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The Transformation of Junior High School Mathematics Teachers in Yogyakarta to Enhance AI-Driven Numeracy Literacy for Regional Education Standardization Assessment (ASPD)

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Abstract: The modest rise in the Programme for International Student Assessment (PISA) in numeracy literacy necessitates that junior high school students improve their numeracy literacy skills by incorporating Artificial Intelligence (AI) into Mathematics instruction. Comprehending numeracy literacy is crucial for students to effectively address questions in the Regional Education Standardization Assessment (ASPD). Teachers are important figures in the success of Indonesia's human resources that are AI literate. The problem that occurs in facing the industrial revolution is the literacy ability of adolescent students in Indonesia. Have the teachers commenced the implementation of numeracy and literacy-based learning activities? What methods do mathematics teachers employ to instruct students in numeracy literacy issues? In what ways do mathematics teachers employ Artificial Intelligence (AI) to tackle the Regional Education Standardization Assessment (ASPD)? This research method utilizes a qualitative technique. The research period is scheduled for August 2024 in Yogyakarta. The research subjects are Mathematics teachers at three junior high schools in Yogyakarta. The research findings indicate that junior high school mathematics teachers have already adopted AI-driven transformation with their students; nevertheless, the learning pace differs for teachers and students, as demonstrated by the ASPD scores. Adaptive teachers provide learning activities that correspond with contemporary circumstances by integrating numeracy literacy into daily living, thereby aiding students in addressing ASPD challenges.

Keyword: Numeracy literacy, Mathematics, Junior High School, Regional Education Standardization Assessment (ASPD), Artificial Intelligence (AI)

INTRODUCTION

Indonesia is a nation that embraces modern innovations, integrating all aspects of technological progress into various industries that compete to utilize artificial intelligence (AI). Technology transfer, integral to advancing the 4.0 industrial revolution, necessitates preparation and qualified human resources in artificial intelligence; it cannot occur instantaneously. The preparation of resources for technological breakthroughs is linked to the

educational frameworks established in Indonesia. The educator plays a crucial role in the success of Indonesia's AI-literate human resources. The challenge encountered in addressing the industrial revolution is the literacy proficiency of adolescents in Indonesia. The Ministry of Education (kemendikbud, 2017) defines secondary schools that advocate for the school literacy movement as institutions that foster not only proficiency in (a) reading and writing but also include (b) numeracy, (c) science, (d) digital literacy, (e) financial literacy, (f) cultural awareness, and citizenship, which ultimately influence behaviors in everyday life.

The term "literacy" is derived from "literatus," signifying "a learned individual." Literacy refers to an individual's capacity to read, write, communicate, compute, and resolve issues at a requisite skill level essential for daily living, as the Comprehensive Dictionary of the Indonesian Language (KBBI) defines. Literacy is also associated with the term "language." Numeracy refers to the capacity to utilize mathematical concepts and principles in daily life scenarios (Tim Gerakan Literasi Nasional, 2017). In the digital age and the face of disruption, significant measures must be undertaken to elevate the quality of human resources, encompassing the enhancement of literacy and numeracy alongside technological adaptation. Numeracy literacy refers to the capacity to (a) employ diverse numerical representations and mathematical symbols to address practical issues in various daily situations and (b) evaluate information displayed in multiple formats, including graphs, tables, and charts, subsequently utilizing the analysis to forecast and make informed decisions (Kemendikbud, 2017). The consequences of low literacy stated in various sources taken can be concluded: (1) many millennials are lazy generations, (2) low knowledge possessed by the millennial generation, so they are unable to compete with other regions and even foreign countries, (3) skin gets a job because of lack of knowledge, the young generation who are lazy to read will find it difficult to socialize because of lack of insight, (4) the millennial generation will find it difficult to develop their potential because of lack of knowledge, (5) many millennials do not care about the surrounding environment and tend to have a sense of egoism because they are busy with smartphones. There are several events to increase literacy, namely: students must be able to fight laziness for literacy, get used to reading, with routine literacy will get used to literacy in any situation, gather with fellow literacy hobbyists if they are lazy to, start asking how they overcome the problem, discuss and join the literacy community, have a list and collection of popular books or recommendations.

