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TECHNOLOGY-BASED CURRICULUM CONSTRUCTION AND LEARNING PERSONALIZATION: A CONCEPTUAL FRAMEWORK FOR ADAPTIVE CURRICULUM DEVELOPMENT IN JUNIOR HIGH SCHOOLS

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Abstract

This study examines the construction of a technology-based curriculum integrated with learning personalization to support more flexible and adaptive education at the junior high school level. It aims to analyze the relationship between educational technology, personalized learning, curricular flexibility, and adaptability, and to formulate a conceptual framework for curriculum development. The study employs a conceptual approach through a review and critical analysis of relevant literature on curriculum development, educational technology, personalized learning, and adaptive education. The analysis identifies six interconnected components: learning objectives and outcomes; mapping students' needs and learning contexts; pedagogical design and technology selection; flexible and personalized learning implementation; monitoring and evaluation; and curriculum adaptation and improvement. These components are supported by cross-cutting conditions, including teacher competence, educational leadership, infrastructure, accessibility, data ethics, privacy protection, and accountability. The proposed framework positions technology as a pedagogical support rather than an educational end, while personalization enables differentiated learning experiences without compromising common learning outcomes. The framework offers a conceptual foundation for developing a more responsive and equitable junior high school curriculum. However, its applicability and effectiveness require further empirical investigation in diverse educational settings.

Keywords: Adaptive Curriculum; Educational Technology; Junior High School; Learning Personalization; Curriculum Development.

INTRODUCTION

Curriculum development faces increasingly complex challenges in line with digital transformation and the increasing diversity of student needs. The curriculum serves not only as a guide for delivering material but also determines the direction of learning outcomes, educational experiences, pedagogical strategies, and assessment systems. The quality of the curriculum is largely determined by the integration of all these components to support a meaningful learning process. At the junior high school (SMP) level, this challenge becomes crucial because students differ in their prior knowledge, learning pace, interests, readiness, and support needs. Learning that relies too heavily on a uniform approach has the potential to ignore this diversity. Therefore, curriculum development needs to maintain consistent educational standards while allowing for adjustments to student characteristics and needs.

The development of digital technology opens up opportunities to expand access to learning resources, enrich learning media, enhance interaction, and support monitoring of student learning progress. However, the availability of digital devices and platforms does not automatically guarantee improved educational quality. The Global Education Monitoring Report Team (2023) emphasized the importance of aligning educational technology with learning objectives and needs. Similarly, the Organization for Economic Co-operation and Development (OECD, 2023) emphasized the importance of supporting factors that ensure the quality, equity, and efficiency of digital education. Both perspectives demonstrate that the success of technology integration should not be measured by the number of devices or applications used, but rather by its contribution to the pedagogical process and the achievement of educational goals. Therefore, technology should be positioned as an instrument for enhancing learning, rather than as an end in itself in curriculum development.

Another equally important issue is the diversity of students' learning needs. Personalized learning provides the opportunity to tailor learning experiences based on initial abilities, developmental milestones, and individual needs. Tetzlaff et al. (2021) view personalized education as a dynamic process that adapts educational experiences to individual development. In practice, personalization can be realized through a variety of learning resources, learning activities, learning pathways, feedback, and forms of mentoring. However, personalization does not mean that each student must have completely different educational goals. Common learning outcomes and competency standards remain the benchmark, while the process to achieve them can be tailored to each student's individual needs. This distinction is important to prevent personalization from resulting in fragmented learning experiences or reducing the consistency of educational standards.

The integration of technology and personalized learning also require a clear understanding of curriculum flexibility and adaptability. Flexibility allows for adjustments to methods, learning resources, assessment strategies, and learning organization to meet educational needs. Meanwhile, adaptability relates to the ability to respond to information regarding student development and changing learning conditions. The OECD (2024) places curriculum flexibility and autonomy as crucial aspects in creating a learning environment that supports student development. These two concepts are interrelated but have different emphases. Flexibility provides room for adjustments, while adaptivity uses information and evaluation results as a basis for determining the type of adjustments needed. Without clear learning objectives and evaluation mechanisms, flexibility risks resulting in inconsistent practices. Conversely, technology-based adjustments without the professional consideration of educators can result in decisions that are inappropriate for students' circumstances.

