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ARTIFICIAL INTELEGENCE & MULTIPLE INTELEGENCE REDESIGNING PERSONALIZED LEARNING IN THE ERA SOCIETY 5.0

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Abstract-Educational transformation in the Society 5.0 era demands the integration of digital technology with a more humanistic and adaptive learning approach. One of the main challenges is how to accommodate the diversity of student potential according to the theory of Multiple Intelligences (MI), which in manual practice is often hampered by time constraints, the number of students, and the subjectivity of teacher assessments. This study aims to formulate a conceptual framework for the integration of MI with Artificial Intelligence (AI) to support personalized learning and strengthen 21st-century competencies (6Cs). This study uses a systematic literature review approach to relevant international publications (2019–2025), with additional classical literature as a theoretical foundation. A total of 47 selected sources were analyzed and synthesized thematically.

The study results produce a conceptual framework consisting of the following flow: learning data input → AI analysis → MI mapping → adaptive learning strategies → 6Cs reinforcement. Examples of potential implementation are demonstrated through the use of AI in providing automated feedback, adaptive questions, VR/AR simulations, self-reflection, and collaborative projects based on global issues. This study concludes that AI–MI integration has the potential to increase assessment objectivity, strengthen personalization, and accelerate learning feedback. Theoretically, this research contributes to the development of the AI–MI conceptual model, while practically it provides a reference for teachers and policymakers to design inclusive and adaptive learning. However, because it is still conceptual, further research is needed to test the effectiveness of this framework through an empirical approach in schools.

Keywords : Artificial Intelligence, Multiple Intelligences, Personalized Learning, Society 5.0, 6Cs

1. INTRODUCTION

Before the advent of Artificial Intelligence (AI), the application of Multiple Intelligences (MI) theory in learning relied heavily on teachers' ability to manually observe, assess, and design differentiation strategies. Identification of students' dominant intelligences was typically conducted through behavioral observations, simple questionnaires, or portfolio assessments. This process was often subjective, time-consuming, and lacked systematicity [1], [2]. As a result, although the MI concept was recognized as capable of accommodating the diversity of student potential, its implementation in the classroom was often hampered by time constraints, high teacher-student ratios, and the difficulty of developing personalized learning strategies for each individual.

The development of the Society 5.0 era presents a fundamental transformation in education, where digital technology is no longer merely a tool but an integral part of a humanistic and adaptive learning process [3], [4]. 21st-century education demands graduates who not only master knowledge but also possess six core competencies: critical thinking, creativity, collaboration, communication, character, and citizenship [5], [6].

However, the reality on the ground shows that learning approaches still tend to be uniform, making them less able to accommodate the diversity of student potential [7]. MI theory emphasizes that each individual possesses a unique dominant intelligence, but the main challenge is how to integrate this theory into efficient and measurable learning practices [8].

In this context, AI offers significant opportunities through its capabilities in learning data analysis, intelligence mapping, and personalized strategy recommendations based on MI profiles [9], [10]. The resulting information enables teachers to design learning strategies that are truly personalized and tailored to the unique needs of each student. Thus, AI not only reduces the subjectivity of teachers' manual assessments but also increases the effectiveness of personalized learning, accelerates feedback, and encourages the optimal development of student potential in the era of Society 5.0 [11].

II. THEORETICAL FOUNDATION

2.1 Artificial Intelligence in Education

Artificial Intelligence (AI) in education is developing through various applications, such as intelligent tutoring systems, adaptive learning platforms, and learning analytics. AI enables in-depth analysis of student learning data to predict needs, provide real-time feedback, and adapt learning strategies [12], [13]. Recent studies have shown that AI has great potential to improve personalization, engagement, and motivation in student learning [14].

2.2 Multiple Intelligences Theory

The Multiple Intelligences (MI) theory introduced by Gardner [1] explains that every individual possesses eight primary intelligences: linguistic, logical-mathematical, spatial, musical, kinesthetic, interpersonal, intrapersonal, and naturalist. Armstrong [2] emphasizes the importance of diverse learning strategies to accommodate these intelligence profiles. However, manual implementation of MI is often hampered by time constraints, student numbers, and teacher capacity [7].