The Indonesian Education Report indicates that the numeracy skills of junior high school students have remained at a moderate level since 2021, rising by 3.79 from 36.84% to 40.63% (kemendikbud, 2017). Numerous research initiatives have examined the correlation between literacy and numeracy. Additional research has examined literacy and numeracy competencies across elementary, junior high, and high school levels, emphasizing numeracy literacy in addressing unstructured challenges in primary education (Kemendikbud, 2017); (Puspaningtyas, N. D., & Ulfa, 2020). Despite literacy and numeracy being distinct competencies, various factors affect the literacy and numeracy skills of Australian junior high school students (Rothman, S., & McMillan, 2023). The PISA (Programme for International Student Assessment) assessment indicates that there has been no notable enhancement in the mathematical literacy ranking of Indonesian students aged 15 from 2009 to 2015. In 2009, Indonesia was positioned 68th out of 74 countries, and in 2012, its performance was comparatively poor, placing 64th out of 65 countries. In the 2015 PISA results, Indonesia's ranking modestly increased to 63 out of 72 nations, while its mathematics score decreased from 386 in 2015 to 379 in 2018, positioning it below the average among 79 participating countries (Tohir, 2020). In 2018, the Organisation for Economic Cooperation and Development (OECD) reported a math score of 379, whereas the OECD average was 487. In 2022, there was an elevation of 5-6 ranks relative to 2018 (kemendikbud, 2017; ditpsd.kemendikbud.go.id). The data indicates that Indonesian students' mathematical literacy skills are much inferior to those of other nations participating in PISA (Ayuningtyas, Nurina & Sukriyah, 2020).

The availability of smartphones and other suitable devices during online learning might raise students' motivation and improve their comprehension of mathematical subjects (Safitri, R.A., Megantara, B.A., Darmadi, Saadah, A.M., Widyawati, I.O., Budiarto, K.D., 2021). Moreover, there is a heightened interest in learning when educational activities are conducted; it is essential to cultivate a habit of numeracy literacy (Basri, B., Rahayu, A., Rahmadani, F.S., Wulandari, E.P., Yasmun, A.N., Akbaret, 2023). Recent advancements in Research and Development (R&D) seek to enhance students' critical thinking by introducing contextual challenges exemplified through social arithmetic. The module created utilizing the ADDIE paradigm (Analyze, Design, Develop, Implement, and Evaluate) is founded on Problem-Based Learning (PBL). Research findings demonstrate that the PBL-based social arithmetic module is valid, practical, and beneficial for students (Ramadhany, A., & Prihatnani, 2020). The changing times are having an impact on Indonesian education, leading to a change in Indonesia's educational goals (Hignasari, Putri and Wijaya, 2023).

The competency-based curriculum introduced in 2004 started incorporating Ki Hajar Dewantara's educational principles emphasizing freedom and humanization. In 2022, the autonomous curriculum fully embraced the principles of Ki Hajar Dewantara by implementing diverse pedagogical approaches and prioritizing the attainment of student competencies both individually and collectively. The independent curriculum is characterized by a student-centered approach, differentiation, and promoting the Pancasila student profile ideals. Students have access to learning resources supplied by both teachers and additional educational entities that fulfill academic Standardizations, allowing them the autonomy to think and study freely. This aligns with Ki Hajar Dewantara's concept of emancipating students' thought processes (Thariq, Z.Z.A., Karima, 2023). Before implementing the autonomous learning curriculum, schools had a teacher-centered method, concentrating on the teacher, before transitioning to an emphasis on student knowledge. Beginning with the students' experiences, school educational activities can be conducted with the teacher as a facilitator and communicator (Arfandi, A., & Samsudin, 2021). Martinez Otero (2007) defines academic achievement as "the product given by the students and it is usually expressed through school grades" from the perspective of humanity (Farillon, Farillon and Farillon, 2022).

