ARTIFICIAL INTELLIGENCE IN MATHEMATICS EDUCATION: A SYSTEMATIC REVIEW OF OPPORTUNITIES, CHALLENGES AND PEDAGOGICAL IMPLICATIONS

Salvador Magno XIMENES
Instituto Católico para a Formação de Professores (ICFP) Baucau (Timor-Leste)
salvadormx2018@gmail.com

Abstract

This systematic literature review examines the opportunities, difficulties, and educational implications of adopting artificial intelligence (AI) in mathematics education at the tertiary level in Timor-Leste. The review incorporates international evidence collected from 31 peer-reviewed studies published between 2016 and 2025 and presents it, given the realities of a higher education system in a developing country. These results demonstrate that AI, especially large language models like ChatGPT, has significant potential in terms of personalised instruction, customised feedback, and additional tutoring, which would solve the issue of teacher shortages and increase student interest. Despite these, there are still several obstacles, which include threats to academic integrity, algorithm biases, misalignment between cultures/languages, and a lack of infrastructure, particularly in rural areas. AI can be a game changer in mathematics education in Timor-Leste, which should be implemented strategically, in a context-sensitive way, and through strong policies, infrastructure investment, and long-term teacher education leadership.

Keywords: Artificial intelligence, Mathematics education, Higher education, ChatGPT, Timor-Leste.

1. Introduction

Most fields have embraced Artificial Intelligence (AI) as a revolutionary technology, and the educational sector is not resistant to these radical changes. In tertiary education, AI is seen increasingly as a driver of pedagogical innovation, and it can be especially effective in fields with large datasets, such as mathematics, where data insights and adaptive learning tools can enable highly individualised learning experiences. As a supposed gatekeeper subject within science, technology, engineering, and mathematics (STEM) education, mathematics can be particularly improved by AI-based tools that can check learning disabilities, create live feedback, and adapted lesson plans accordingly. AI-enabled educational technologies, including intelligent tutoring systems, automated online learning and math assessments, and predictive analytics, are transformational globally in how mathematics is taught and learnt (Zawacki-Richter et al., 2019). Nevertheless, the possible level of translation of such innovations into the reality of developing countries is an open and, in spite of that, important request.

Introducing AI into various fields, including mathematics education in Timor-Leste, presents complexities but also offers an attractive opportunity. There are significant constraints on the educational structure of the country, which is recovering and reconstructing after years of political instability. The limitations include the absence of digital infrastructure, limited internet connectivity, a shortage of AI-literate teachers, and a significant urban-rural gap in the availability of educational resources. Research findings on the integration of technologies in

sub-Saharan Africa and other developing regions would also imply that the lack of knowledgeable teachers or technical support and general underfunding of the system could play a key role in preventing the successful implementation of technologies in education (Molla et al, 2023). While the idea of digital transformation is gaining momentum, implementing AI-enhanced learning systems in that context remains quite complex. The implementation of AI can be fragile and unnecessary if there are active investments in teacher education and curriculum development, as well as the development of technological capabilities. Furthermore, the danger exists of expanding educational inequalities that are currently present because of the implementation of some sophisticated technologies without the support structures that are necessary to address their educational inequities.

Nevertheless, Timor-Leste also has a special opportunity to consider the integration of AI on a bottom-up scale. The flexibility in designing contextually appropriate and future-bound pedagogical strategies exists since its operative system of tertiary education is still in a growing phase. AI could be designed to fit the linguistic, cultural, and pedagogical details of the nation, for instance, could include a Tetum-language interface and culturally responsive mathematics content. Particularly, AI may address some of the institutional educators have to face barriers, such as overcapacity in the classroom, the unavailability of the latest textbooks, and the shortage of academic mathematics experts. As an example, AI-based tools can be used as virtual tutors and guide students through interactive learning solutions to problems even when a mathematics teacher is not qualified enough to take over the responsibilities (Luckin et al., 2016). Through this path, AI does not simply represent a tech supplement but could represent a primary element to a more comprehensive and efficient education system.

The systematic review suggested in the current study corresponds with the pattern through three overall questions, as follows:(1) What are the opportunities and challenges related to the integration of AI in the development of mathematics lessons at the tertiary level of education in Timor-Leste? What is the best way to align AI technologies with the pedagogical requirements for mathematics education across the country? What are the consequences of incorporating AI for improving the teaching strategies within Timor-Leste's higher education system? We aim to dissect the potential and challenges of integrating AI into a developing country's education system. This research aims to solidify a significant literature gap regarding AI and the teaching of mathematics in low-resource environments by undertaking a wide exploration of international best practices and a critical review of how these practices are relevant to Timor-Leste.

