

Integration of Multiple Intelligence Theory in Curriculum Implementation for Developing Student Potential in Indonesia

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Abstract. Education in Indonesia is experiencing a transformation through the integration of multiple intelligence theories in the curriculum to optimize student potential. The problem is the need to develop students' potential holistically to prepare them to face the demands of future society. The urgency lies in the need for inclusive and diverse education to ensure that every student can develop optimally. This research aims to evaluate the effectiveness of integrating the theory of multiple intelligences in improving student learning in Indonesia. The research method involves direct observation during classroom learning sessions, using the Science Behavior Checklist and Pure Value Observation. Data was collected through structured observation and processed using qualitative analysis methods. The research results show that a learning atmosphere that integrates multiple intelligence elements helps develop students' scientific tendencies and noble values. In conclusion, the integration of multiple intelligence theory in the Indonesian curriculum provides a valuable contribution to developing students' potential holistically, preparing them for academic success, and becoming empowered individuals. The implication of this research is the need to continue to encourage inclusive learning approaches that take into account the diversity of students' intelligence to create a learning environment that supports holistic development.

Keywords: Educational Curriculum, Holistic Integration, Multiple Intelligences, Learning Potential

1. Introduction

The emphasis in education is to develop students' intelligence so they can adapt; Achieve success in life; and prepare to face the society of the future (Estrada Guillén et al., 2022; (Burbules et al., 2020). Therefore, the content of the curriculum and its implementation in the education system should focus on developing students' intelligence, in addition to spiritual, emotional, and physical aspects. According to Paschen et al., (2020), intelligence is the ability to solve problems or make valuable things from one or more cultural backgrounds. The new concept of intelligence was developed based on the theory of multiple intelligences formulated by Gardner in 1983. Based on this theory, Introduction. Intelligence, kinesthetic intelligence, musical intelligence, intrapersonal intelligence, intrapersonal intelligence, and naturalistic intelligence (Aleksić & Politis, 2023; Tratras Contis & Abdallah, 2021; Alcivar et al., 2020). The theory of multiple intelligences has been widely applied in countries such as the United States, England, Canada, and Australia. The results of research by teachers such as Mavrellos & Daradoumis, (2020), García-Martínez et al., (2021), Georgiou et al., (2020) shows that the application of multiple intelligence theory when teaching gifted children contributes to success during the learning process at school. Various types of education believe that elements of multiple intelligences can be integrated into teaching and learning activities. According to Ferrero et al., (2021), elements of multiple intelligences can be integrated into learning activities in a subject to achieve learning goals, in addition to the ability to develop intelligence through learning characteristics. Gkintoni et al., (2022) mentioned integrating elements of multiple intelligences. This should be included in the lesson plan and any type of

Intelligence I am willing to Default He follows Through Relevance. Topics taught. Previously, Cheung et al., (2021) recommended that learning planning must include elements of intelligence. In various ways, the teacher first sets learning objectives and then continues to think about questions as shown in Figure 1.