The Competency-Based Curriculum aligns with the educational approach established by Ki Hajar Dewantara, which uses the among system (Febriyanti, 2021). Among is a system that encapsulates familial bonds and is rooted in the principles of nature and liberty. This system is designated as the "Tut Wuri Handayani" system based on its operational method. In this mentorship approach, the pamong (teacher) must exemplify "Ing Ngarsa Sung Tuladha" (to set an example in the frontline), "Ing Madya Mangun Karsa" (to cultivate creativity in the midst), and "Tut Wuri Handayani" (to guide from behind by providing a positive influence). The three powers must develop concurrently, as prioritizing one may impede human progress (Niyarci, 2022). Simultaneously, cultivating these three powers can facilitate the humanization process in education, enhancing the humanity of individuals. Educating individuals to attain noble humanity will be supported; teachers must exemplify role models for their students. Humanization in education cannot be realized without a commendable exemplar (Noviani, Y., Rajab R.M., Hashifah, 2017). Ki Hadjar Dewantara indirectly facilitated an environment for teachers to adapt to evolving circumstances.

Yogyakarta is a city that evaluates student competencies at the terminal stages, specifically, the sixth grade of Elementary School (SD) and the ninth grade of Junior High School (SMP), utilizing the Regional Education Standardization Assessment (ASPD) instrument. The objective is to comprehend the evolution of education in the region, discern strengths and shortcomings, and offer recommendations for enhancing classes. ASPD is a criterion for admission to Senior High School (Purnasari, P.D., Sadewo Y., Santosa, D.S.S., 2024). Shepard asserts that ASPD provides critical insights for regional educational policy decision-making (Rahmawanto I., Rigiati, 2023). The outcomes of this evaluation can be

utilized to discern effective educational programs or tactics, spend resources judiciously, and enhance the curriculum and instruction at academic institutions.

Teachers face challenges in integrating technology into education. Teachers must capitalize on opportunities associated with this integration (Subroto, D., Supriandi, Wirawan, R., Rukmana, 2023). The need for sufficient cell phones and other devices can impede learning (Safitri, R.A., Megantara, B.A., Darmadi, Saadah, A.M., Widyawati, I.O., Budiarto, K.D., 2021). Moreover, the application of Artificial Intelligence (AI) can substantially enhance the efficacy of students' learning processes, contribute to the cultivation of competencies and collaborative learning, validate the success of educational initiatives, and improve performance outcomes (Oktavianus, A.J.E., Naibaho, L., Rantung, 2023). AI delivers immediate feedback to teachers and students via sophisticated evaluation systems that promptly evaluate student performance and provide specific recommendations for enhancement (Ifenthaler, D., & Schumacher, 2023). In learning, especially literacy, AI is often used for various teaching needs carried out by educators, such as: Customization in Learning: AI can evaluate student learning outcomes and present materials that are appropriate to the needs and ability levels of students. Increase student interaction and learning motivation: AI can make learning media more interactive and interesting by using applications such as chatbots, educational games, and simulations. Provide real-time feedback: AI can provide very fast and appropriate feedback to students on various tasks given to students. Make it easier for educators to provide material: AI can make it easier for teachers to provide tasks such as making lesson plans (RPP), assessment of learning outcomes, and providing support to students who need it.

The slight rise in PISA scores in numeracy literacy necessitates that student enhance their numeracy literacy skills. Have the teachers commenced the implementation of numeracy and literacy-focused learning activities? In what ways may mathematics teachers utilize AI to improve numeracy literacy while addressing ASPD? An adaptable educator designs learning activities that are appropriate for the prevailing circumstances.

METHOD

This section is where you must review the current literature of your research variables do not give a general theory using only one or two sources, outdated sources, or no source at all. You show your understanding by analyzing and then synthesizing the information to (a) determine what has already been written on a topic, (b) provide an overview of key concepts, (c), identify major relationships or patterns, (d) identify strengths and weaknesses, (e) identify any gaps in the research, (f) identify any conflicting evidence, and (g) provide a solid background to a research paper’s investigation.