2.3 Personalized Learning

Personalized learning is the adjustment of objectives, content, methods, and assessments based on the unique needs of students. AI supports this approach by providing data-driven recommendations, reducing teacher subjectivity, and increasing the accuracy of student potential mapping [9], [10]. Recent research has shown that AI-based adaptive models can improve learning outcomes and provide more inclusive learning [15], [16].

2.4 21st-Century Competencies (6Cs)

The 21st-century curriculum emphasizes six core competencies: critical thinking, creativity, collaboration, communication, character, and citizenship [5]. Trilling and Fadel [5] emphasize that these competencies can only develop optimally if learning is designed contextually and based on real-world challenges. AI-MI can help strengthen each dimension of the 6Cs through adaptive and data-driven learning [14].

2.5 Education in the Era of Society 5.0

The concept of Society 5.0 emphasizes the integration of digital technology with humanistic values [3], [4]. Education is aimed at developing a generation capable of utilizing smart technology ethically and responsibly. The OECD emphasizes that the integration of AI in education must be balanced with attention to ethics, data privacy, and equality of access [6], [11].

III. METHODELOGY

This research is a conceptual study based on a systematic literature review (SLR). This approach was chosen to identify, evaluate, and synthesize current research related to the integration of Artificial Intelligence (AI), Multiple Intelligences (MI), personalized learning, and the development of 21st-century competencies in the context of Society 5.0 [17], [18].

3.1 Literature Search Procedure

The literature search was conducted in Scopus, Web of Science, SpringerLink, and Google Scholar databases. Keywords used included: "artificial intelligence in education," "multiple intelligences," "personalized learning," "21st-century skills," and "Society 5.0." The publication period was limited to 2019 and 2025 to ensure data recency, with the addition of

several classic sources as a theoretical foundation [1], [2].

3.2 Inclusion and Exclusion Criteria

• Inclusion: peer-reviewed journal articles, international proceedings, academic books, and relevant official policy reports.

• Exclusions: popular articles without clear methodology, non-academic opinions, or publications that have not undergone a peer-review process.

3.3 Literature Selection

Of the approximately 120 publications found, screening was conducted based on title and abstract. After the exclusion process, 47 sources met the criteria for full review.

3.4 Analysis and Synthesis Process

Each selected article was analyzed based on the research context, educational level, AI algorithm or MI instrument used, and learning outcome indicators. The appraisal process was conducted by assessing methodological transparency and reporting quality [19]. The findings were then thematically synthesized to develop a conceptual framework for AI–MI integration that connects learning data input → AI analysis → MI mapping → learning strategy recommendations → achievement of the 6Cs competencies.

IV. RESULTS AND DISCUSSION

4.1 Conceptual Framework for AI–MI Integration

The conceptual framework resulting from the literature review positions AI as an enabler that facilitates the implementation of MI theory in a more measurable and sustainable manner. At the input stage, collected data includes academic test results, activity records on digital platforms, learning media preferences, and student attendance and interaction records. This data reflects student learning patterns more objectively than manual teacher observations.

The process stage involves the use of AI algorithms, such as machine learning to detect performance patterns, natural language processing for analyzing student text, or recommender systems to predict appropriate learning strategies [12], [13]. Through this analysis, each student's MI profile can be mapped more accurately.

At the output stage, the system generates personalized learning recommendations, including content, activities, and assessments tailored to the student's dominant intelligence. Ultimately, the expected impact is improved learning outcomes that are not only cognitive but also strengthen 21st-century competencies (6Cs) [14], [15]. Within this framework, teachers act as facilitators who interpret AI recommendations, rather than being completely replaced by technology.

4.2 Potential Implementation Examples

The application of the AI–MI framework can be seen in a number of scenarios:

• Linguistics: AI can provide automated feedback on student writing through analysis of sentence structure, vocabulary, and argumentation. Such systems have been shown to improve the quality of academic writing while accelerating the learning cycle [20].

• Logical-Mathematical: Adaptive problem sets allow students to face problems with gradually increasing difficulty based on their performance. Research shows that students are more motivated because the challenges remain within their capacity [21].