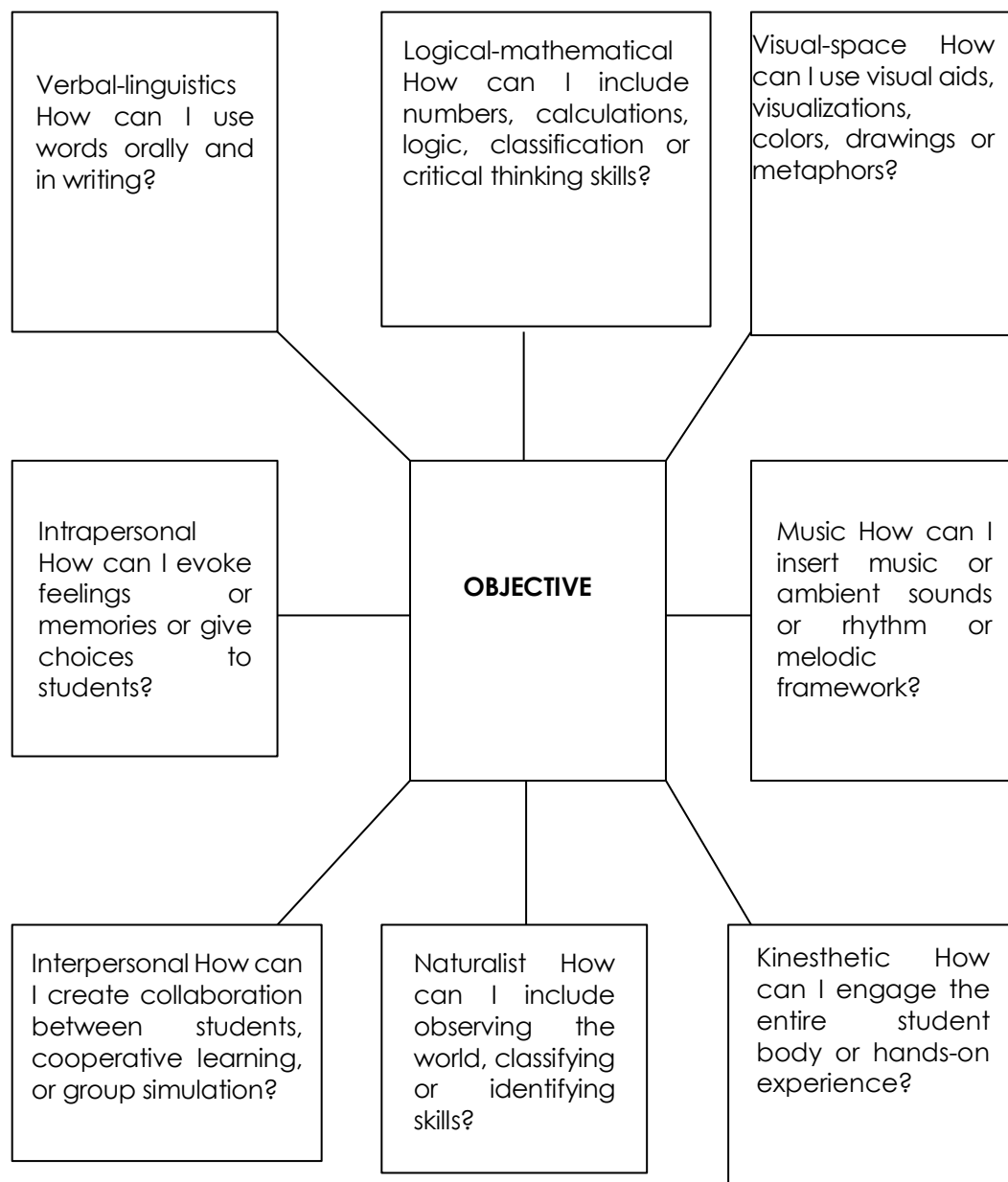


Figure 1. Multiple Intelligence Objects in Teaching (Benvenuti et al., 2023)

The Indonesian Ministry of Education introduced the theory of multiple intelligences into the education system through the 2022 Curriculum Development Center, which is now known as the Curriculum Development Department. The reasons include that the Multiple and Multiple Intelligence model not only creates well-rounded students but also helps students obtain what they need to live in the next century. In model theory, intelligence can help someone move and focus content on the overall learning outcomes that are most important and useful for students. Based on this, it can be said that all elements of multiple intelligences are things that must be integrated into the school curriculum to complement human resource development efforts which can ultimately contribute to the country's development.

1.1. Problem Statement

All elements of multiple intelligences must be developed in each student through a curriculum that is based on the aim of the national education philosophy, which is to create individuals who are able to contribute to the welfare of themselves, their families, society and the country. The development of all elements of multiple intelligence in each student is very necessary because all elements of multiple intelligence are important for a better life. Problems such as unemployed graduates and migration problems are that graduates are unable to use their abilities to interpret and utilize the spaces and opportunities that exist around their environment. Graduates are also unable to use the motor skills they have learned to apply. Some simple problems often become increasingly serious problems among students, such as learning difficulties and lack of concentration in studying. These problems relate to daily life and reflect differences in the level of intelligence of Indonesian society in general. Therefore, it is clear that capacities related to all elements of multiple intelligences must be developed in every student through curriculum and education. The implementation of education and learning in schools in Indonesia focuses more on academic aspects and achieving good results in tests or examinations (Zein et al., 2020; Muhtar et al., 2021; Nurtanto et al., 2020). Therefore, teachers focus more on mastering facts and theories. According to Guo et al., (2020) , not all students can concentrate fully on theoretical aspects which are considered 'dry' and meaningless. This is also not the aim of the national educational philosophy. Desire to provide human resources; As well as the desire to create a prosperous society. This article describes several studies that show that integrating all elements of multiple intelligences into the teaching and learning process can be implemented practically, in addition to achieving the goal of developing scientific attitudes and moral values. Therefore, the integration of these elements by teachers must be carried out in accordance with the requirements of the Curriculum Development (González-pérez & Ramírez-montoya, 2022; García-Lázaro et al., 2022).

1.2. Related Research

All elements of multiple intelligences such as verbal-linguistic, logical-mathematical, visual-spatial, motoric, musical, intrapersonal, and natural intelligence are elements that are expected to be developed in the teaching and learning process (Hairudin et al., 2023; Ray, 2023). Scientific views and pure values are by the wishes of the national education philosophy (Alam, 2020; Samways et al., 2020; Rowe, 2020). Scientific Attitude and Pure Values in this research show the pure value component in elementary school subjects and summarize learning through Curriculum development (Meta-analysis, 2023; Liu, 2022). This research is limited to integrating multiple intelligence elements in the teaching and learning process of fifth-grade science subjects in elementary schools (Putri & Indonesia, 2020; Hwang et al., 2020). Because the researcher's first study showed that fifth-grade elementary school science teachers still doubted the smoothness of the teaching and learning process that integrated elements of multiple intelligences (Kumar et al., 2021).

1.3. Research Objectives

This research aimed to get an idea of its flexibility or usefulness in practical education and to study every combination of all elements of multiple intelligence. Specifically, this research aims to determine the state of development of students' scientific attitudes and moral values in the teaching and learning process when all elements of multiple intelligences are also integrated into the teaching and learning process. So, the research question that must be answered is; What is the situation of the development of students' scientific behavior as an element of intelligence in various types of proverbs? And is this also integrated into the teaching and learning process?