Research Design

This research method incorporates a qualitative approach. Researchers utilize qualitative research methods in naturalistic settings (Sugiyono, 2015). Qualitative research comprehensively seeks to comprehend the phenomena encountered by subjects, including perceptions, motivations, behaviors, and actions, through linguistic descriptions within a specific natural context, employing diverse natural methods (Moleong, 2005). Analysis of numeracy literacy using AI facing ASPD students using qualitative research methods. Qualitative methods according to Creswell are used because the problems studied are very complex and researchers intend to understand the situation in more depth and want to analyze further about teacher transformation towards student numeracy literacy which cannot be known using quantitative research methods. Then Creswell (2010) also stated that qualitative is a type of research that produces findings that cannot be achieved or obtained using statistical procedures or other methods of quantification. The type of research used in this qualitative research is grounded theory, with an emphasis on teacher transformation in student numeracy literacy. The selection of this method is based on the researcher's curiosity to conduct a more

in-depth analysis of teacher transformation in student numeracy literacy. In the end, a new theory can be formulated based on existing theories that can provide a clear picture of teacher transformation in student numeracy literacy. Grounded research offers a different approach from other types of qualitative research, such as phenomenology, ethnography, case studies and narratives. In qualitative research, grounded theory does not start from theory to produce a new theory but rather seeks to find a theory based on empirical theory, not building a theory deductively logically. Therefore, grounded theory releases theory and researchers go directly into the field to collect data. In other words, grounded model research moves from data to concepts. The data that has been obtained is analyzed into facts, and facts become concepts. Grounded theory is developed inductively during ongoing research and through continuous interaction with data in the field.

Sections Population and Sample

The study period in August 2024 was scheduled to occur in Yogyakarta. The research topic is a data source that can furnish information pertinent to the research problem under investigation. The method for selecting research subjects is purposive sampling, determined by particular criteria and goals (Sugiyono, 2015). The researchers established criteria for study participants as those engaged in the activities under investigation, possessing knowledge and comprehension of relevant information about the research. This research focuses on mathematics teachers at three junior high schools in Yogyakarta.

This study utilizes a triangulation strategy, wherein the researcher applies various techniques to get data from a singular source. Researchers employed observation and comprehensive interviews that anticipated several perspectives would yield findings that approximate truth (Moleong, 2005). Researchers designed interview questions for junior high school mathematics teachers in Yogyakarta. The researcher commenced the analysis of interview data to examine the methods employed by mathematics teachers in three junior high schools to utilize AI to deal with ASPD.

RESULTS AND DISCUSSION

Junior high school students aged 11 to 15 reach the formal operational period, characterized by the development of abstract thinking and logical reasoning for diverse issues. Their literacy and numeracy challenges and prior knowledge and experiences significantly aid students in addressing ASPD problems. Piaget identified four phases of cognitive development: (1) the sensorimotor stage, (2) the preoperational stage, (3) the concrete operational stage, and (4) the formal operational stage (Jeanette, 1981).

All teachers can elucidate the concept of numeracy literacy; however, confident teachers offer a more comprehensive explanation by addressing its multifaceted nature across several disciplines and its relevance to daily life through mathematical computations. The assertions of literacy concepts and facts, aligned with the attributes of Bloom's taxonomy in Mathematics, reside within the C3-C4 spectrum. Literacy is regarded solely at the conceptual level but is advanced to an analytical level. The only variation is in the teacher's approach to instruction, not in the content itself (Anderson, L.W.& Krathwohl, D.R.Anderson, L.W.& Krathwohl, 2017).

All interviewed teachers stated that initially, students perceived the literacy questions as tiresome due to the extensive texts. Nevertheless, one institution has facilitated it through collaborative literacy initiatives within the school. The school promotes collaborative literacy initiatives because not all students possess a conducive learning environment for literacy development (Vygotsky L. S, 1978). One of the schools has been biweekly conducting literacy programs for grades 7, 8, and 9. A teacher stated, “The school has instituted a literacy culture every Monday and Thursday; Mondays are dedicated to reading literacy across all subjects, while Thursdays concentrate on numeracy.” A journal exists for this purpose; it will be

recorded in the library, evaluated, and stamped, requiring the students to complete it. The numeracy and literacy activities on Mondays and Thursdays last 30 minutes, during which the students receive questions. They are instructed to solve them and document their responses in their journals.

