse learning needs and support holistic development. This study aims to develop and evaluate the feasibility and practicality of a STEAM-based adaptive curriculum integrated with civic and character values in inclusive elementary education. This study employed a Research and Development (R&D) approach based on the ADDIE model, consisting of five phases: analysis, design, development, implementation, and evaluation. Data were gathered through questionnaires, interviews, classroom observations, and expert validation, involving students with diverse learning needs, including dyslexia, high-functioning autism spectrum disorder (ASD), and slow learning profiles. The developed curriculum includes adaptive learning objectives, contextual themes, STEAM-based project activities, differentiated instruction, and adaptive assessment aligned with Universal Design for Learning (UDL) principles. Civic and character values such as empathy, responsibility, cooperation, and self-confidence are systematically embedded in learning activities. The results of expert validation indicate that the curriculum is highly feasible, while teacher responses demonstrate its practicality and ease of implementation in inclusive classroom settings. These findings suggest that the developed curriculum provides a structured and accessible framework for inclusive student-centered learning and contributes to adaptive STEAM-based curriculum development with character integration. Further research is recommended to examine its effectiveness on student learning outcomes.

Introduction

The increasing enrollment of students with special needs in regular schools in Indonesia reflects the expanding implementation of inclusive education policies aimed at ensuring equal access to quality education. Inclusive education emphasizes the provision of responsive learning environments that accommodate diverse learner characteristics and optimize individual potential (Ahmadi, 2022; Astawa, 2021). In elementary education, inclusive practices are intended not only to improve academic outcomes

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but also to support students' cognitive and socio-emotional development, and character development, particularly in promoting social awareness, empathy, and respect for diversity, which are central to civic education (Molina Roldán et al., 2021).

Despite these policy advancements, the application of inclusive education in elementary schools is still uneven and encounters considerable challenges (Romadhon et al., 2021). Previous studies show that teachers often lack the pedagogical capacity to design differentiated instruction that addresses diverse learning needs (Hamidaturrohmah, 2023). In addition, structural constraints such as limited accessibility, insufficient adaptive learning resources, and shortages of special education support personnel further hinder effective implementation (Sari & Hendriani, 2021; Wulandari & Setiawan, 2023). More critically, the prevailing curriculum in many schools remains standardized and content-oriented. This limits flexibility to accommodate learner diversity and restricts opportunities for holistic development beyond academic achievement (Aksoy, 2021). As a result, inclusive practices often fail to fully support meaningful learning experiences as well as character development.

To address these challenges, the development of an adaptive curriculum has been identified as a crucial strategy in inclusive education. An adaptive curriculum enables the adjustment of learning objectives, instructional strategies, materials, and assessment based on students' abilities and learning profiles (Moberg et al., 2020). Such flexibility supports more personalized learning experiences and contributes to the development of life skills, social competencies, and character values essential for participation in school and society. However, current adaptive curriculum practices are often fragmented and lack systematic integration with innovative pedagogical approaches. In this context, (Aini et al., 2024) found that differentiated teaching modules are positively perceived by teachers as an effective way to accommodate diverse learning needs and increase student engagement, despite ongoing implementation challenge. Building on this instructional perspective, the Science, Technology, Engineering, Arts, and Mathematics (STEAM) approach has become a promising framework for fostering interdisciplinary and student-centered learning. STEAM-based learning engages students in solving real-world problems through inquiry and project-based activities, thereby enhancing creativity, collaboration, and problem-solving skills (Syahmani et al., 2021). In addition, STEAM learning contributes to the development of character values such as responsibility, perseverance, cooperation, and self-confidence (Garbenis & Kaffemaniene, 2025). These competencies align with the goals of civic education in fostering active and socially responsible learners.

STEAM also provides pedagogical flexibility that supports students with special needs. Through multimodal learning such as visual design, hands-on experimentation, storytelling, and technological interaction, STEAM accommodates diverse sensory and cognitive learning profiles. This is particularly beneficial for students with dyslexia or mild autism who require alternative pathways for understanding (Nurdiyanso et al., 2025). Moreover, STEAM enables differentiation in learning processes and products, enabling students to express their understanding through diverse forms such as models, drawings, digital projects, or performances. This flexibility enhances engagement and accessibility in inclusive classrooms (Mansour et al., 2026).