• Spatial-Visual: Interactive graphic design technology and 3D-based simulations help students develop visualization skills. For example, the use of virtual labs for science experiments [22].

Musical: The integration of rhythmic patterns and audio media can help students memorize abstract concepts. For example, associating physics formulas with simple melodies [23].

• Kinesthetic: VR and AR enable realistic simulation-based learning, such as anatomy exercises or physics experiments, to be safely conducted virtually [21].

• Interpersonal: AI can group students into collaborative teams based on complementary intelligence profiles, thus optimizing the quality of discussions and project outcomes [16].

• Intrapersonal: Self-reflection features integrated into LMSs allow students to set learning goals, track progress, and receive adaptive feedback [9].

• Naturalistic: IoT-based environmental sensors and analytics applications help students explore natural phenomena directly, strengthening their connection to global environmental issues [24].

These implementations demonstrate that AI not only increases efficiency but also opens up new possibilities for more creative, personalized, and meaningful learning.

4.3 Relevance to 21st-Century Competencies (6Cs)

The AI–MI framework comprehensively supports the strengthening of 21st-century competencies:

• Critical thinking: Data-driven feedback encourages students to analyze, evaluate, and revise their own learning strategies [15].

• Creativity: AI opens access to new media such as 3D design, digital music composition, or multimedia content creation, which align with students' dominant intelligences [23].

• Collaboration: AI-based systems can organize adaptive learning groups, making collaboration more productive because it is based on each student's individual strengths [16].

• Communication: Adaptive platforms provide digital communication tools (forums, chat, peer feedback) tailored to student preferences, improving written and oral communication skills [20].

• Character: With personalized learning paths, students practice independence, responsibility, and consistency. AI can also help identify areas of non-cognitive development [26].

• Citizenship: projects based on global issues (e.g., the environment or sustainability) can be personalized to MI profiles, enabling students to engage with social issues in meaningful ways [24].

Thus, the AI–MI framework can bridge students' personal needs with the demands of a global curriculum.

4.4 Critical Discussion

Despite its great potential, the implementation of the AI–MI framework is not without challenges.

• Advantages: more objective personalization, increased inclusivity for students with diverse learning styles, and efficiency in feedback [9], [10].

• Limitations: Most research is still proof-of-concept, so there is not much long-term empirical evidence supporting its effectiveness [18].

• Ethical Issues: The use of AI poses risks related to data privacy, algorithmic bias, and the security of student information [25].

• Teacher Readiness: Implementing this framework requires adequate digital literacy and pedagogy, so intensive teacher training is essential [26].

• Infrastructure: Limited devices, networks, and operational costs in certain schools remain significant obstacles, especially in developing countries.

This discussion shows that although AI has the potential to strengthen MI implementation and support the 6Cs, its success is highly dependent on educational policies, human resource readiness, and the ethical aspects surrounding it [11], [25].

V. CONCLUSION

This study emphasizes the importance of integrating Artificial Intelligence (AI) with Multiple Intelligences (MI) theory in redesigning personalized learning in the era of Society 5.0. A systematic literature review demonstrates that AI can act as a catalyst to strengthen MI implementation through learning data analysis, intelligence profile mapping, and adaptive strategy recommendations. The resulting conceptual framework depicts the flow: data input → AI analysis → MI mapping → personalization strategy → strengthening 6Cs competencies.

The theoretical contribution of this study is the development of a conceptual framework linking AI, MI, personalized learning, and strengthening 21st-century competencies. Its practical contribution is providing a reference for teachers and policymakers to design inclusive, adaptive, and humanistic learning supported by intelligent technology.

However, this study has limitations because it is still conceptual and has not been empirically tested. Therefore, further research is recommended using a design-based research approach and mixed methods to test the effectiveness of the AI–MI framework in schools, assess the actual impact on achieving the 6Cs, and explore issues of ethics, data privacy, and equity of access.

Thus, AI–MI integration has the potential to become a key strategy in realizing 21st-century education that is personalized, inclusive, and globally competitive in the Society 5.0 era.

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