This study aims to increase the literature on the subject of AI in education because it focuses on the experiences of a less-discussed but more relevant section. In focusing the research on mathematics education as a major driving force of intellectual and economic growth. It highlights the concern that must be turned towards providing settings, knowledge, and techniques for 21st-century learning in the tertiary learning institutions of Timor-Leste. The results were likely to supply practical information to educators, policymakers, and technologists, thus concreting the way to future-proof, more inclusive, and more flexible mathematics teaching in Timor-Leste.

2. Literature Review

The use of Artificial Intelligence (AI) in the learning environment has been a topic that has garnered increased academic interest, especially in light of universities pursuing new methods of enhancing effectiveness and the quality of teaching and educating people. Mathematics education is one subject with abstract cognition that requires great intellectual insight. Therefore, AI has a promise of transforming all these pedagogical practices with adaptive teaching, automation, and individual feedback. The review of literature critically reflects the

discussions being discussed by academics regarding the potential use of AI, particularly the generative models such as ChatGPT, in teaching mathematics at the tertiary level. It discusses the possible and conceivable powers of AI along with its traditional restrictions and draws attention to its acceptance in the context of higher education in Timor-Leste.

2.1. Opportunities Offered by AI in Mathematical Education

The application of AI-related technologies has significantly transformed the instruction and teaching of mathematics (Meylani, 2024; Borah and Borah, 2024). Large language models (LLMs), such as ChatGPT, have the potential to optimise real-time communication, afford scaffolding of abstract concepts, and differentiate content in line with the needs of a particular learner (Cotton et al., 2023; Farrokhnia et al., 2023). Such affordances are especially useful in under-resourced or developing contexts, such as in Timor-Leste, where fewer qualified teachers and learning resources are available.

According to Wardat et al. (2023), ChatGPT can become a revolutionary tool in mathematics education, as it allows teaching students step-by-step explanations and helps them resolve such complicated problems. Likewise, Sánchez-Ruiz et al. (2023) demonstrate that ChatGPT has a positive impact on engineering mathematics courses, promoting student self-control and problem-solving strategies. Xiao and Zhi (2023) examined language education and found that learners considered ChatGPT a beneficial resource for completing tasks and reinforcing knowledge, according to a survey. This result suggests that studying mathematics would yield similar benefits since ChatGPT can respond.

Opportunities for personalisation in education also exist in the case of AI. Yu et al. (2017) also believe that AI-infused platforms are better suited to adapt to the learners' rate of progress and needs, thereby enhancing engagement and success. It adapts to the studies of Jeon and Lee (2023), who support the view of a complementary approach to interactions between AI tools and a human educator, with the main focus being on the ability of AI to add to what an instructor does, not substitute him or her. Further, it is essential to learn more about attitudes to AI usage. Kuleto et al. (2021) clarify that the willingness of students to use AI correlates with its effective use. Chan and Lee (2023) attached importance to the fact that there should be adjustments according to their generations in AI acceptance as an element of designing AI-enhanced curricula.

2.2. Challenges and Ethical Considerations

Despite the advantages, it is clear that incorporating AI into mathematics education raises several concerns, such as academic integrity is one of the pivotal problems (Seaton, 2020; Barrientos et al., 2024). AI-based tools such as ChatGPT put plagiarism and overdependency at risk, which may negatively affect students' self-thinking abilities and independent problem-solving skills (Michel-Villarreal et al., 2023; Cotton et al., 2023). The ethical implications go beyond malpractice to cover fairness, responsibility, and transparency in algorithms' decision-making.

Hwang and Tu (2021) observed that in spite of the offered support of routine activities, AI is problematic in dealing with higher-level mathematical thinking, and the implementation of this technology in pedagogy should be closely monitored. Lameras and Arnab (2021) confirmed the importance of critical ways of how to engage with AI technologies by educators, as following their uncritical adoption could increase existing inequities or pedagogical gaps. Moreover, Raji et al. (2021) note that the pedagogy of exclusion is a concern in the instruction of AI ethics because it contributes to the socialisation of social biases in education without an inclusive and critical design. These issues are close to the situation in Timor-Leste, where the level of digital literacy is different in various population groups, and the education policies concerning AI are not properly developed.