Students are permitted to utilize gadgets to browse on Mondays and Thursdays. One of the schools features a reading space designed for students to read while awaiting their classmates after completing their homework and having remaining time. In preparation for the ASPD, implementing reading and numeracy literacy programs for all grades 7 to 9 corresponds with Thorndike's three learning principles. The principle of readiness: effective learning occurs when the individual is prepared to engage in the activity. The second principle is the law of exercise: proficiency in learning is achieved via extensive practice. The law of effect posits that learning is motivated when individuals recognize and attain favorable outcomes (Rahmawanto I., Rigiati, 2023).

A school has already instituted STEM instruction (Science, Technology, Engineering, and Mathematics) (Xie, Yu and Fang, Michael and Shauman, Kimberlee, 2015). They offer chances for students, wherein teachers facilitate “learning entrepreneurship” through collaboration with several disciplines, specifically Mathematics, Practical Arts, and Cultural Arts (conducting P5) by developing projects. Students participate in culinary arts, engage in cultural arts through packaging design, and acquire independent shopping skills while calculating profits and losses, gaining practical experience in numeracy literacy. The school has conducted an open market for the community in the schoolyard twice and has also extended an invitation to the Yogyakarta Education Office. Through the study of entrepreneurship, students can augment their competencies in literacy, numeracy, analytical skills, attention concentration, note-taking, retention, comprehension, and material review, as presented by the teacher (Sukmadinata N. S, 2005).

In the development of LKPD (Student Work Sheets) concerning teachers' preparedness for instruction and the design of teaching materials, particularly in numeracy literacy, two out of the three teachers interviewed indicated that they independently prepared the materials, asserting, “I prepare the material myself; only the template adheres to the Education Office's guidelines.” In designing numeracy literacy exercises, the two teachers employed the phrase stimulus, signifying “authentic for the students.” They stated, “Initially, there is a stimulus, followed by content that may encompass examples on climate, weather, statistics, numerical data, uncertainty, and geometry.” A teacher expanded on the Statistics content by presenting photographs of candidates for the student council president (OSIS) and subsequently inquired, “Where do you believe our lesson today is directed?” The students replied, “Totally, Ma'am, who won the OSIS election.” Ausubel contends that the primary determinant of student learning is the student's pre-existing knowledge (Sukmadinata N. S, 2005). It provides an alternative pedagogical model known as reception learning. Contextual, engaging, and modern stimuli for students can cultivate curiosity. This stimulation is especially pertinent to numeracy literacy (Suparno, 1997).

One of the schools conducts Regular literacy drills on Mondays and Thursdays, stating, “We drill on Mondays and Thursdays to cultivate the habit of reading.” David Ausubel and Floyd G. Robinson identified four modalities of the teaching and learning process: reception learning, discovery learning, meaningful learning, and rote learning (Sukmadinata N. S, 2005). Ausubel and Robinson differentiate between meaningful learning and mindless memorization. In rote learning, students endeavor to acquire and master the content presented by the teacher or read without comprehending its significance (Suparno, 2001). Meaningful learning encompasses the individual's cognitive structure and the subject matter being acquired. For a meaningful learning process to occur, the material must be substantially and systematically linked to the cognitive structure, students must possess concepts that correspond with the

material for connection, and students must be willing to integrate those concepts into their mental framework in a substantial and orderly manner (Bryce, T.G., & Blown, 2023).

During the preparation for literacy-based education, a teacher stated, “For instance, in statistics, students generate samples, and our sample space must facilitate differentiated learning.” I establish differentiation in both the process and the result (the product). When I organize the students into groups, one group consists of 8 individuals, and they generate data only among these eight members. However, the more astute individuals can operate within the entire class or potentially from outside the school, such as how parents drop off students, data derived from parents' occupations, or the distance from home to school. Students are granted the autonomy to generate data by the teacher; in this instance, “the students must first possess literacy to ascertain the material they will engage with, and subsequently, for numeracy, they must represent it in the form of data, which can be organized into tables or diagrams.” This is encompassed inside the literacy process, extending beyond mere literacy inquiries to the point where students may display their facts, produce effective infographics utilizing tools such as Canva and PowerPoint, and submit them to Google Drive.