Several previous studies have examined important dimensions of this issue. Fariani et al. (2023), through a systematic literature review, analyzed personalized learning in the context of higher education and identified materials and learning pathways as some of the features used in personalized approaches. Du Plooy et al. (2024) examined the characteristics of personalized adaptive learning in higher education, including its relationship to academic performance and student engagement. Furthermore, CAST (2024), through its Universal Design for Learning Guidelines version 3.0, offers principles for learning design that consider learner diversity and reduce barriers to participation. These studies provide an important foundation for understanding personalization, adaptive learning, and inclusive learning design. However, the scope of each study differs. Findings in the context of higher education or learning design cannot be directly generalized to explain curriculum construction at the junior high school level.

Rahmatika and Sulasmi's (2025) study is particularly relevant because it directly addresses the construction of a technology-based curriculum and personalization to achieve more flexible and adaptive education. This closeness of substance necessitates a clear academic position for this article. This paper's contribution is not based on the claim that the integration of technology and personalization has never been discussed, but rather on an attempt to construct a conceptual synthesis that explicitly links learning objectives and outcomes, student needs mapping, pedagogical design, technology selection, flexible learning implementation, monitoring and evaluation, and curriculum improvement. This synthesis also considers the institutional and ethical conditions required for its implementation, including educator competence, educational leadership, infrastructure, accessibility, ethical data use, privacy protection, and accountability. Thus, the framework offered not only identifies the elements that constitute a curriculum but also explains the functional relationships between components in a continuous development process.

Based on this description, this article aims to analyze the integration of educational technology and personalized learning in curriculum construction to support flexibility and adaptability at the junior high school level. Furthermore, this article identifies the supporting conditions and constraints for implementing this integration and formulates a conceptual framework for developing an adaptive curriculum. This study uses a conceptual approach through a review and critical analysis of relevant literature. Therefore, this article does not present empirical findings from specific schools and does not claim that the formulated framework has been proven effective through field testing. Its primary contribution lies in the development of a more structured conceptual model as a foundation for curriculum development and a reference for further empirical research. Further testing is needed to assess the feasibility, contextual relevance, and effectiveness of this framework in various junior high school educational units.

LITERATURE REVIEW

1. Curriculum Construction and Integration of Educational Technology

The curriculum is a framework for organizing education that connects learning objectives, materials, learning experiences, learning strategies, and assessments. Therefore, curriculum construction cannot be understood simply as compiling a list of materials or determining competencies, but rather as a systematic process to ensure that all

educational components support each other. The UNESCO International Bureau of Education (nd) defines curriculum development as a design and refinement process that encompasses objectives, content, methods, and evaluation. This perspective emphasizes that curriculum quality is largely determined by the alignment between the intended competencies and the learning experiences provided.

In the context of digital transformation, educational technology expands the possibilities for planning, implementing, and evaluating learning. The OECD (2023) places digital education within the framework of quality, equity, and efficiency. This means that technology integration needs to be considered as part of educational policy and design, not simply as a matter of device procurement or application use. Technology can enrich learning resources, provide a variety of media, and help educators obtain information about student development. However, these benefits depend on the technology's alignment with pedagogical objectives and the context in which it is implemented.

This view aligns with the Global Education Monitoring Report Team (2023), which cautions that the use of technology in education must be assessed based on its contribution to learning and student interests. The availability of digital devices does not automatically result in improved educational quality. Inequality of access, educator readiness, content quality, and data protection are factors that can determine the success or limitations of its use. Therefore, technology should be positioned as a supporting instrument for achieving curriculum objectives, not as an educational goal in itself.

2. Personalization of Learning and Student Diversity

Personalized learning is an approach that allows for the customization of learning experiences based on the learner's initial abilities, needs, development, and characteristics. Tetzlaff et al. (2021) explain the development of personalized education through a dynamic framework that positions learning customization as an ongoing process. This perspective demonstrates that personalization is not simply achieved by providing a choice of materials; it requires an understanding of learner development and the pedagogical basis for determining the form of customization.

Fariani et al. (2023), through a systematic review of personalized learning in the context of higher education, identified learning materials and pathways as elements widely used in personalization models. The review provides an overview of the variations in personalization applications and demonstrates the need for further research on the impact of implementation and use of learning theories in model development. The strength of this review lies in its systematic literature mapping, but its scope focuses on higher education, so its application at the secondary level requires consideration of student characteristics and the school environment.