Nevertheless, existing studies on STEAM-based instruction in elementary education have largely emphasized improvements in students' academic achievement and engagement through project-based learning approaches (Amran & Arismunandar, 2025). However, these studies are predominantly conducted in non-differentiated classroom settings, with limited attention to learner diversity and curriculum adaptation for students with special educational needs. Although previous research highlights that STEAM contributes positively to learning outcomes, most studies remain fragmented and focus on isolated classroom activities rather than coherent curriculum-level integration within inclusive education contexts (Efwinda et al., 2025; Pettersson, 2021).

Furthermore, Universal Design for Learning (UDL) has been widely discussed as a framework for inclusive instruction; however, its implementation is often separated from STEAM-based pedagogical practices, resulting in a lack of integrated instructional models that simultaneously address differentiation, inclusion, and interdisciplinary learning (Ewe & Galvin, 2023). In addition, teachers continue to report

insufficient practical guidance for implementing differentiated STEAM learning in inclusive classrooms, particularly in relation to adapting instruction for students with diverse learning needs (Mullick et al., 2025). These findings indicate that while individual components such as STEAM, differentiation, and inclusive pedagogy have been widely studied, there is still a lack of comprehensive curriculum models that integrate these elements into a unified adaptive framework for inclusive elementary education. This fragmentation is not only a conceptual limitation but also a practical barrier, as it prevents teachers from translating inclusive pedagogical principles into consistent classroom practices that address the full diversity of learners. This gap becomes more critical given that inclusive education extends beyond academic achievement to foster civic values, social responsibility, and character development in diverse classrooms.

Accordingly, this study is intended to develop a STEAM-based adaptive curriculum that integrates inclusive pedagogy with civic and character competencies in elementary education. The research is guided by the following questions: (1) How can a STEAM-based adaptive curriculum be developed to support inclusive elementary education? (2) How can the curriculum integrate inclusive pedagogy, differentiated instruction, and civic-character competencies in classroom practice? The proposed curriculum is expected to provide a systematic and practical framework for addressing learner diversity while supporting academic achievement, social development, and character formation (Nufa & Istichomahwati, 2025) in inclusive classrooms. The novelty of this study is the development of a STEAM-based adaptive curriculum that integrates inclusive education principles, differentiated instruction, and civic-character competencies into a single coherent framework for inclusive elementary learning.

Methods

This research used a Research and Development (R&D) design to create a STEAM-based adaptive curriculum for inclusive elementary education that integrates humanistic values and character education. The development followed the ADDIE model, which includes five phases: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was chosen because it offers a structured and iterative approach for designing, developing, and assessing educational products. The purpose of this study was to produce a STEAM-based adaptive curriculum model that supports students' skills and character development through a humanistic approach in inclusive elementary classrooms. The complete research procedure based on the ADDIE model is presented in Figure 1.