2. Theoretical Framework

Previous research was carried out using a survey method through observation during the teaching and learning process, resulting in a theory that states that observation integrates elements of multiple intelligences to determine the state of development of scientific attitudes and assess students' morals (Temitayo et al., 2022; Tsz et al., 2021; Tsz et al., 2022). Education and learning every to combine an object Intelligence Various type of locked for eight weeks (Evrpidou et al., 2020). The teaching and learning process that takes place at any time is supervised by researchers to ensure that it is carried out according to the wishes and objectives of the research (Jan, 2020). During this period, two observers, namely P1 and P2, made observations separately (Viallon-galinier et al., 2020). P1 and P2 are the teachers selected in the research This is based on experience teaching science subjects in elementary schools for more than five years, as well as experience conducting assessments of practical science work in elementary schools (PEKA) (Mertala et al., 2022). This research uses observation methods and techniques used at PEKA IPA Elementary School. Several students demonstrated academic enthusiasm and noble values In some teaching and learning sessions, it is carried out based on feedback (Brandt et al., 2021). Integrating various elements of intelligence into the teaching and learning process found in previous research and producing a new theory using the method of integrating elements of multiple intelligences. The teaching and learning process according to the existing model, as seen in Figure 1, where the teacher first determines the learning objectives, followed by thinking about questions to identify and combine activities with the aim of integrating elements of multiple intelligences (Ley et al., 2023). All elements of multiple intelligence as shown in Figure 1- Integrate into the teaching and learning process by the objectives of the national educational philosophy, namely developing the potential of all students in a harmonious, comprehensive, and integrated manner, in addition to achieving the objectives of science learning, namely the development of scientific tendencies and noble values. The researchers worked closely with teachers from the schools participating in the study. Again, First He chose Title And Subtitle Lessons like it ever found In the curriculum (Prelitz et al., 2023) and curriculum descriptions (Girón-garcía & Fortanet-gómez, 2023). Various types of Title. In the fifth-grade elementary school science class, the title Light and Sound was chosen based on the concept of convenience sampling, because at the time of the research, this title was the title that would be taught in school (Tark et al., 2020). The educational goals to be achieved are also identified and determined Element Intelligence Various types of every in accordance Not fun Default in Teaching and learning activities (Dahalan et al., 2024). All material is recorded in the lesson plan. This means It is clear that this learning is a learning process that aims to integrate elements of multiple intelligences (Hainora Hamzah et al., 2022). Teaching and learning activities that integrate elements of multiple intelligences are carried out in collaboration with teachers at related schools. In the teaching and learning process, the teacher then integrates different elements of intelligence that are relevant to the activities carried out (Guill et al., 2022).

3. Method

3.1. Research Design

The method in this research is quantitative with an observational approach. In observations using instruments. The research instrument used was a checklist sheet for assessing attitudes and Pure Scientific Values. Scientific tendencies and pure values in this research refer to the components of scientific tendencies and pure values in basic-level subjects as stated in Curriculum Development (Yusof et al., 2020). Aspects of his scientific position and pure mark in research are not limited to ten aspects, namely interest and curiosity about the world around him; Honesty and accuracy in recording and verifying data; persistence in doing or pursuing something; Responsible for the safety of yourself and others regarding everything; clean and healthy living, great care and respect; systematic; cooperation; Dare to try; Confident and independent. Observations were carried out using a Behavior Checklist and pure value observations adapted from the Elementary School Practical Action Assessment. Researchers use the external criticism method to calculate the index. Content validity is based on the

average cumulative score obtained from expert assessors in the field (Bremer et al., 2020). The services of seven expert evaluators in the field of basic education were used to assess content and value validity. The content validity index obtained was 0.93.

3.2. Respondent

Schools and research samples were selected to meet the needs of the founding design and research objectives. Therefore, the selection of schools and research samples was based on the concept of convenience sampling. Three classes of fifth-grade students from the selected schools were selected based on the whole group concept and based on the results of discussions and permission from school management. The three classes in the category of students who are research subjects have simple criteria, namely achievement, learning attitude, and strict discipline that do not interfere with the implementation of investigation procedures. The number of people in this study was 102 people consisting of 47 male students and 55 female students.

3.3. Data Collection

Data collection techniques by providing questionnaires. The questionnaires given are more authentic because language barriers can be minimized. A cluster sampling technique was used to select research respondents. The Motivated Strategies for Learning Questionnaire (MSLQ) indicator was developed into an instrument and used to measure students' self-regulation learning abilities, while the psychological factor indicators were used to see the influence of the child's self-efficiency scale, goal orientation scale, and intelligence goal orientation scale and self-confidence scale. These indicators were developed into instruments and have been modified for use in Indonesia. Trials are carried out to ensure that the administration and data collection process runs smoothly during testing. This permission was also obtained from the Educational Planning and Research Section of the Ministry of Education of the Republic of Indonesia and the Center for Educational Studies. In obtaining data, during observation, the questionnaire was assessed on a Likert scale from point one to point 5. Instruments were also given to respondents totaling 102 people to provide assessments, the scores given by students were from point one to point 5.

3.4. Data Analysis

The analysis technique used in this research is Statistics Version 25.0 (Freedberg et al., 2020) and inference analysis namely Pearson's Correlation r and Stepwise Multiple Regression are used to analyze the study data. The Stepwise Multiple Regression analysis technique is used to examine the influence of psychological factors on the self-regulation learning of elementary school students because it has many advantages. This technique has strength compared to other multiple regression because it is more economical and can avoid multicollinearity problems caused by strong correlation between predictor variables (Shafiee et al., 2021). Future settlement procedures have been implemented. Screening of the research data including normality tests was carried out before the inferential statistical analysis was carried out.