In curriculum construction, personalization must be distinguished from the development of entirely individualized educational objectives. Learning outcomes remain the shared goal, while the process of achieving them can be adjusted through variations in materials, methods, tempo, learning resources, forms of feedback, and the intensity of mentoring. Thus, personalization seeks to accommodate student diversity without diminishing competency standards and the educational unit's responsibility for learning quality.

Technology can facilitate personalization by providing diverse materials, monitoring learning activities, and providing feedback. However, recommendations generated by digital systems cannot be treated as definitive pedagogical decisions. Digital information needs to be interpreted in conjunction with assessment results, educator observations, student work, and student conditions. Therefore, responsible personalization still requires the professional role of educators as the primary decision-makers in the learning process.

3. Flexibility and Adaptability of the Curriculum

Flexibility and adaptivity are two related concepts, but they have different emphases. Flexibility refers to the room for adjustment provided in curriculum design, while adaptivity relates to the ability to use information and evaluation results to determine necessary adjustments. The OECD (2024) explains that curriculum flexibility can relate to learning objectives and content, pedagogy, assessment, and learning time management. Thus, flexibility concerns not only the freedom of educators to choose methods but also the distribution of authority and governance of curricular decisions.

Flexibility allows educators to adapt learning strategies to student needs and the conditions of the educational unit. However, this adjustment does not mean that all curriculum components can be changed indefinitely. Learning outcomes, quality standards, and equity principles must still be maintained. Meanwhile, adaptability guides the adjustment process based on information obtained during the learning process. When evaluations indicate learning difficulties, for example, educators can change the sequence of material, provide reinforcement, provide alternative activities, or increase mentoring.

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The relationship between these two concepts can be understood as a cycle. Flexibility provides space for change, while adaptivity determines the direction of change based on needs and evidence of learning. Without flexibility, responding to student diversity can be hampered by overly rigid structures. Conversely, flexibility without continuous evaluation risks resulting in inconsistent adjustments. Therefore, a flexible and adaptive curriculum requires clear objectives, achievement indicators, educator capacity, and accountable evaluation mechanisms.

4. Previous Research and Critical Synthesis

Several studies and conceptual frameworks provide an important foundation for developing a technology-based and personalized curriculum. Rahmatika and Sulasmi (2025) directly address the construction of a technology-based and personalized curriculum to support more flexible and adaptive education. The closeness of these themes indicates that the integration of technology, personalization, flexibility, and adaptability has received attention in the literature. Therefore, the contribution of this article cannot be based solely on combining these terms, but must be demonstrated through synthesis and developed conceptual relationships.

Fariani et al. (2023) provide a mapping of the characteristics of personalized learning, particularly regarding materials and learning pathways. The study's primary contribution is its explanation of the variety of personalization models and the need to develop evidence of implementation. However, its focus on higher education means that the discussion does not directly explain how personalization is embedded in curriculum construction at the junior high school level.

Meanwhile, du Plooy et al. (2024) conducted a scoping review of 69 studies on personalized adaptive learning in higher education. The results showed potential for improved academic performance in most of the studies analyzed and increased engagement in others. However, limited technological resources and time presented implementation challenges. This study reinforces the premise that adaptive learning has pedagogical potential, but findings regarding learning impacts do not necessarily prove that all curriculum components have been systematically integrated. Furthermore, the context of higher education needs to be distinguished from the characteristics of educational delivery at the junior high school level.

CAST (2024), through *its Universal Design for Learning Guidelines* version 3.0, offers learning design principles that take into account learner diversity from the planning stage. This framework emphasizes variation in student engagement, information presentation, and actions and expressions. Its contribution is relevant for building more inclusive learning environments and reducing barriers to participation. However, these learning design principles are not identical to the overall curriculum construction framework. Their integration at the curriculum level still requires a connection with learning objectives, material structure, assessment, resource management, and implementation policies.

Comparatively, these studies and frameworks have complementary focuses. Rahmatika and Sulasmi (2025) discuss technology-based curriculum construction and personalization; Fariani et al. (2023) focus on personalized learning; du Plooy et al. (2024) examine the characteristics and impacts of adaptive learning; and CAST (2024) provides principles for learning design that accommodate learner diversity. These differences in focus demonstrate that each study contributes to a specific aspect, but the relationships between these aspects need to be analyzed in an integrated manner before they can be used as a basis for curriculum construction.