2.3. Frameworks for Effective Integration

In order to accommodate these issues, researchers promote structured, policy-based frameworks to inform how AI is put to use in university teaching (Jin et al, 2025). Chan (2023) presented a detailed AI policy education framework with pedagogic, operational, and governance aspects. The model requires such institutional policies that promote ethical integration, infrastructural development, and decision-making by means of including the stakeholders (Cacho, 2024).

Eager and Brunton (2023) also suggested that ethical literacy be integrated into curricula with the combination of AI so that students can negotiate both technical and social consequences of the technology. They agreed with previous studies conducted by Chen et al. (2022), where chatbot-based help with classroom interactions and student success was designed to demonstrate the necessity of effective AI integration as purpose-driven and learner-centred. This systematic order will be particularly pertinent in mathematical learning. According to Wardat et al. (2023) and Jeon and Lee (2023), it is possible to use AI successfully, and it will occur when human teaching and machine-generated assistance are aligned, so AI may complement, not substitute, the pedagogical objectives of the curriculum.

2.4. Knowledge Gaps and Future Research Directions

Even though there is continuously growing research on AI in education, there are still important knowledge gaps, particularly with regard to low-income countries such as Timor-Leste (Saldanha et al., 2024). Current research strengths predominantly focus on data from high-income countries, with little research on the long-term impact of adopting AI in resource-limited contexts. Longitudinal studies are urgently needed to evaluate the effect of AI on student learning outcomes, teacher performance, and overall institutional improvement in teaching mathematics. Instantly need longitudinal studies to evaluate the impact of AI on student learning outcomes, teacher performance, and overall institutional improvement in mathematics teaching.

Furthermore, there is a lack of knowledge regarding how people can modify AI to support inclusive education. Michel-Villarreal et al. (2023) and Chan (2023) underscore the need for AI tools that are culturally responsive and adaptable to various linguistic and social contexts. One possible path for future work would be to study how models such as ChatGPT can be localised, such as by adding Tetum or Portuguese language interfaces.

The incorporation of AI in the nature of mathematics learning is transformational, especially in settings like Timor-Leste, with structural and economic constraints in place with regard to educational systems. Although AI tools, such as ChatGPT, can promise more interaction, personalisation, and learner agency, they come with ethical, pedagogical, and institutional issues (Can et al., 2023; Asy'ari & Sharov, 2024). It will be necessary to respond with strong policy frameworks and professional development, as well as research-inclusive approaches. With the world already showing increasing interest in the possibilities of AI-enhanced learning. It is imperative that new systems, like that of Timor-Leste, be designed to take advantage of the potential of AI but offer protection to ensure the maintenance of educational integrity and equity.

3. Research Methods

3.1. Search Strategy and Source Selection

This study, a systematic literature review (SLR) approach was used to critically examine the implementation of artificial intelligence (AI) in mathematics, with a particular focus on its contextual applicability within the domain of the tertiary education domain in Timor-Leste.

A systematic review was chosen because it allows for a rigorous, transparent, and replicable synthesis of existing scholarly work (Snyder, 2019; Zawacki-Richter et al., 2019).

Academic databases, such as Scopus, Web of Science, ERIC, Google Scholar, and DOAJ, were used when conducting the literature search. Controlled vocabulary terms were used in combination with the Boolean operators to achieve maximum coverage. The main search terms were "Artificial Intelligence", "mathematics education", "AI in education", "higher education", "developing countries", "ChatGPT" or "large language models", "mathematics instruction", and "AI in education" and "Timor-Leste".

Only sources published between 2015 and 2023 were considered, as they had to be relevant to current AI capabilities and educational policies. Besides journal articles, grey literature (institutional reports) was used as well when regionally specific (e.g., regarding information on the educational infrastructure or teacher readiness in developing countries).

3.2. The Inclusion and Exclusion Criteria

The inclusion or exclusion criteria are well drawn to ensure the review's relevance and completeness (Arya et al, 2021; Prill, 2021). Studies were considered eligible when they were targeted at the use of artificial intelligence (AI) in mathematics or STEM learning in any higher education setting. In addition, considered pedagogical, ethical, or institutional aspects of AI integration and was published in professional, peer-reviewed, or other reputable professional sources in English in or after 2015. Other studies that seemed to fit the study criteria also provided either theoretical or empirical arguments for the research purpose. On the other hand, studies were excluded when they focused simply on primary or secondary learning, had no straightforward significance to higher learning or math learning, or lacked clear methodological reporting in spite of being peer-reviewed. This thorough review method resulted in an intellectual but contextually relevant database of literature that reflects the higher education landscape in Timor-Leste.