3.5. Validity

From the results of the instrument validation test, the number of respondents who met $n = 102$ were declared valid with a value of $\alpha = 0.05$ (one side), effect size = 0.15 (medium), and the actual strength of the instrument (medium). actual power or $1 - \beta$) inferential statistical test value 0.95. The instrument used in this research was declared valid, normal homogeneous, and suitable for use as research measuring tool and suitable for distribution to be used as an assessment measuring tool in this research and suitable for being assessed by respondents.

4. Findings

In this research the results found were as follows: During the research period the total number of observations carried out by each class observer, integrating elements of multiple intelligences into the teaching and learning process was eight times. The collected data is analyzed using the calculation of the average score of the percentage of students who show scientific attitudes and moral values that apply in education in their practice and learning. The

results can be seen minute by minute and the facts are calculated, as well as the average score of the data collection The overall mean percentage value obtained is as in Table 1.

Table 1. Average Percentage of Overall Positive Scientific Attitudes and Scientific Quality

No	Aspects of scientific position and the value of pure	The result minimum Student ratio		
		Question (Q1)	Question (Q 2)	all
1	Interest And Of course I am willing Is know I like this Love research questions, Focus, provide feedback	98.38	96.93	97.66
2	Amen And by comment Data verification is like writing facts or data correctly so they can be read or seen	95.25	95.33	95.29
3	Be diligent and persistent in doing something I like this hard work, Give concentration Complete, and really	98.48	95.33	96.91
4	- Be responsible for your safety and the safety of your friends, such as avoiding accidents and their causes, NO Working on Stand for That is dangerous	98.42	100	99.21
5	Appreciate and practice clean and healthy living, such as maintaining cleanliness, keeping tables clean, and arranging books and materials education and learning (research and development)	96.77	99.14	97.95
6	Be considerate and respectful, and don't interrupt the giving friend, for example, opinion or Answer, Agreed By the teacher's decision	98.42	100	99.21
7	systematic I like this tasty Manage time, P&P materials or assignments are provided	95.25	94.91	95.08
8	Collaboration is similar to caring and sharing discussion, help friends or Teachers jointly manage P&P materials	96.90	94.91	95.91
9	Dare to try, like dare to answer questions, be a brave question, brave carry out Exam	91.52	92.14	91.83
10	Self-confident And independent I like this NO Confused Through What to do, don't rely on friends, you can Stand for Bachelor, Answer questions in trust _	94.75	94.91	94.83

Based on Table 1, it can be shown that the average percentage of students' scores showing scientific scores and pure scores is in the range of 91.52 to 100 percent. Therefore, it can be said that in a teaching and learning process that integrates elements of multiple intelligences, the percentage of students who show a scientific attitude and noble values in the process. High progress in teaching and learning is visible, meaning that a teaching and learning process that integrates elements of different intelligences will be beneficial for students. In other words, a teaching and learning process that integrates various elements of intelligence does not harm the development of students' scientific attitudes and moral values. The analysis was carried out using the Pearson product-moment correlation statistic Not found on two to measure Fact comments and based on Q1 and Q2 The value of $r = 0.88$ at a significant level of $p = 0.001$. The results of this analysis show that there is a significant relationship between the Integration of Multiple Intelligence Theory in the Implementation of the Curriculum for Developing Student Potential in Indonesia, which means that this assessment has good inter-rater reliability over a long period in developing student potential in Indonesia.

5. Discussion

Based on the results of this research, it was determined that education that integrates elements of multiple intelligences does not limit the development of scientific attitudes and values. Students understand what is happening. Scientific attitudes and moral values are one aspect that needs to be developed in students through scientific subjects at the basic level. Scientific attitudes and moral values among lay students This can be developed when all elements of multiple intelligence are developed. Developing the potential of all students wide, balanced,

and harmonious He is in its format Through To expect National education philosophy and integrated curriculum concept. The results of this study are also in line with the research results (Miseliunaite et al., 2022; (Purwanto et al., 2023). This research also gives an impression of the learning process and finds that the process of integrating elements of multiple intelligences can create an educational atmosphere that is conducive to learning. The teaching and learning process that integrates various elements is in line with the concept of mind-based learning and an integrated curriculum. Incorporating elements of multiple intelligences into the teaching and learning process creates a diverse environment that stimulates students' brains to create learning environment. This learning environment interaction is a process that occurs during learning, namely when someone wants to gain knowledge and other people provide interaction (Branigan & Donaldson, 2020; Wooten, 2019). By the concept of mind-based learning, the learning process will be more effective if synapses occur frequently in the human brain. Therefore, teachers should not doubt the impact of integrating different intelligence elements into teaching and learning activities. On the other hand, teachers should try to diversify their teaching methods or techniques so that students do not feel bored in carrying out the teaching and learning process, and can develop the potential intelligence of different students.

Integrating elements of multiple intelligences into the curriculum should also be an educational agenda within the integrated curriculum concept which aims to create a skilled generation along with providing human resources and a more prosperous life. Curriculum implementation and the teaching and learning process of Natural Sciences are important aspects of developing student potential in Indonesia. It was found that the integration of multiple intelligences theory in the curriculum has been proven to have a positive impact on student development in terms of scientific intelligence and noble values. In this context, a learning approach that takes into account students' various intelligences can make a significant contribution to shaping students' character and potential. The importance of integrating multiple intelligences theory in the curriculum can also be seen from the emphasis on developing students' intelligence as preparation for life in future society. The curriculum and its implementation in the education system should focus on developing students' intelligence, in addition to spiritual, emotional, and physical aspects. The intelligence and abilities possessed by students will be able to solve problems and create something of value from their cultural background and surrounding environment. This new concept of intelligence was developed based on the theory of multiple intelligences formulated by Gardner in 1983. In the context of teaching, the integration of elements of multiple intelligences can also enrich the learning process. By paying attention to the diverse intelligence of students, teachers can create an inclusive learning environment and support students' holistic development. Through this approach, students have the opportunity to develop their potential as a whole, not only in the academic realm but also in other aspects such as social skills, creativity, and problem-solving. The application of multiple intelligences theory in learning has also proven effective in improving student learning achievement. This shows that the integration of multiple intelligences theory is not only relevant in the context of one lesson but also applies to other subjects such as science.