5. Literature Gaps and Conceptual Position of the Article

Based on a synthesis of the literature discussed, the scope for development of this article lies in the need to explain the functional relationship between curriculum objectives, technology utilization, personalization of learning experiences, flexibility of curricular decisions, adaptation based on evaluation, and governance of its implementation. Previous studies provide a foundation for each aspect, but the differences in focus and context require a synthesis that explicitly shows how these components can be connected within a conceptual framework for curriculum development at the junior high school level.

This article offers a conceptual framework that connects six components, namely: (1) learning objectives and outcomes; (2) mapping learners' needs and contexts; (3) pedagogical design and technology selection; (4) flexible and personalized learning implementation; (5) monitoring and evaluation; and (6) curriculum adaptation and improvement. These six components are supported by educator competence, educational leadership, infrastructure, accessibility, ethical data use, privacy protection, and accountability.

Thus, this article's contribution lies in synthesizing the relationships between these components, not in claiming that technology or personalization are entirely new ideas. The framework developed positions technology as a pedagogical support tool, personalization as an approach to tailoring learning experiences, flexibility as a space for decision-making, and adaptivity as a process of adjustment based on information and evaluation. This framework

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is still conceptual, so its suitability, feasibility, and effectiveness for implementation in junior high school education units need to be tested through further empirical research.

METHOD

Research Design

This study employed a *Systematic Literature Review* (SLR) method with a qualitative synthesis approach to identify, evaluate, compare, and synthesize previous research findings on technology integration and personalization in developing adaptive curricula at the junior high school (SMP) level. The SLR method was chosen because it allows for a structured literature review through a search, selection, and analysis process, resulting in a traceable academic basis for the resulting conclusions. The systematic review reporting process adheres to the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) 2020 guidelines, specifically in reporting information sources, search strategies, eligibility criteria, selection processes, and literature synthesis results (Page et al., 2021).

The study focused on five main aspects: curriculum construction, educational technology integration, personalized learning, curriculum flexibility, and learning adaptability. These five aspects were analyzed to understand their conceptual and implementation relationships in curriculum development at the junior high school level. The unit of analysis for this study was scientific publications that met the inclusion criteria. Therefore, the study did not involve respondents, human samples, or primary data collection in educational institutions.

Information Sources and Literature Search Strategies

The literature search was designed using four information sources: Scopus, ERIC, Garuda, and Google Scholar. Scopus was used to reach international scientific publications, ERIC to obtain educational literature, Garuda to identify national scientific publications, and Google Scholar was used as an additional search source. The use of these multiple sources was intended to obtain coverage of international and national literature relevant to the research focus.

The primary publication range was set from January 2021 to November 2026. Literature prior to this range was limited to those with fundamental theoretical contributions to the concepts of personalized learning, curriculum development, or adaptive learning design. The search used Indonesian and English keywords combined with the Boolean operators AND and OR.

Keywords used include “technology-based curriculum,” “educational technology,” “personalized learning,” “personalized learning,” “adaptive learning,” “adaptive curriculum,” “curriculum flexibility,” “curriculum development,” “secondary education,” and “junior high school.” Indonesian keywords include “technology-based curriculum,” “educational technology,” “personalized learning,” “adaptive learning,” “curriculum flexibility,” and “curriculum development.”

The main search strategy is formulated in the following combinations:

1. (“technology-based curriculum” OR “educational technology”) AND (“personalized learning” OR “personalized learning”).
2. (“adaptive learning” OR “adaptive curriculum”) AND (“curriculum flexibility” OR “curriculum development”).
3. (“personalized learning” OR “adaptive learning”) AND (“secondary education” OR “junior high school”).
4. (“educational technology” OR “technology-based curriculum”) AND (“personalized learning” OR “adaptive learning”).
5. (“curriculum flexibility” OR “curriculum development”) AND (“junior high school” OR “secondary education”).

Keyword combinations were adjusted to suit the search features of each information source. The search also took into account publication titles, abstracts, and keywords to ensure results matched the focus of the study.