Constructivism posits that knowledge is a construct individuals develop as they seek to comprehend a subject. An individual who learns actively constructs understanding or information rather than merely absorbing it from teachers, engaging in the ongoing development of knowledge within the educational process (Suparno, 1997). Jean Piaget's Theory of Cognitive Development posits that an individual's knowledge progresses through distinct stages from infancy to adulthood. Students acquire knowledge. The teacher does not merely impart knowledge; the students organize, reflect upon, and construct that knowledge. The development of an individual is influenced by the maturity of their organs, nervous system, and physical state (Suparno, 2001).

As articulated by two teachers, the numeracy literacy learning paradigm entails “collaborating with tablemates,” while another teacher incorporated the NHT (Numbered Heads Together) strategy within groups (Diana, L.M., Arif, M., Stefany, E.M., Aini, 2023). This method facilitates students who comprehend the material to instruct those who do not. The teacher arranges groups according to the criterion that students with comprehension collaborate with those without understanding, intending to enhance learning results (Rijal, M., Mastuti, A.G., Safitri, D., Bachtiar, S., Samputri, 2021). The application of NHT transpires when the teacher announces a number (for instance, the teacher requests number 4), and the student assigned that number is accountable for responding. The accuracy of the answer affects the group's score, as members are prohibited from aiding one another. All group members must comprehend the responses during the discussion, necessitating collaboration and mutual support between competent and ordinary students. If the teacher calls a number during the group session and cannot respond, the group will earn a low score, resulting in the same grade for all members. If the group members successfully answer the teacher's question, the entire group will receive a favorable score from the teacher. This corresponds with Piaget's assertion that three categories of constructivism are contingent upon the entity responsible for knowledge development. Initially, personal-psychological constructivism underscores that an individual independently constructs knowledge. Secondly, sociological constructivism posits that society is the architect of expertise. Third, sociocultural integrates both social and individual construction. Concurrently, an educator continues to use the lecture method. (Vygotsky, 1978).

They use Google Classroom, Canva, Quizizz, PowerPoint, Zoom meetings, and projectors. All schools possess projectors, except one institution that has not fully utilized them due to having only one projector. Two teachers have employed all these media in their institutions despite a regulation mandating students relinquish their devices; they may utilize them if necessary for examinations. “If intended for educational purposes, they may be retrieved later with the teacher's authorization.” Ausubel posits that an individual acquires knowledge by linking new events to pre-existing schemas (Bryce, T.G., & Blown, 2023).

During this process, individuals may either augment or alter their existing schemas. One can synthesize their acquired knowledge through the learning process. Vygotsky proposed that two categories of concepts exist: spontaneous concepts and scientific ones (Vygotsky L. S, 1978). Spontaneous concepts originate from daily experiences, whereas scientific concepts are acquired through formal education. Spontaneous notions arise from particular events and lack logical coherence within a system of thought, whereas scientific concepts are integrated into a systematic framework (Suparno, 1997).

Two teachers articulated the difficulties in numeracy literacy regarding the formulation of new questions, asserting, “We require time to read initially to generate ideas; it must be narrative-driven to avoid appearing awkward, and occasionally, even when we comprehend the narrative, the numerical values do not align.” Vygotsky further delineated two categories of concepts: spontaneous concepts and scientific concepts. Spontaneous concepts originate from daily experiences, whereas scientific concepts are acquired through formal education. Spontaneous notions arise from particular instances and lack logical coherence within a systematic framework, whereas scientific concepts are integrated into a cohesive system of thought (Suparno, 1997). Literacy, especially in schools, as the ability to access, understand, and use information intelligently, while numeracy competence means the ability to analyze using numbers. Good numeracy literacy will be able to produce students who have skills in applying mathematics with confidence, both in school learning and in everyday life. Mathematics learning is closely related to numeracy literacy in the process of its application, numeracy literacy is the knowledge and skills to use various numbers and symbols related to basic mathematics to solve real problems in different everyday life situations, in order to provide information in different formats, be it graphs, tables, or charts, then use the interpretation of the analysis results for decision making.