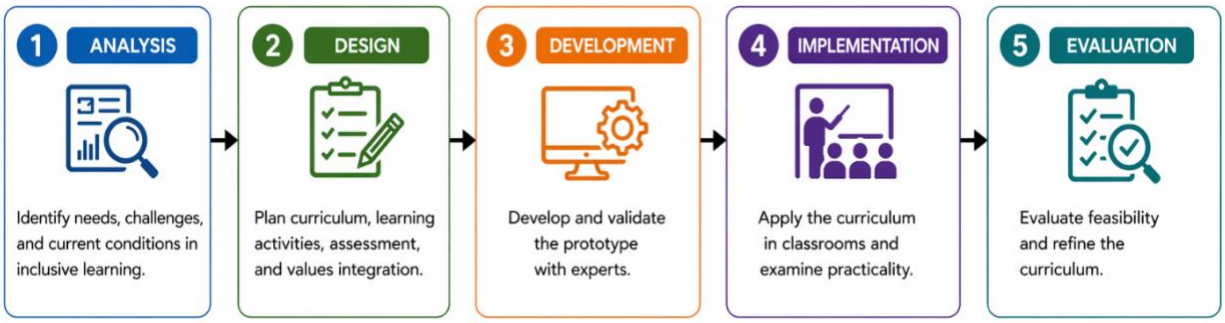

Figure 1. Research Procedure Using the ADDIE Development Model

Analysis Stage

The analysis stage was conducted to identify the needs and challenges associated with implementing inclusive learning in elementary schools. Data were collected through literature review, teacher questionnaires, interviews with teachers and school principals, and classroom observations. The analysis focused on learner characteristics, educational barriers faced by students with special needs, classroom conditions, and limitations of the existing curriculum. In addition, attention was given to the integration of character values and humanistic principles in current instructional practices.

Design Stage

Based on the needs analysis, the curriculum framework was designed by formulating learning objectives, STEAM-based learning activities, and adaptive assessment strategies. The design incorporated project-based learning and the core principles underlying Universal Design for Learning (UDL) to ensure accessibility for diverse learners. Furthermore, humanistic values (empathy, respect, and student-centered learning) and character values (responsibility, cooperation, and self-confidence) were systematically embedded into the learning activities.

Development Stage

At this stage, a prototype of the adaptive curriculum was developed, including curriculum guidelines, STEAM-based project activities, teacher instructional guides, and adaptive assessment instruments. The prototype was validated by experts in inclusive education, curriculum development, and STEAM learning. The validation process aimed to evaluate content relevance, instructional design, accessibility, and the integration of humanistic and character values.

Implementation Stage

A limited pilot implementation was conducted in inclusive elementary classrooms in Jepara Regency. The developed curriculum was implemented by classroom teachers during regular learning activities involving students with diverse needs. This stage focused on examining the practicality and usability of the curriculum from the teachers' perspective. Classroom observations were conducted to document how teachers implemented and adapted the curriculum in inclusive settings.

Evaluation Stage

The evaluation stage aimed to assess the practicality and feasibility of the developed curriculum based on teacher responses. Data were primarily collected through teacher questionnaires and supported by classroom observations. The evaluation focused on aspects such as ease of use, flexibility, instructional clarity, and relevance of STEAM-based activities, including the integration of civic and character values. The results of this stage were used to refine the developed curriculum.

Participants and Data Collection

Participants included classroom teachers, special assistant teachers, school principals, and students with special needs, including dyslexia, high-functioning autism spectrum disorder (ASD), and slow learning profiles, from inclusive elementary schools in Jepara, selected through purposive sampling. Teachers and school principals served as evaluators of the developed curriculum, while students were involved in the pilot implementation phase. Data were collected using questionnaires, interviews, observation sheets, and expert validation forms. The questionnaire (five-point Likert scale) assessed feasibility, clarity, relevance, and usability. Interviews and observations provided supporting qualitative data, while expert validation examined alignment with inclusive education principles, STEAM approaches, and the integration of civic and character values.

Table 1. Aspects of Expert Validation for the STEAM-Based Adaptive Curriculum

Aspects	Functions
Curriculum Relevance	Evaluating alignment with inclusive education and diverse student needs
Content Feasibility	Assessing suitability for students with special needs
Instructional Design	Evaluating clarity and execution process of STEAM-based learning
Accessibility (UDL)	Assessing the application of UDL principles
Assessment Strategy	Evaluating adaptive and differentiated assessment methods
Humanistic Values Integration	Assessing integration of empathy, respect, and student-centered learning

Aspects	Functions
Character Development Integration	Evaluating development of responsibility, cooperation, and self-confidence