Inclusion and Exclusion Criteria

Publication selection was based on inclusion and exclusion criteria established prior to the screening process. Inclusion criteria included: (1) publications published between 2021 and 2026 or relevant foundational theoretical literature; (2) discussing at least one major research aspect, namely educational technology, personalized learning, curriculum flexibility, adaptive learning, or curriculum development; (3) having verifiable bibliographic identity; (4) providing abstracts and substantial information that can be used to assess relevance; and (5) having a relationship to primary or secondary education, particularly junior high school, or providing a conceptual foundation relevant to that context.

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Table 1. Literature inclusion and exclusion criteria

Aspect	Inclusion criteria	Exclusion criteria
Year of publication	2021–2026; fundamental theoretical literature can be considered	Out of range and theoretically irrelevant
Publication type	Verifiable scientific articles and academic publications	Popular writing without academic basis
Focus of study	Technology, personalization, flexibility, adaptivity, and curriculum	Not related to the research focus
Context	Primary and secondary education and relevant theoretical literature	Context is not relevant to the purpose of the study
Availability of information	Abstract or full text can be checked	Insufficient information for assessment

Exclusion criteria included: (1) duplicate publications; (2) articles unrelated to the research question and focus; (3) sources lacking adequate bibliographic information; (4) publications not providing substantial information for analysis; and (5) popular writings that do not meet the standards of primary academic sources. Research at the higher education level may still be considered if it provides a theoretical basis or relevant findings, but differences in educational context must be taken into account in the analysis and synthesis process.

Literature Selection Procedure

Literature selection was carried out through the stages of identification, duplication removal, screening, eligibility checking, and determining which publications to include in the final synthesis. During the identification stage, publications were collected based on predetermined keyword combinations. Duplicate publications were then removed to prevent a single article from being counted more than once.

The screening stage involved examining titles and abstracts to assess their relevance to the research focus. Publications that met the initial screening were then reviewed in full text to ensure they met the inclusion and exclusion criteria. Articles that did not meet the criteria were excluded, with the reason for exclusion noted. Publications that met all requirements were then identified as sources in the final synthesis.

The entire selection process is reported using a PRISMA 2020 flowchart. The diagram includes the number of publications found, the number of duplicates removed, the number of publications screened, the number of full-texts reviewed, the reasons for exclusion, and the number of publications ultimately included in the synthesis. Recording was conducted consistently to ensure the selection process is traceable and replicable.

Data Extraction and Literature Quality Assessment

Publications meeting the inclusion criteria were analyzed using a data extraction sheet. Information collected included author names, year of publication, article title, journal name, DOI (publication address), country or research context, educational level, research objectives, methods used, key findings, limitations, and relevance to the study's focus.

Table 2. Components of publication data extraction

No.	Component	Extracted information
1	Identity	Author, year, title, journal, DOI
2	Context	Country and level of education
3	Objective	Focus and research questions
4	Method	Research design and approach
5	Findings	Main results of the study
6	Limitations	Reported limitations
7	Relevance	Relationship to the focus of the article

Publication quality is assessed by considering the clarity of the research objectives, the appropriateness of the design and methods, the adequacy of procedural information, the accuracy of the analysis, the evidential support for the findings, and the relevance of the results to the research question. The assessment is conducted critically so that the synthesis relies not only on the number of publications but also on the strengths and limitations of the available evidence. Differences in research design are taken into account in the assessment, so that articles with qualitative, quantitative, or conceptual approaches are not assessed using the same methodological assumptions.

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Data Analysis and Synthesis Techniques

The data obtained were analyzed using thematic-qualitative synthesis through a process of grouping, comparing, interpreting, and integrating findings. The first stage was grouping publications based on five main themes: curriculum construction, educational technology integration, learning personalization, curriculum flexibility, and learning adaptability. The second stage was a comparative-critical analysis by comparing the objectives, approaches, contexts, findings, and limitations of previous research. The third stage was a conceptual synthesis to identify interrelationships between themes, patterns of findings, differences in perspectives, and aspects requiring further development.

The synthesis results were used to formulate a conceptual framework for developing a technology-based and personalized curriculum at the junior high school level. The framework includes six interrelated components, namely: (1) learning objectives and outcomes; (2) mapping student needs and contexts; (3) pedagogical design and technology selection; (4) flexible and personalized learning implementation; (5) monitoring and evaluation; and (6) curriculum adaptation and improvement. These six components were then analyzed by considering cross-component supporting factors, including educator competence, educational leadership, infrastructure, accessibility, ethical data use, privacy protection, and accountability.