3.3. Study Selection Process

The methodology following the selection of studies was based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework (Moher et al., 2009; Arya et al, 2021). In the first search, 112 articles were found. Following duplicate removal and title/abstract screening, 68 studies were left over. These were put under full-text examination, where the 13 articles were further excluded because they did not follow the set entry criteria. The ultimate sample contained 31 studies whose in-depth analysis was carried out. The snowballing technique was also used to ascertain other pertinent studies via the bibliography of primary articles. Disagreements in the selection of studies were later on solved collaboratively among reviewers, as it is best practice in the methodology of SLRs (Thomas & Harden, 2008).

3.4. Quality Assessment

To identify studies of high methodological quality, the process of quality appraisal was conducted, and all of the selected studies were assessed using a slightly modified version of the Critical Appraisal Skills Programme (CASP) checklist (CASP, 2018). This instrument compared every study on several main points, such as the specificity of purposes; methodology appropriateness; relative context for education in the developing world; and the data reporting and analysis process should be straightforward.

The studies received ratings of high, moderate, and low quality. High-quality and moderate-quality studies were the only ones that remained in the final synthesis. The judgement not only emphasised that the results are based on reasonable and sound evidence, but it also acknowledged work that could have provided regional knowledge, such as the study by Molla,

Yayeh, and Bisaw (2023) on faculty competence in Ethiopia, which contributed contextual relevance to the literature despite its methodological limitations.

3.5. Data Extraction and Synthesis

The author established a structured data extraction form to ensure the systematic collection of pertinent information from each study. This form contained the bibliographic data—author names, publication year, and source—as well as contextual data, like the geographical location and relevant educational level. It also captured the specification and planned usage of AI tools like ChatGPT and adaptive learning systems and their aimed outcomes, including improved learning of the students and assistance in the work of teachers, as well as considerations of ethics. Additionally, the form listed barriers to the process of AI integration and distinguished solutions to address the barriers in integration. The obtained information was then broken into pieces and analysed by way of thematic analysis (Thomas & Harden, 2008) or recurrent coding, with the aim of producing the final themes and subthemes following the research questions. Four major topics have been identified: (1) personalisation and adaptive feedback as significant pedagogical possibilities (Yu et al., 2017; Wardat et al., 2023); (2) academic dishonesty, including such concepts as academic dishonesty, academic misconduct, and algorithmic bias (Michel-Villarreal et al., 2023; Cotton et al., 2023); and (3) institutional and infrastructural challenges, with poor funding and cyberilliteracy as examples (Tadesse & Gill, 2015).

4. Results and Discussion

4.1. Results

In this systematic literature review, evidence from 31 peer-reviewed studies was synthesised to answer the three guiding research questions mentioned in the introduction.

Opportunities and Challenges of AI Integration

The review provided evidence that there was room to develop mathematics education in Timor-Leste using AI. The research also showed consistent findings, supported by the ability of AI systems, especially large language models like ChatGPT, to individualise instruction by developing content according to the speed and needs of a particular student, explaining things step-by-step, and immediately providing feedback to facilitate conceptual learning (Yu et al., 2017; Wardat et al., 2023). The tools have the potential to fill in the teacher capacity gaps since they operate as supplementary tutors in situations with a shortage of qualified mathematics educators or discouragingly large class sizes. Moreover, previous studies conducted in other developing settings imply that AI can lead to increased engagement among students, increased learner autonomy, and thus the maintenance of persistence in mathematics learning (Sánchez-Ruiz et al., 2023; Xiao and Zhi, 2023).

However, the review also identified several significant issues that require attention to ensure the successful adoption of AI. The idea of academic dishonesty was prominent, with different research highlighting that depending too much on AI-solved tasks could negatively affect students' independent reasoning and problem-solving achievements and make students more prone to plagiarism (Michel-Villarreal et al., 2023; Cotton et al., 2023). Other problems, like algorithmic bias and cultural mismatch, were also mentioned, since systems developed in English-speaking settings by and large do not represent the same linguistic and cultural experience in Timor-Leste. Additionally, infrastructural constraints such as the unavailability of internet connectivity, technological device accessibility, and the lack of AI literacy among teachers are a significant barrier to the implementation, especially among the rural and underserved regions (Tadesse & Gillies, 2015; Molla et al., 2023).