Qualitative findings gathered through interviews and observations were analyzed using the interactive model developed by Miles and Huberman, which includes data reduction, data presentation, and conclusion drawing (Miles, Matthew B., 2014). Meanwhile, quantitative data obtained from questionnaires and expert validation were processed using descriptive statistical analysis to assess the feasibility and practicality of the developed curriculum. The validation instrument used a five-point Likert scale ranging from 1 (very poor) to 5 (very good). Although Likert scale data are ordinal, they were treated as interval data to enable the calculation of mean scores, a procedure commonly applied in educational research. The mean scores obtained from expert validation were used to determine the overall feasibility level of the developed curriculum. The results were then categorized into several levels (very feasible, feasible, less feasible, and not feasible) based on predetermined score intervals adapted from commonly used Likert scale interpretation guidelines. The use of mean scores enables the aggregation of expert judgments into a single representative value, providing a clearer overview of the overall quality and feasibility of the developed curriculum. The combination of qualitative and quantitative data allowed for a comprehensive evaluation of the developed curriculum.

Results

This study resulted in the development of a STEAM-based adaptive curriculum module intended for students with special needs in inclusive elementary schools. The curriculum was created using the ADDIE development model, which consists of the Analysis, Design, Development, Implementation, and Evaluation stages. The results revealed that the developed curriculum achieved a high level of feasibility and has the potential to support the improvement of students' skills and character development within inclusive learning environments.

Needs Analysis Results (Analysis Stage)

The analysis stage aimed to identify the learning needs of students with special needs as well as the current conditions of inclusive education implementation in elementary schools. Data were collected through teacher questionnaires, interviews with teachers and school principals, classroom observations in inclusive classes, and analysis of curriculum documents used in schools. The analysis focused on the characteristics of students with special needs who participated in this study. Identifying students' characteristics is essential to understand their diverse learning needs so that the development of an adaptive curriculum can be designed more appropriately. Based on the identification conducted in two inclusive elementary schools, several types of special needs were found with varying conditions. Most students demonstrated slow learner characteristics, mild autism spectrum disorder, and specific learning difficulties such as dyslexia, which require more flexible instructional approaches, the use of varied learning media, and contextual and multisensory learning strategies.

The results of the analysis indicate that most teachers do not yet have systematic adaptive curriculum guidelines to accommodate the learning needs of students with special needs. Learning planning is still largely based on the regular curriculum with only limited informal adjustments. Teachers also reported difficulties in adapting learning objectives, instructional strategies, learning materials, and assessment systems to match students' diverse abilities and learning characteristics. Classroom observation results showed that the learning process still tends to be uniform and teacher-centered. This condition limits the participation of students with special needs in classroom activities. In addition, learning activities rarely provide opportunities for students to engage in exploration, collaborative work, or problem-solving activities connected to real-world situations.

The teacher questionnaire results also provide a quantitative overview of teachers' needs for adaptive curricula in inclusive classrooms. The findings show that approximately 75% of teachers experience difficulties in adapting the curriculum to meet the learning needs of students with special needs. In addition, 85% of teachers reported the need for systematic guidance in designing inclusive learning. Only 30% of teachers have implemented STEAM-based learning, while 30% of teachers have applied differentiated assessment in their teaching practices. The detailed results of the teacher needs analysis are presented in Table 2.

Table 2. Teachers' Needs for Adaptive Curriculum in Inclusive Classrooms

Indicator	Percentage
Teachers experiencing difficulty adapting the curriculum	75%
Teachers needing guidance for inclusive instruction	85%
Teachers who have implemented STEAM-based learning	30%
Teachers using differentiated assessment	30%

These findings indicate that teachers in inclusive elementary schools require practical guidelines and structured curriculum models to support the implementation of inclusive learning. The limited implementation of STEAM-based learning and differentiated assessment suggests that innovative instructional approaches capable of accommodating diverse student needs are still rarely applied. Therefore, the results of the needs analysis highlight the importance of developing an adaptive curriculum that is flexible, contextual, and practical for teachers, while integrating STEAM-based learning approaches to support the development of skills and character among students with special needs in inclusive elementary education.