Through these stages, the synthesis aims to produce a comprehensive understanding of the relationship between technology, personalization, flexibility, and adaptability in curriculum development. The resulting framework is a conceptual construct based on reviewed literature. Therefore, the framework is not considered direct proof of the effectiveness of implementation in the field, but rather serves as a theoretical basis that can be tested through subsequent empirical research.

RESULTS AND DISCUSSION

1. Results of Literature Synthesis on Technology Integration and Personalization in Curriculum Development

The literature review indicates that technology integration and personalized learning need to be understood as part of a comprehensive curriculum, not simply the use of digital devices or applications in teaching and learning activities. Technology has the potential to expand access to learning resources, provide a variety of learning activities, support student progress monitoring, and assist educators in providing feedback. However, these benefits are highly dependent on the alignment of technology use with curriculum objectives, pedagogical design, educator readiness, and student conditions. Therefore, the success of technology integration cannot be measured solely by the level of digital device use but must be seen in terms of its contribution to the quality of learning experiences and outcomes.

These findings align with a systematic review by Msafiri et al. (2023) examining the integration of information and communication technology in secondary education. The study demonstrated that technology integration has the potential to support access to learning resources, curriculum coverage, and personalized learning. However, its implementation also faces challenges such as educator professional competence, technology-curriculum alignment, infrastructure maintenance, time constraints, and institutional support. These findings demonstrate that technology does not operate in isolation from the education system but is instead influenced by the pedagogical and organizational readiness surrounding it.

Regarding personalization, the literature demonstrates the importance of tailoring learning experiences based on students' needs, readiness, interests, and development. Personalization does not necessarily result in entirely different learning objectives for each individual. At the junior high school level, core learning outcomes should remain a shared reference, while learning pathways, learning resources, the pace of specific activities, forms of support, and feedback can be adjusted. This perspective aligns with the personalized education framework, which positions the learning process as dynamic and responsive to changing student needs (Tetzlaff et al., 2021).

The synthesis also shows that flexibility and adaptivity are related, but not identical concepts. Flexibility refers to the room for adjustment designed into curriculum implementation, while adaptivity relates to the ability to use monitoring and evaluation information to determine necessary changes. Flexibility provides the possibility for adjustment, while adaptivity guides those adjustments based on needs and available evidence. Therefore, an adaptive curriculum requires clear objectives, evaluation mechanisms, and accountable pedagogical decisions.

Based on the relationships between these themes, this research synthesis yielded six components of a conceptual framework for developing a technology-based and personalized curriculum at the junior high school level. These six components are presented in Table 1.

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Table 1. Results of the Synthesis of the Components of the Adaptive Curriculum Conceptual Framework

No.	Component	Main Focus	Expected results
1	Learning objectives and outcomes	Determination of competencies, materials, and success indicators	Clear and measurable learning directions
2	Mapping of student needs and context	Identify initial knowledge, readiness, interests, support needs, and access	The basis for adapting learning experiences
3	Pedagogical design and technology selection	Determination of strategies, media, learning resources, and assessments	Technology that suits pedagogical needs
4	Implementation of flexible and personal learning	Variety of learning paths, resources, activities, pace, and support	A more relevant learning experience
5	Monitoring and evaluation	Analysis of assessments, assignment results, observations, and feedback	Information about learning development and barriers
6	Curriculum adaptation and improvement	Adjustment of materials, strategies, support, and assessments based on evaluation	Continuous curriculum improvement

Source: Author's conceptual synthesis based on the reviewed literature.

These six components form an interconnected cycle. Learning objectives and outcomes serve as the starting point, while monitoring and evaluation results form the basis for determining subsequent adjustments. Mapping student needs connects curriculum objectives with actual learning conditions. Next, pedagogical design determines how technology is appropriately used, while learning implementation provides space for a variety of learning experiences. Evaluation results are then used to improve curriculum design and implementation.

This framework also demonstrates that several supporting factors operate across all components. These factors include educator competence, educational leadership, infrastructure availability, accessibility, ethical data use, privacy protection, and accountability. These factors are not viewed as standalone stages, but rather as conditions that determine the quality of each component's implementation.