6. Conclusion

In the context of curriculum implementation in Indonesia, the integration of multiple intelligence theories in learning has a positive impact on students' scientific development and noble values. This shows that a learning approach that pays attention to students' multiple intelligences can make a significant contribution to developing students' character and potential. The importance of integrating the theory of multiple intelligences in the curriculum can also be seen from the emphasis on developing students' intelligence as preparation for life in future society. In this context, the curriculum and its implementation in the education system should focus on developing students' intelligence, in addition to spiritual, emotional, and physical aspects. The intelligence and abilities possessed by students will be able to solve problems and create something of value from a cultural background and the surrounding environment. This new intelligence concept was developed based on the theory of multiple intelligences which was formulated and tested in this research. In the teaching context, the

integration of multiple intelligence elements can also enrich the learning process in this research. By paying attention to students' diverse intelligence, teachers can create an inclusive learning environment and support students' holistic development. Through this approach, students have the opportunity to develop their potential as a whole, not only in the academic realm but also in other aspects such as social skills, creativity, and problem-solving. The application of multiple intelligence theory in learning has also proven effective in improving student learning achievement. This shows that the integration of multiple intelligence theory is not only relevant in the context of one lesson but this research finds this theory applies to other subjects such as science. Overall, the integration of multiple intelligence theory in curriculum implementation in Indonesia provides a valuable contribution to developing student potential. By paying attention to students' diverse intelligence and creating an inclusive learning environment, educators can help students develop various aspects of their intelligence holistically. Thus, this approach not only prepares students to achieve academic success but also helps them become empowered individuals who have strong noble values.

Limitation

Despite the numerous benefits of integrating multiple intelligences theory into curriculum implementation in Indonesia, there are certain limitations and challenges that educators may encounter in the process. Understanding these limitations is crucial for effective implementation and to address potential obstacles that may arise. One limitation is the need for adequate teacher training and professional development to effectively integrate multiple intelligences theory into teaching practices. Educators may require additional support and resources to understand how to identify and cater to different types of intelligence in their students. Without proper training, teachers may struggle to implement diverse teaching strategies that address the various intelligences effectively. Another limitation is the potential for time constraints within the curriculum. Balancing the integration of multiple intelligences with the existing curriculum requirements and time constraints can be challenging. Educators may find it difficult to allocate sufficient time to incorporate activities and assessments that cater to different intelligences while covering the necessary content within the given timeframe. Furthermore, assessing and evaluating students' development across multiple intelligences can be complex. Traditional assessment methods may not accurately capture the full range of students' abilities and intelligences. Developing appropriate assessment tools that align with the principles of multiple intelligences theory and provide meaningful feedback to both students and teachers is essential but can be a challenging task. Additionally, the availability of resources and materials tailored to different intelligences may pose a limitation. Educators may struggle to access or create diverse learning materials that cater to each type of intelligence. A lack of resources can hinder the implementation of varied teaching strategies and activities that effectively engage students with different learning preferences. Moreover, addressing individual differences and ensuring equity in the classroom can be a challenge when integrating multiple intelligences theory. Educators need to be mindful of providing equal opportunities for all students to develop their intelligence, regardless of their background or learning styles. Creating an inclusive learning environment that values and nurtures diverse intelligences requires careful planning and consideration. Lastly, resistance to change and traditional teaching practices within the education system can also present a limitation. Implementing a new approach like multiple intelligences theory may face resistance from stakeholders who are accustomed to traditional teaching methods. Overcoming resistance and fostering a culture that embraces innovation and diversity in teaching approaches may require time and effort. In conclusion, while integrating multiple intelligences theory in curriculum implementation offers numerous benefits for student development, educators must be aware of the limitations and challenges that may arise. By addressing these limitations through targeted training, resource allocation, assessment strategies, and a focus on inclusivity, educators can enhance the effectiveness of integrating multiple intelligences theory in the Indonesian education system.

Recommendation

To address the limitations and enhance the successful integration of multiple intelligences theory in curriculum implementation in Indonesia, several recommendations can be considered. Firstly, providing comprehensive and ongoing professional development opportunities for teachers is essential. Training programs should focus on understanding and implementing diverse teaching strategies that cater to different intelligences effectively. Secondly, schools and educational institutions should allocate resources and support for the development of diverse learning materials and tools that align with multiple intelligences theory. This includes creating a repository of resources that cater to various intelligences and ensuring equitable access for all students. Additionally, promoting a culture of innovation and collaboration among educators can foster a supportive environment for implementing new teaching approaches. Encouraging experimentation and sharing best practices can help overcome resistance to change and promote the adoption of multiple intelligences theory in the education system. Lastly, involving stakeholders, including parents and students, in the process of integrating multiple intelligences theory can enhance buy-in and support for the initiative. Engaging the community in discussions about the benefits of diverse teaching approaches and the importance of nurturing all intelligences can create a more inclusive and supportive learning environment for students.