Curriculum Design Results (Design Stage)

As indicated by the results of the needs analysis, the design stage generated a conceptual framework for a STEAM-based adaptive curriculum to foster skill development and character building among students with special needs. The curriculum structure consists of several key components: adaptive learning objectives, contextual learning themes, STEAM project-based learning activities, adaptive learning strategies, and differentiated assessment systems. The curriculum design aims to provide a flexible learning framework that allows teachers to adjust learning activities according to the abilities and characteristics of students with special needs. In addition, the curriculum is designed to encourage students' active engagement through exploratory, collaborative, and problem-based learning activities.The structure of the STEAM-based adaptive curriculum developed in this study is presented in Table 3.

Table 3. Structure of the Developed STEAM-Based Adaptive Curriculum

Curriculum Component	Description
Adaptive Learning Objectives	Flexible learning objectives tailored to the abilities and learning needs of students with special needs
Contextual Learning Themes	Learning themes related to students' daily lives to enhance meaningful learning experiences
STEAM Project Activities	Project-based learning activities integrating science, technology, engineering, arts, and mathematics
Adaptive Learning Strategies	Differentiated learning strategies utilizing multisensory activities, group work, and exploration
Assessment Strategies	Process-based assessment including portfolios, performance tasks, and observation of students' learning progress

The curriculum design also integrates the principles of Universal Design for Learning (UDL) to ensure that learning is accessible to all students with diverse learning characteristics. Through this approach,

students are provided with multiple ways to understand the material, express ideas, and take an active role in the learning process. The output of this stage is a draft of a STEAM-based adaptive curriculum module, which serves as the foundation for further development.

Curriculum Development Results (Development Stage)

At the development stage, the curriculum design was transformed into a comprehensive and systematic STEAM-based adaptive curriculum module for use in inclusive elementary schools. The developed curriculum module includes several key components: adaptive learning outcomes, contextual learning themes, STEAM-based project learning activities, differentiated learning strategies, adaptive assessment techniques, and implementation guidelines for teachers. Learning activities in the module are designed using a STEAM-based project-based learning approach, encouraging students to engage in inquiry and exploration, experimentation, and collaborative problem-solving. In addition, humanistic values and character education are integrated into learning activities through group work, reflective practices, and project assignments that emphasize responsibility, collaboration, and students' self-confidence. After the curriculum module was fully developed, it was organized into a systematic and user-friendly format for teachers prior to the expert validation process.

STEAM-Based Adaptive Curriculum Model

Based on the needs analysis and development process, this study proposes a conceptual model of a STEAM-based adaptive curriculum for inclusive elementary education. This model integrates three main components: 1) An adaptive curriculum that enables differentiation in learning objectives, materials, instructional strategies, and assessment. 2) The approach applies STEAM by integrating science, technology, engineering, arts, and mathematics through project-based learning activities. 3) The principles of Universal Design for Learning (UDL) to ensure accessibility for all students. (4) Humanistic and character integration, including empathy, respect, responsibility, cooperation, and civic values such as tolerance, social responsibility, and collaboration within a student-centered learning environment; and (5) The anticipated learning outcomes include not only cognitive growth but also the development of social interaction skills and character building. This model demonstrates that the needs analysis of students with special needs serves as the foundation for developing an adaptive curriculum. The curriculum is then implemented through STEAM-based learning activities designed to enhance critical thinking, creativity, collaboration, and character values such as responsibility, empathy, and self-confidence.

Expert Validation Results

The feasibility of the STEAM-based adaptive curriculum module was evaluated through a validation process conducted by two experts: a STEAM education expert and an inclusive education expert. The validation process used an assessment instrument covering several key aspects, including curriculum structure, relevance of learning materials, integration of the STEAM approach, and alignment with inclusive education principles. The expert validation aimed to ensure that the developed curriculum meets adequate academic standards and is relevant for implementation in inclusive elementary school contexts. A summary of the findings from expert validation is presented in Table 4.