Positioning AI in Pedagogical Needs

The results of the review highlighted the opinion that the effective introduction of AI in the teaching of mathematics is preconditioned by its consistency with the available pedagogical systems, school curricula, and cultural realities. In their work, scholars always tried to build a case that AI should not substitute the work of a teacher but only support it, allowing the latter to improve his or her practices without losing the relational and contextual aspect of teaching (Jeon & Lee, 2023). Culturally responsive and linguistically inclusive design was a critical need in the case of Timor-Leste, where the AI platform concerned needed to interface with the Tetum and Portuguese languages, and the interface was designed with the inclusion of locally relevant examples to make the platform accessible and relevant to all students nationwide.

The literature also referred to the value of integrating AI into instruction planning and the measuring techniques to facilitate more efficient instruction planning, formative assessment, and differentiated instruction (Chan, 2023; Eager & Brunton, 2023). The second theme that was replicated several times was ethical literacy in the use of AI, where the studies highlighted that focused education should be provided to not only educators but students as well. Alignment strategies of this nature are needed to ensure the pedagogical potential of AI is maximised as much as possible but does not violate academic integrity or inclusivity.

Teaching Strategies in Higher Education

The facts indicate that marrying AI with mathematics education (third-level) in Timor-Leste may revolutionise teaching methods in a few ways. AI tools can enhance the efficiency of the instructional process by automating tasks performed by instructors, such as grading and providing feedback. This automation allows instructors to free up their time and focus more on superior learning processes, including encouraging critical thinking, facilitating collaborative problem-solving, and training individual learners. Adaptive learning systems can improve learning outcomes by providing targeted interventions and timely assistance to overcome specific conceptual challenges faced by students.

Furthermore, using AI can promote pedagogical innovation, especially the use of blended and flipped learning paradigms, where students will access AI-supported pre-class content, and classroom time will still be interactive and application-driven. Nevertheless, there is a risk of increasing disparities between urban and rural learners due to unequal access to AI technologies and educational opportunities. The results also point to the fact that long-term professional growth will be crucial to making sure that teachers have the capability and confidence to successfully incorporate AI, keep up with the developments in technology, and sustain the quality and inclusivity of higher education mathematics education.

4.2. Discussion

The results of this systematic review provide a more intricate meaning to the prospects, alignment, and implications of Artificial Intelligence (AI) incorporation in the study of mathematics at the higher education level in Timor-Leste. The results demonstrate this potential transformative power, which, nevertheless, points to the need to plan, adapt to context, and ethically control comprehensively.

Opportunities and Challenges Contextually

Personalised learning, adaptive feedback, and the support of underqualified or overburdened teachers are identified as possibilities that are very appropriate in Timor-Leste, where the insufficient number of teachers and crowds that have to be taught commonly constrain individualised instruction. The potential of AI to engage as a virtual tutor correlates

with the priorities in the educational field in the country, providing an avenue through which the issues associated with the system can be touched upon without limiting it to the physical resources. The same result obtained in other developing settings (Wardat et al., 2023; Yu et al., 2017) repeats the usefulness of AI as a pedagogical tool rather than an added technological tool.

Nonetheless, concerns regarding academic integrity, algorithmic bias, and infrastructural constraints are particularly significant in Timor-Leste. Given the lack of AI literacy among faculty and the wide gaps between urban and rural connectivity, there are risks that early adoption may increase, rather than decrease, inequity. The lack of localised AI tools in Tetum or Portugal could potentially diminish accessibility and cultural proximity, thereby intensifying this threat.

Bringing AI into Consultation with Pedagogical Needs

The findings underscore the need for goal-oriented AI integration, with the entire process grounded in pedagogical principles. The human-AI collaboration is preferable to AI replacement in the sense that, in this case, technology is used to complement the experiences of an educator and does not replace the interpersonal and situational component of teaching (Jeon & Lee, 2023). Such an approach concurs with the constructivism methods in mathematics learning, where educators use guidance with inquiry and problem-solving to help learners.

A culturally responsive design of AI is especially important in Timor-Leste. This would not only increase comprehensibility but also inclusion, given that it would adapt the interfaces and instructional content to local languages and contexts. Without this type of adaptation, there is a risk of reinforcing linguistic stratifications that oppress students who are either outside the country or have a different first language. Both teachers and students need to be exposed to ethical literacy, which should become part of teacher professional development and student learning based on the recommendations made in the reviewed frameworks (Chan, 2023; Eager & Brunton, 2023). It is particularly topical because the worldwide community is worried about the possibility of AI promoting bias and revenue against academic integrity.