A teacher stated that he participated in Facebook groups focused on discussions over the Olympic Summer Games (OSN) and the Programme for International Student Assessment (PISA). These lessons can be assigned to students for study. “I become a member of an engaging learning community on Facebook that shares content regarding OSN.” Utilizing Facebook as a social media platform to enhance and refine math lesson plans to address ASPD has been considered adequate. This also assists teachers in acquiring references when writing about numerical literacy. The teacher offers a 24-hour question and answer session for students struggling to complete given activities. "I provide the students with my WhatsApp number to facilitate communication whenever they encounter challenges in their mathematics studies." This exemplifies a teacher's guidance regarding student behavior, akin to Mangunwijaya's assertion that students are directed through the emancipation process with three objectives: Human explorer (who enjoys inquiry and exploration and acknowledges students responding to prevailing questions). 2) Human creativity (e.g., innovative, open-minded, critical, imaginative, and resilient in adversity). The integral individual (aware of life's multidimensionality, recognizes the potential for alternate pathways, excels in making prudent choices grounded in sound reasoning, and embraces the diversity of existence, yet possesses the ability to synthesize it within a coherent framework) (Mangunwijaya, 2004).

CONCLUSION

Research on literacy and numeracy in Indonesia, namely in Yogyakarta, indicates that while progress has been made, other difficulties still need to be solved to confront the digital and AI-driven industrial revolution 4.0. While increasing yearly, junior high school students' literacy and numeracy skills continue to be troubling internationally, particularly as indicated by the PISA test results. This signifies the necessity for more efficacious measures from diverse stakeholders to improve Indonesia's education quality.

This research underscores the significance of a cohesive and flexible educational framework, wherein teachers are pivotal in implementing pedagogical approaches that align

with contemporary demands. Education emphasizing cultivating critical, analytical, and creative thinking skills and employing technology and numeracy-oriented methods is essential. Integrating AI in education can be helpful, yet it presents obstacles for teachers who must acclimate to the swift technological changes. The absence of amenities, such as smartphones or other suitable devices, might be a significant obstacle, particularly in underdeveloped regions. Consequently, education policy should focus on curricular and pedagogical advancements and enhancing the educational infrastructure to guarantee equitable and high-quality student access.

Adopting the Merdeka Belajar curriculum and STEM-oriented education represents a substantial advancement. This facilitates an environment for students to engage in active and creative learning, design projects, and cultivate collaborative and interdisciplinary competencies. Educational approaches like Project-Based Learning (PBL) and Numbered Heads Together (NHT) are anticipated to assist students in linking theoretical concepts with practical applications while enhancing their willingness to learn. The application of Ki Hajar Dewantara's educational ideals, which promote intellectual freedom and creativity, remains pertinent and should be integrated into the contemporary school system. Establishing an inclusive and supportive academic environment is a collective obligation of schools, teachers, students, and public policy.

This research underscores that while reading and numeracy are fundamental components of education, the method must be holistic. Numeracy literacy encompasses the resolution of mathematical problems and the capacity to address real-world challenges that necessitate critical thinking skills. Conversely, augmenting student participation and motivation is essential for effective and meaningful learning. To address global issues and improve competitiveness, Indonesia must prioritize curriculum reform, teacher development, technological integration, and the enhancement of reading and numeracy from an early age. Through a planned and strategic approach, future generations are anticipated to be more equipped to navigate an increasingly competitive digital landscape. The following are the benefits of studying numeracy literacy for literacy friends who are still studying at school: (1)Strengthening and honing students' numeracy knowledge and skills in interpreting data, numbers, tables, graphs, and diagrams, (2) Improving students' verbal skills, analytical skills, thinking skills, and concentration skills, (3) Strengthening and shaping Indonesian human resources who can manage the wealth of natural resources (SDA) to be able to compete with other countries, (4) Applying numeracy literacy skills and knowledge to solve problems and make decisions in everyday life based on logical considerations, (5)Students will have the skills and knowledge to carry out good management and planning of activities in everyday life.

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