Table 4. Expert Validation Findings on the STEAM-Based Adaptive Curriculum

Assessment Aspect	Mean Score	Category
Curriculum structure	4.4	Very feasible
Material relevance	4.7	Very feasible
STEAM integration	4.6	Very feasible
Inclusivity principles	4.5	Very feasible

The findings from expert validation indicated that the STEAM-based adaptive curriculum was highly feasible for application in inclusive elementary school settings. The highest score was obtained in the material relevance aspect, indicating that the learning materials have been designed in accordance with the

characteristics and needs of students with special needs. Furthermore, the STEAM integration aspect also received a high score, demonstrating that the interdisciplinary learning approach has been systematically incorporated into the curriculum structure. Overall, these results suggest that the developed STEAM-based adaptive curriculum module has strong quality in terms of curriculum structure, material appropriateness, STEAM integration, and the application of inclusive education principles. Therefore, the curriculum is considered suitable for implementation in inclusive elementary schools.

Implementation Results and Teacher Responses

The implementation was carried out through a small trial in inclusive elementary classrooms in Jepara Regency. STEAM-based project activities like making body dolls, hygiene posters, sensory experiments, healthy food sorting, mini obstacle courses, and cardboard house models, helped students learn in a more active and fun way. These activities also supported character and civic skills, such as responsibility, empathy, self-discipline, and caring for the environment. This study focused on teacher responses, which showed that the curriculum is practical, flexible, and easy to adapt for different student needs. Teachers reported that STEAM projects helped students work together, be creative, solve problems, and interact positively in class. Student participation and cooperation improved during the trial. The teacher questionnaire gave an average score of 85 (very good), showing that the STEAM-based adaptive curriculum is useful and suitable for inclusive elementary schools.

Discussion

This section presents the study's research questions. It presents findings demonstrating that a STEAM-based adaptive curriculum can be systematically developed through the ADDIE model and effectively integrates inclusive pedagogy, differentiated instruction, and civic-character competencies in elementary education. The findings of this study highlight a fundamental issue in inclusive elementary education, namely the lack of a systematic and adaptive instructional framework to assist teachers in meeting diverse student needs. The needs analysis revealed that most teachers still rely on a uniform curriculum and make only limited adjustments when teaching students with special needs. Such practices indicate a gap between inclusive education policy and classroom implementation. Previous studies have emphasized that the effectiveness of inclusive education closely related to curriculum flexibility and teachers' ability to implement differentiated instruction (Cline et al., 2023; Dewi et al., 2025).

From a theoretical viewpoint, this situation is inconsistent with Jean Piaget's constructivist learning theory, which highlights that learners actively build knowledge in accordance with their developmental stage. Students in elementary school, who are generally in the concrete operational stage, require contextual and meaningful learning experiences (Gustafsson, 2024). The lack of adaptive curriculum practices observed in this study suggests that learning has not yet fully aligned with students' cognitive development characteristics. The results further show that teachers experience difficulties in adapting learning objectives, instructional strategies, and assessment methods. The high demand for practical guidance suggests that curriculum adaptation remains a major challenge in inclusive classrooms. In this context, the development of a coherent pedagogical design provides a practical solution to support teachers in implementing more inclusive and responsive learning practices (Prajalani et al., 2021).

This finding is also strongly aligned with Vygotsky's sociocultural theory, especially the concept of the Zone of Proximal Development (ZPD), which highlights the crucial role of instructional scaffolding in education. Without adaptive strategies and structured guidance, teachers may struggle to provide appropriate support that bridges students' current abilities and potential development (Raslan, 2024; Sanders D, 2025). Therefore, the proposed curriculum model can function as a scaffolding tool that assists teachers in facilitating more effective and inclusive learning.

The STEAM-based adaptive curriculum developed in this study offers a flexible framework that integrates interdisciplinary learning through project-based activities (Israel & Wibowo, 2025; Rahman &

Yusmaliana, 2025). Previous research has shown that STEAM approaches can promote active learning and student engagement (Chappell et al., 2025; Filipe et al., 2024; Wang & Lin, 2025). In this study, however, the emphasis is not on measuring learning effectiveness, but on how the curriculum supports teachers in designing more interactive and inclusive learning environments. Teacher responses indicate that the integration of STEAM-based activities facilitates classroom management and helps accommodate diverse learning needs. Despite increasing advocacy for inclusive education, STEAM is still widely implemented as an isolated instructional strategy rather than as part of a curriculum-level system. This limits its effectiveness in heterogeneous classrooms, particularly for learners requiring continuous differentiation. This condition highlights the need for a more structured instructional system that can operationalize inclusive pedagogical principles in classroom practice.