Implications of Teaching Strategies in Higher Education

The use of AI in mathematics teaching in Timor-Leste would trigger a transition to a more interactive and student-centered method. Through the automation of routine feedback and the creation of personalised learning pathways, AI enables teachers to dedicate more time to instructional tasks at a higher level, stimulates critical thinking, assists in problem-solving, and supervises project-based applications. However, it still needs to be noted that the possibility of achieving better learning outcomes relies on fair access to AI consumables as well as long-term teacher capacity building. Unless national governments make smart infrastructure investments, there is a significant risk of creating a two-tiered system where students in geographically privileged urban areas excessively utilise AI advancements while rural students fall further behind.

The literature also implies that the adoption of AI can promote blended and flipped learning models that concentrate on supporting independent learning with the help of AI and active classroom learning involvement. Although this can be a real asset in teaching mathematics, it must be adopted cautiously, given the technological capability and cultural needs of higher education institutions in Timor-Leste.

Management implications for Timor-Leste

Combined, the results and analysis lead to the conclusion that it is best to be cautious yet proactive about integrating AI into the education of mathematics in Timor-Leste. Since higher education is still developing in the country, it is in a unique position until now to implement AI

in a manner that is locally relevant, culturally responsive, and pedagogically sound. However, a cohesive plan that integrates efforts in policy creation, infrastructure investment, professional education, and the development of AI tools suitable for regional contexts will be the key factor.

5. Conclusion and Recommendation

5.1. Conclusion

The systematic literature review focused on the prospects, barriers, programmatic efforts, and the possible repercussions of embracing Artificial Intelligence (AI) in the teaching and learning of mathematics within tertiary education in Timor-Leste. A synthesis of 42 peer-reviewed articles demonstrated that AI promises significant changes to teaching and learning via the use of personalised instruction, adaptive feedback, and assistance for under-resourced or overstressed educational professionals. When applied correctly, AI technologies can help address long-standing issues in mathematics learning, such as large class sizes, teacher workforce shortages, and the lack of modern and tailored instructional methods, with learner interaction and independence being potential outcomes.

However, the findings also identified potential risks and limitations that require attention to fully realise the potential of AI in this area. The key obstacles to fair implementation include issues of academic integrity, bias in algorithms, and the lack of culturally specific AI that incorporates distinct linguistic features. These pressures are further aggravated by infrastructural constraints, especially poor internet connectivity, a lack of device accessibility, and low levels of literacy among educators, especially in rural and underserved regions.

As pointed out in the review, it is important that the implementation of AI is done through a pedagogical goal with the perspective of enhancing the use of educators rather than replacing them. The alignment with the local curricula, local cultures and language realities should be effective enough to make it accessible, inclusive and relevant. Furthermore, it is essential to integrate ethical literacy into the training of teachers and the learning of students to reduce the risks related to bias, transparency, and responsible use of AI.

Incorporating AI into Timor-Leste's tertiary mathematics education presents both opportunities and challenges. To fulfil its pioneering promise, policymakers, teachers, and institutional heads need to take a strategic, contextual view, which integrates infrastructural investment, teacher improvement, moral administration, and culture-sensitive design. It is only by making such measures synchronous that AI will become a driving force for more inclusive, effective, and future-focused mathematics education in Timor-Leste.

5.2. Recommendations

Policymakers ought to create a national AI-in-education policy that looks into the issues of infrastructure, governance, and ethical implications. This tactic should contain the specifications of the integration of AI into the tertiary mathematics course in such a way that it will complement the role of an educator, not merely substitute it.

The financing of digital infrastructure and the provision of dependable and equal access to digital devices capable of AI applications are fundamental to ensuring that the gap between rural and urban learners does not increase in the challenge of COVID-19. Culturally and linguistically responsive artificial intelligence tools should be developed to ensure inclusivity and relevance for local communities. The Tetum and Portuguese languages should be integrated into the AI applications, and the examples used should also be relevant to the locals to make them more inclusive, culturally friendly, and engaging.

The ethical utilisation of AI must be integrated into teacher training programmes and student lessons where the use and emphasis are on transparency, bias reduction and the ethical use of AI-generated outputs.

More holistic capacity-building programs are also required to prepare teachers with the technical expertise, methodologies, and confidence to use AI tools in mathematics instruction.

AI can facilitate blended and flipped learning, enabling active, student-centred learning with solid pedagogical foundations.

There needs to be longitudinal assessments to track the progress of the benefits of AI integration in impending results and teacher behaviours, as well as the institutions' achievements, which should be a consistent positive activity and sustainable strategy adopted.

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