2. Discussion: The Meaning of Technology Integration and Personalization for the Junior High School Curriculum

The synthesis results reinforce the view that technology-based curriculum development should begin with educational needs, not the availability of digital devices. Technology should be selected after learning objectives, student characteristics, pedagogical strategies, and assessment formats have been determined. This principle is crucial because the use of technology that is not directly related to learning outcomes risks becoming an additional activity that makes no meaningful contribution to the educational process. UNESCO (2023) also reminds us that the use of technology in education needs to be assessed based on its relevance, equity, and contribution to learning, not solely on the sophistication of the devices used.

In the context of junior high school, this principle is crucial because students are at a developmental stage that exhibits diverse abilities, interests, readiness, and support needs. Therefore, personalization needs to be designed while maintaining shared learning outcomes. Educators can vary the teaching materials, exercise formats, levels of support, or ways students demonstrate their understanding, as long as these variations remain aligned with established competencies. This approach allows for individual needs to be addressed without compromising the equality of learning standards.

Curriculum flexibility also does not mean that each student is free to determine their entire learning process without direction. Flexible spaces need to be designed with clear boundaries, objectives, and indicators of success. The OECD (2024) identifies curriculum flexibility and autonomy as elements that must be managed to create a learning environment that supports student development. In the framework developed in this article, flexibility is implemented through a variety of learning pathways and experiences, while learning outcomes remain the shared orientation. Thus, flexibility does not eliminate curriculum structure but rather provides space for educators to respond to diverse learning conditions.

The distinction between flexibility and adaptivity also needs to be considered in practice. For example, educators can provide a variety of learning resources and activities as a form of flexibility. However, a new curriculum demonstrates adaptive character when information from assessments, observations, and feedback is used to determine whether students need reinforcement, additional support, strategy changes, or alternative learning resources. This means that adaptability is not simply demonstrated by providing a wide range of options; it requires a decision-making process based on relevant information.

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The monitoring and evaluation component is a crucial link between learning implementation and curriculum improvement. Digital data can help educators observe patterns of task completion, participation, and learning outcomes. However, this data cannot be treated as a complete picture of student abilities. Digital information needs to be interpreted in conjunction with assessment results, educator observations, dialogue with students, and the learning environment. This way, pedagogical decisions are not entirely dependent on automated recommendations or platform-generated indicators.

3. Supporting Factors and Challenges in Implementing Adaptive Curriculum

A literature synthesis shows that the implementation of a technology-based and personalized curriculum is influenced by interrelated factors. Educator competence is a key factor, as educators are responsible for translating curriculum objectives into learning strategies, selecting relevant technology, interpreting assessment results, and providing feedback. Digital competence alone is insufficient without pedagogical skills. Educators need to understand when technology is needed, how it can be used, and when direct interaction and non-digital approaches are more appropriate.

Educational leadership also determines the sustainability of implementation. Educational unit leaders need to provide policies, training, mentoring, planning time, and technical support for educators. Without institutional support, personalization can increase teacher workloads, as educators must prepare varied materials and activities without adequate resources. Findings regarding the importance of professional development, organizational support, and technology alignment with the curriculum are also evident in studies of technology integration in secondary education (Msafiri et al., 2023; Msambwa et al., 2024).

The next challenge is the inequality of digital access. Not all students have the same devices, internet connections, learning environments, and family support. If the curriculum relies too heavily on online platforms, students with limited access risk missing out on equal learning opportunities. Therefore, curriculum design needs to provide alternatives, such as downloadable materials, printed materials, offline learning resources, and direct mentoring. Accessibility must be considered from the planning stage to avoid becoming an issue that is only addressed after learning has taken place.

The use of digital data and systems also raises ethical and privacy concerns. Personalization systems can process information about student learning outcomes, activities, and needs. This information should be collected proportionally, used for clear educational purposes, and protected through adequate access controls and security mechanisms. Furthermore, automated recommendations should remain reviewable by educators. Decisions that impact student learning experiences should not be left entirely to algorithms, especially when the data used is incomplete or does not fully reflect the student's condition.

These challenges demonstrate that the success of an adaptive curriculum isn't solely determined by the quality of the technology. Success also requires human resource readiness, institutional policies, equitable access, quality assessments, and data governance. Therefore, implementation needs to be carried out in stages, starting with an analysis of educational unit readiness, determining the scope, measurable implementation, and periodic evaluation.