The findings further show that the transformation of STEAM, Universal Design for Learning (UDL), and differentiated instruction into a unified curriculum model represents a key contribution of this study. Unlike previous studies that treat these components separately, this study integrates them within a single ADDIE-based instructional system grounded in real classroom needs. This integration enables more consistent and practical management of learner diversity in inclusive elementary education. Moreover, the proposed model differs from conceptual or fragmented adaptive curriculum frameworks because it is grounded in empirical needs analysis and validated through expert review and classroom implementation. This strengthens both its theoretical robustness and its practical applicability. As a result, the curriculum provides a coherent and context-responsive instructional system for inclusive education practice.

Building on this pedagogical structure, the integration of Universal Design for Learning (UDL) ensures flexible methods of presenting information, engagement, and expression. Consistent with previous studies (Anggraini & Subasno, 2024). teachers perceived UDL as helpful in increasing accessibility and participation in inclusive classrooms. Classroom observations further indicate that the curriculum supports more engaging learning environments, although these findings are interpreted as supportive evidence rather than measures of effectiveness. The key contribution of this research lies in presenting the curriculum as a practical pedagogical tool for inclusive classroom implementation. In addition, the integration of humanistic values within STEAM-based activities aligns with inclusive education principles that promote students' well-being, engagement, and social development (Deroncele-Acosta & Ellis, 2024). These values are closely aligned with civic education goals, particularly in fostering responsibility, empathy, cooperation, and respect for diversity. Teachers reported that students demonstrated positive participation in collaborative activities, indicating the curriculum's potential to support both academic and social learning outcomes, although further research is required to examine its broader impact (Atikah & Biru, 2024).

Teacher responses further indicate that the curriculum is practical, flexible, and applicable in classroom settings. This highlights the importance of providing teachers with structured instructional support to enhance inclusive practices (Leifler, 2020). When such support is available, teachers are more likely to implement student-centered and differentiated learning effectively. From a theoretical standpoint, this study advances the development of inclusive curriculum models by combining constructivist theory (Piaget), sociocultural theory (Vygotsky), Universal Design for Learning (UDL), and humanistic education principles into an integrated instructional framework. Practically, the results indicate that schools and policymakers need to emphasize well-structured curriculum designs and strong professional support systems to improve the implementation of inclusive education. Despite showing high feasibility and practicality, this study is limited to a small-scale implementation and relies on teacher-based evaluations. Therefore, future studies are encouraged to test the curriculum's effectiveness through experimental or quasi-experimental approaches and to investigate its long-term effects on students' academic, social, and emotional development.

Conclusion

This study concludes that inclusive elementary schools need a structured adaptive curriculum to better meet the diverse learning needs of students with special needs. The results of the needs analysis show that teachers still experience difficulties in adapting the curriculum and implementing differentiated instruction, indicating the need for clearer and more practical guidance. Through the ADDIE model, this study developed a STEAM-based adaptive curriculum that integrates adaptive learning objectives, project-based learning activities, differentiated strategies, and Universal Design for Learning (UDL) principles. The results of expert validation suggest that the curriculum is highly suitable for implementation in inclusive classroom settings. The findings from the limited implementation, supported by positive teacher responses, show that the curriculum is practical, flexible, and helpful for teachers in designing more inclusive and engaging learning activities. This curriculum is suitable for implementation among students with mild to moderate learning needs. Thus, the developed curriculum can serve as a practical reference for supporting inclusive teaching practices in elementary schools. However, this study is limited to assessing its feasibility and practicality. Future research is required to evaluate the curriculum's effectiveness in enhancing student learning outcomes through wider implementation and experimental research designs.

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