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Conflict of Interest

The authors declare no conflict of interest in relation to this research project.

References

- Alam, A. (2020). What is the "Philosophy of Chemistry Education"? Viewing Philosophy behind Educational Ideas in Chemistry from John Dewey's Lens: The Curriculum and the Entitlement to Knowledge. *The New Research Assessment*, 17(9), 6857–6889.
- Alcivar, C. M. M., Santos, R. O. Z., & Gamez, M. R. (2020). The musical intelligence as a basic competition in parvular teacher. *International Journal of Psychosocial Rehabilitation*, 24(04), 352–360. <https://doi.org/10.37200/ijpr/v24i4/pr201014>
- Aleksić, V., & Politis, D. (2023). Trait Emotional Intelligence and Multiple Intelligences as Predictors of Academic Success in Serbian and Greek IT Students. *International Journal of Cognitive Research in Science, Engineering and Education*, 11(2), 173–185. <https://doi.org/10.23947/2334-8496-2023-11-2-173-185>
- Benvenuti, M., Cangelosi, A., Weinberger, A., Mazzoni, E., Benassi, M., Barbaresi, M., & Orsoni, M. (2023). Computers in Human Behavior Artificial intelligence and human behavioral development: A perspective on new skills and competences acquisition for the educational context. *Computers in Human Behavior*, 148(August), 107903.1-8. <https://doi.org/10.1016/j.chb.2023.107903>
- Brandt, J., Barth, M., Merritt, E., & Hale, A. (2021). A matter of connection: The 4 Cs of learning in pre-service teacher education for sustainability. *Journal of Cleaner Production*, 279(2), 123749. <https://doi.org/10.1016/j.jclepro.2020.123749>
- Branigan, H. E., & Donaldson, D. I. (2020). Teachers matter for metacognition: Facilitating metacognition in the primary school through teacher-pupil interactions. *Thinking Skills and Creativity*, 38(1), 1-24. <https://doi.org/10.1016/j.tsc.2020.100718>
- Bremer, A., Andersson, M., Tavares, W., & Paakkonen, H. (2020). Nurse Education in Practice Translation and further validation of a global rating scale for the assessment of clinical competence in prehospital emergency care. *Nurse Education in Practice*, 47(2), 1-8.

<https://doi.org/10.1016/j.nepr.2020.102841>

- Burbules, N. C., Fan, G., & Repp, P. (2020). Five trends of education and technology in a sustainable future. *Geography and Sustainability*, 1(2), 93–97. <https://doi.org/10.1016/j.geosus.2020.05.001>
- Cheung, S. K. S., Kwok, L. F., Phusavat, K., & Yang, H. H. (2021). Shaping the future learning environments with smart elements: challenges and opportunities. *International Journal of Educational Technology in Higher Education*, 18(1), 1–9. <https://doi.org/10.1186/s41239-021-00254-1>
- Dahalan, F., Alias, N., Shahril, M., & Shaharom, N. (2024). Gamification and Game Based Learning for Vocational Education and Training: A Systematic Literature Review. In *Education and Information Technologies* (Vol. 29, Issue 2). Springer US. <https://doi.org/10.1007/s10639-022-11548-w>
- Estrada Guillén, M., Monferrer Tirado, D., & Rodríguez Sánchez, A. (2022). The impact of COVID-19 on university students and competences in education for sustainable development: Emotional intelligence, resilience and engagement. *Journal of Cleaner Production*, 380(November 2021), 1–9. <https://doi.org/10.1016/j.jclepro.2022.135057>
- Evripidou, S., Georgiou, K., Doitsidis, L., Amanatiadis, A. A., Zinonos, Z., & Chatzichristofis, S. A. (2020). Educational Robotics: Platforms, Competitions and Expected Learning Outcomes. *IEEE Access*, 8, 219534–219562. <https://doi.org/10.1109/ACCESS.2020.3042555>
- Ferrero, M., Vadillo, M. A., & León, S. P. (2021). A valid evaluation of the theory of multiple intelligences is not yet possible: Problems of methodological quality for intervention studies. *Intelligence*, 88(September), 1–14. <https://doi.org/10.1016/j.intell.2021.101566>
- Freedberg, D. E., Conigliaro, J., Wang, T. C., Tracey, K. J., Callahan, M. V., Abrams, J. A., Sobieszczyk, M. E., Markowitz, D. D., Gupta, A., O'Donnell, M. R., Li, J., Tuveson, D. A., Jin, Z., Turner, W. C., & Landry, D. W. (2020). Famotidine Use Is Associated With Improved Clinical Outcomes in Hospitalized COVID-19 Patients: A Propensity Score Matched Retrospective Cohort Study. *Gastroenterology*, 159(3), 1129–1131.e3. <https://doi.org/10.1053/j.gastro.2020.05.053>
- García-Lázaro, I., Conde-Jiménez, J., & Colás-Bravo, M. P. (2022). Integration and Management of Technologies Through Practicum Experiences: A Review in Preservice Teacher Education (2010–2020). *Contemporary Educational Technology*, 14(2), 1–9. <https://doi.org/10.30935/cedtech/11540>
- García-Martínez, I., Gutiérrez Cáceres, R., Luque de la Rosa, A., & León, S. P. (2021). Analysing educational interventions with gifted students. Systematic review. *Children*, 8(5), 1–15. <https://doi.org/10.3390/children8050365>
- Georgiou, G. K., Guo, K., Naveenkumar, N., Vieira, A. P. A., & Das, J. P. (2020). PASS theory of intelligence and academic achievement: A meta-analytic review. *Intelligence*, 79(January), 1–61. <https://doi.org/10.1016/j.intell.2020.101431>
- Girón-garcía, C., & Fortanet-gómez, I. (2023). English for Specific Purposes Science dissemination videos as multimodal supporting resources for ESP teaching in higher education. *English for Specific Purposes*, 70(2), 164–176. <https://doi.org/10.1016/j.esp.2022.12.005>
- Gkintoni, E., Halkiopoulos, C., & Antonopoulou, H. (2022). Neuroleadership as an Asset in Educational Settings: An Overview. *Emerging Science Journal*, 6(4), 893–904. <https://doi.org/10.28991/ESJ-2022-06-04-016>
- González-pérez, L. I., & Ramírez-montoya, M. S. (2022). Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review. *Sustainability (Switzerland)*, 14(3), 1–31. <https://doi.org/10.3390/su14031493>
- Guill, M. E., Tirado, D. M., & S, A. R. (2022). The impact of COVID-19 on university students and competences in education for sustainable development: Emotional intelligence ,