4. Implications of the Conceptual Framework for Curriculum Development

The resulting six-component framework has implications for the planning, implementation, and evaluation of the junior high school curriculum. During the planning stage, educational units need to ensure that learning objectives and outcomes are clearly defined before determining the technology to be used. Student needs mapping is also necessary to identify variations in readiness, support needs, and access conditions. This information forms the basis for determining realistic learning strategies and personalization.

During the implementation phase, educators need to develop learning experiences that allow for a variety of resources, activities, and support. This variety doesn't have to be exclusively digital. Technology can be used when it adds value, while face-to-face approaches, discussions, practices, and non-digital learning resources can still be used as needed. This principle positions technology as a pedagogical instrument that complements, not replaces, all educational interactions.

During the evaluation phase, educational institutions need to use broader indicators than platform usage frequency or digital activity volume. Evaluations should consider competency attainment, quality of understanding, student engagement, appropriateness of support, equitable access, and educators' ability to use evaluation results to improve learning. These indicators help distinguish between digitalization of learning activities and improving the quality of the learning process.

Institutionally, this framework can be used as an analytical tool to assess the alignment between curriculum objectives, student needs, pedagogical design, technology utilization, evaluation, and improvement. This framework

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is not a standard model that must be applied uniformly across all educational units. Its implementation must take into account student characteristics, subject matter, resources, educational policies, and local social conditions.

5. Conceptual Contribution and Limitations of the Study

The primary contribution of this study lies in integrating technology integration, personalized learning, flexibility, and adaptability into a single curriculum development framework. Previous studies have discussed technology integration in secondary education and the use of personalized and adaptive learning. However, this article focuses on the interconnectedness of these components within the curriculum development cycle, from establishing learning outcomes to adapting and improving based on evaluation results. Therefore, the contribution offered is not a claim that each component is a new concept, but rather a synthesis that connects these components within the framework of the junior high school curriculum.

However, the resulting framework remains conceptual. The relationships between components have not been empirically tested in specific educational settings. Furthermore, differences in infrastructure, policies, student characteristics, and educator capacity may influence the framework's implementation. Therefore, further research is needed to test the framework's suitability, feasibility, and applicability through field studies in various junior high school contexts. Empirical research is also needed to determine how personalization is implemented, how data is used in decision-making, and whether the framework's implementation can support improvements in the quality and equity of learning experiences.

CONCLUSION

This study concludes that technology integration and personalized learning need to be integrated into the development of an adaptive curriculum at the junior high school (SMP) level. Technology plays a role in supporting the provision of learning resources, activity variety, progress monitoring, and feedback, while personalization allows learning experiences to be tailored to students' needs, readiness, interests, and development. Integration of both must be based on clear learning objectives and outcomes to ensure flexibility does not compromise the direction, standards, and quality of education.

The synthesis results in a conceptual framework consisting of six components: learning objectives and outcomes; mapping of learner needs and contexts; pedagogical design and technology selection; flexible and personalized learning implementation; monitoring and evaluation; and curriculum adaptation and improvement. These six components form an interconnected development cycle. Flexibility provides room for adjustment in the learning process, while adaptivity ensures that adjustments are made based on information from monitoring and evaluation results. Thus, an adaptive curriculum does not mean providing absolutely different goals for each learner, but rather providing diverse learning experiences and support to achieve predetermined learning outcomes.

Implementing this framework requires support from educator competency, educational leadership, infrastructure, accessibility, assessment quality, ethical data use, privacy protection, and accountability. The availability of technology alone does not guarantee improved learning quality without pedagogical and institutional readiness. Therefore, curriculum development must address equitable access, maintain a balance between digital learning and in-person interactions, and ensure that pedagogical decisions remain within the professional responsibility of educators.

In practice, this conceptual framework can serve as a foundation for educational units in designing, implementing, and evaluating a curriculum that is more responsive to student diversity. Its development can be carried out in stages through needs analysis, mapping educational unit readiness, strengthening educator competencies, limited implementation, and ongoing evaluation. However, the resulting framework is still conceptual in nature and has not yet proven its effectiveness empirically. Therefore, further research is needed to test the suitability and feasibility of the framework through field research in various junior high school educational units, including examining its impact on learning achievement, student engagement, equitable access, and the quality of pedagogical decision-making. This testing is necessary so that the conceptual framework can be refined into a curriculum development approach that is relevant, measurable, and applicable to educational conditions.

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