- resilience and engagement. *Journal of Cleaner Production*, 380(November 2021), 1-9. <https://doi.org/10.1016/j.jclepro.2022.135057>
- Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, 102(May), 101586.1-13. <https://doi.org/10.1016/j.ijer.2020.101586>
- Hainora Hamzah, Mohd Isa Hamzah, & Hafizhah Zulkifli. (2022). Systematic Literature Review on the Elements of Metacognition-Based Higher Order Thinking Skills (HOTS) Teaching and Learning Modules. *Sustainability (Switzerland)*, 14(2), 1-15. <https://doi.org/https://doi.org/10.3390/su14020813>
- Hairudin, S. N., Ariffin, K., Nor, M., Ibrahim, A., Mello, G. De, Husin, M. S., Omar, N. H., & Ishak, N. (2023). Effectiveness of Integrating Multiple Intelligence Theory in English Teaching and Learning: A Systematic Literature Review. 19(4), 717–727.
- Hwang, G., Sung, H., Chang, S., & Huang, X. (2020). Computers and Education: Arti fi cial Intelligence A fuzzy expert system-based adaptive learning approach to improving students ' learning performances by considering affective and cognitive factors. *Computers and Education: Artificial Intelligence*, 1(August), 100003.1-15. <https://doi.org/10.1016/j.caeai.2020.100003>
- Jan, A. (2020). Social Sciences & Humanities Open A phenomenological study of synchronous teaching during COVID-19: A case of an international school in Malaysia. *Social Sciences & Humanities Open*, 2(1), 100084.1-9. <https://doi.org/10.1016/j.ssaho.2020.100084>
- Kumar, A., Krishnamurthi, R., Bhatia, S., Kaushik, K., Ahuja, N. J., Nayyar, A., & Masud, M. (2021). Blended Learning Tools and Practices: A Comprehensive Analysis. *IEEE Access*, 9(4), 85151–85197. <https://doi.org/10.1109/ACCESS.2021.3085844>
- Ley, T., Tammets, K., Pishtari, G., Chejara, P., Kasepalu, R., Khalil, M., Saar, M., Tuvi, I., Väljataga, T., & Wasson, B. (2023). Towards a partnership of teachers and intelligent learning technology: A systematic literature review of model-based learning analytics. *Willy, May*, 1397–1417. <https://doi.org/10.1111/jcal.12844>
- Liu, Y. (2022). Effects of problem-based learning instructional intervention on critical thinking in higher education: A meta-analysis. *Thinking Skills and Creativity*, 45(May), 1-21. <https://doi.org/10.1016/j.tsc.2022.101069>
- Mavrelou, M., & Daradoumis, T. (2020). Exploring multiple intelligence theory prospects as a vehicle for discovering the relationship of neuroeducation with imaginative/waldorf pedagogy: A systematic literature review. *Education Sciences*, 10(11), 1–26. <https://doi.org/10.3390/educsci10110334>
- Mertala, P., Fagerlund, J., & Calderon, O. (2022). Computers and Education: Artificial Intelligence Finnish 5th and 6th grade students ' pre-instructional conceptions of artificial intelligence (AI) and their implications for AI literacy education. *Computers and Education: Artificial Intelligence*, 3(May), 100095.1-11. <https://doi.org/10.1016/j.caeai.2022.100095>
- Meta-analysis, E. E. F. A. (2023). Effectiveness of science-technology-society (STS) approach on students ' learning outcomes in science. *Journal of Technology and Science Education*, 13(3), 718–739.
- Miseliunaite, B., Kliziene, I., & Cibulskas, G. (2022). Can Holistic Education Solve the World's Problems: A Systematic Literature Review. *Sustainability (Switzerland)*, 14(15), 1-22. <https://doi.org/10.3390/su14159737>
- Muhtar, T., Supriyadi, T., Lengkana, A. S., Hadist, S., & Cukarso, I. (2021). Character Education in Physical Education Learning Model: A Bibliometric Study on 2011-2020 Scopus Database. *International Journal of Human Movement and Sports Sciences*, 9(6), 1189–1203. <https://doi.org/10.13189/saj.2021.090613>
- Nurtanto, M., Pardjono, P., Widarto, W., & Ramdani, S. D. (2020). The effect of STEM-EDP in

- professional learning on automotive engineering competence in vocational high school. *Journal for the Education of Gifted Young Scientists*, 8(2), 633–649. <https://doi.org/10.17478/JEGYS.645047>
- Paschen, U., Pitt, C., & Kietzmann, J. (2020). Artificial intelligence: Building blocks and an innovation typology. *Business Horizons*, 63(2), 147–155. <https://doi.org/10.1016/j.bushor.2019.10.004>
- Prelitz, K., Szydlowski, N., Roy, M., Davis, A., Agee, A., & Chan, E. K. (2023). The Journal of Academic Librarianship How ethnic studies faculty use streaming video: Instructional needs , applications , and challenges. *The Journal of Academic Librarianship*, 49(2), 102654.1-11. <https://doi.org/10.1016/j.acalib.2022.102654>
- Purwanto, Y., Suprpto, Munaf, D. R., Albana, H., Marifataini, L., Siregar, I., & sumarni. (2023). The peace education concept and practice at universities: A systematic review. *Cogent Education*, 10(2), 1-15. <https://doi.org/10.1080/2331186X.2023.2260724>
- Putri, H. E., & Indonesia, U. P. (2020). Increasing self-regulated learning of elementary school students through the concrete-pictorial-abstract approach during the COVID-19 pandemic. *Premiere Educandum: Journal of Basic Education and Learning*, 10(2), 187–202. <https://doi.org/10.25273/pe.v10i2.7534>
- Ray, P. P. (2023). Internet of Things and Cyber-Physical Systems ChatGPT: A comprehensive review on background , applications , key challenges , bias , ethics , limitations and future scope. *Internet of Things and Cyber-Physical Systems*, 3(April), 121–154. <https://doi.org/10.1016/j.iotcps.2023.04.003>
- Rowe, F. (2020). International Journal of Information Management Contact tracing apps and values dilemmas: A privacy paradox in a neo- liberal world. *International Journal of Information Management*, 55(June), 102178.1-5. <https://doi.org/10.1016/j.ijinfomgt.2020.102178>
- Samways, M. J., Barton, P. S., Birkhofer, K., Chichorro, F., Deacon, C., Fartmann, T., Fukushima, C. S., Gaigher, R., Habel, J. C., Hallmann, C. A., Hill, M. J., Hochkirch, A., Kaila, L., Kwak, M. L., Maes, D., Mammola, S., Noriega, J. A., Or, A. B., Pedraza, F., ... Cardoso, P. (2020). Solutions for humanity on how to conserve insects. *Biological Conservation*, 242(February), 1-15. <https://doi.org/10.1016/j.biocon.2020.108427>
- Shafiee, S., Lied, L. M., Burud, I., Dieseth, J. A., Alsheikh, M., & Lillemo, M. (2021). Sequential forward selection and support vector regression in comparison to LASSO regression for spring wheat yield prediction based on UAV imagery. *Computers and Electronics in Agriculture*, 183(1432), 106036.1-9. <https://doi.org/10.1016/j.compag.2021.106036>
- Tank, T., Yunus, D., & Veli, B. (2020). Efficiency of digital and non-digital educational games : A comparative meta-analysis and a meta- thematic analysis. *Journal of Research on Technology in Education*, 0(0), 1–41. <https://doi.org/10.1080/15391523.2020.1743798>
- Temitayo, I., Adewale, S., Sunday, S., & Dixon, R. A. (2022). Investigating learners ' competencies for artificial intelligence education in an African K-12 setting. *Computers and Education Open*, 3(August 2021), 100083.1-12. <https://doi.org/10.1016/j.caeo.2022.100083>
- Tratras Contis, E., & Abdallah, B. (2021). Sustaining Solutions in Undergraduate STEM Education. *Athens Journal of Sciences*, 8(3), 199–212. <https://doi.org/10.30958/ajs.8-3-3>
- Tsz, D., Ng, K., Ka, J., Leung, L., Kai, S., Chu, W., & Shen, M. (2021). Computers and Education : Artificial Intelligence Conceptualizing AI literacy : An exploratory review. *Computers and Education: Artificial Intelligence*, 2(2), 100041.1-11. <https://doi.org/10.1016/j.caeai.2021.100041>
- Tsz, D., Ng, K., Lee, M., Jun, R., Tan, Y., Hu, X., Downie, J. S., Kai, S., & Chu, W. (2022). A review of AI teaching and learning from 2000 to 2020. In *Education and Information Technologies* (Issue December). Springer US. <https://doi.org/10.1007/s10639-022-11491-w>
- Viallon-galinier, L., Hagenmuller, P., & Lafaysse, M. (2020). Cold Regions Science and

- Technology Forcing and evaluating detailed snow cover models with stratigraphy observations. *Cold Regions Science and Technology*, 180(September), 103163.1-13. <https://doi.org/10.1016/j.coldregions.2020.103163>
- Wooten, J. (2019). Integrating Discussion and Digital Media to Improve Classroom Interaction. *SSRN Electronic Journal*, September. <https://doi.org/10.2139/ssrn.3429007>
- Yusof, R., Mokhtar, M., Nur, S., Sulaiman, A., Syafril, S., & Mohtar, M. (2020). Consistency between personality career interest with sciences field among gifted and talented students. *Journal for the Education of Gifted*, 8(3), 1147–1161.
- Zein, S., Sukyadi, D., Hamied, F. A., & Lengkanawati, N. S. (2020). English language education in Indonesia: A review of research (2011-2019). *Language Teaching*, 53(4), 491–523. <https://doi.org/10.1017/S0261444820000208>