Google Notebook LM: Artificial intelligence to manage plurilingual learning through the Lean-Kaizen process

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ABSTRACT: In a previous study, which will be published in the coming months, intercultural competence was analysed through Microsoft Teams, considering the Lean-Kaizen Method, usually applied to industry, services, and the business sector: Microsoft Teams: Artificial intelligence to manage intercultural learning through the 'Lean-Kaizen' process. In this case, as part of the same project on educational artificial intelligence, this study focuses on language acquisition in multilingual environments through Google Notebook LM of AI. The main objective of this research is to improve the acquisition of languages and cultures, thereby supporting the holistic development and identity construction of learners. This work analyses and reflects on how this resource can optimise the learning of languages in multilingual environments by providing tools to organise learning materials, generate summaries, compare different languages and idioms, and facilitate linguistic and cultural reflection, thereby improving students' language skills and competencies. Again, the applied IAE innovatively incorporates the Lean-Kaizen method to achieve greater efficiency and adaptability to the real needs of the students.
Keywords: Lean-Kaizen Process, artificial intelligence, plurilingual learning environment, Notebook LM Google

Google Notebook LM: inteligencia artificial para gestionar el aprendizaje plurilingüe mediante el proceso Lean-Kaizen

RESUMEN: En un estudio anterior, que se publicará en los próximos meses, se analizó la competencia intercultural a través de *Microsoft Teams* teniendo en cuenta el *Método Lean-Kaizen*, normalmente aplicado a la industria, los servicios y el sector empresarial: *Microsoft Team: Inteligencia artificial para gestionar el aprendizaje intercultural mediante el proceso 'Lean-Kaizen'*. En este caso, como parte del mismo proyecto sobre inteligencia artificial educativa, este estudio se centra en la adquisición de lenguas en entornos plurilingües a través de *Google Notebook LM* de AI. El objetivo principal de esta investigación es mejorar la adquisición de lenguas y culturas, apoyando así el desarrollo integral y la construcción de la

identidad de los aprendices. Este trabajo analiza y reflexiona sobre cómo este recurso puede optimizar el aprendizaje de lenguas en entornos plurilingües al proporcionar herramientas para organizar materiales de aprendizaje, generar resúmenes, comparar diferentes idiomas y modismos y facilitar la reflexión lingüística y cultural mejorando las habilidades y competencias lingüísticas del alumnado. Nuevamente, se incorpora la IAE aplicada de manera innovadora el método Lean-Kaizen para lograr una mayor eficiencia y adaptabilidad a las necesidades reales de los estudiantes.
Palabras clave: Proceso Lean-Kaizen, Inteligencia Artificial, entornos plurilingües de aprendizaje, Notebook LM Google

1. Introduction

This article offers a vision of the transformative potential of educational artificial intelligence (AI) to enhance multilingual and intercultural competence at various educational levels and, consequently, to improve students' linguistic opportunities. The development of these skills is essential for effective communication and social integration. Educational systems face the challenge of preparing students to use different languages to function effectively in different contexts. Current advances in artificial intelligence offer support for the development of these skills at all educational levels, as highlighted by recent studies (Kohnke, Moorhouse, and Zou, 2023; Liu, Darvin, and Ma, 2024). However, during their learning, the methodology used often fails to integrate them in a holistic and beneficial way. Therefore, this article explores the transformative potential of artificial intelligence (AI) to enhance these skills through the Lean-Kaizen philosophy. This method focuses on the continuous improvement of any process, creating a more efficient, personalised, and sustainable learning environment.

To speak languages, in addition to linguistic knowledge, it is necessary to acquire other skills, such as cultural competence, which allows interaction with people from a specific culture (Burgos, 2023; Kirmayer, 2012; Lekas et al., 2020; Saavedra Macías et al., 2016); and intercultural competence to interact with people from different backgrounds (Aguado Odina, 2019; Castro Suárez, 2019; Cerezo and Bertolín, 2020; de la Cruz Estudillo and Peña García, 2023; Sabariego, 2002). We understand that linguistic, cultural and intercultural training is essential to improve the knowledge and skills that enable communicative self-sufficiency and the integration of speakers in different cultural contexts (Solórzano et al., 2024; Juncal et al., 2023; Paredes García, 2020; Coelho et al., 2011). However, another question is what methodology is used to achieve this.

Evidently, the use of AI in educational settings is bringing about a significant change in the educational trajectory of students at all levels. In fact, current research already shows how AI-driven technologies can significantly improve student learning outcomes (Berns and Reyes-Sánchez, 2021; Burgos et al., 2022; Druga et al., 2019; Kang, 2022; Mathai, A., 2024), as has been the case in other areas of sociocultural and economic life (Holmes et al., 2019; Kulikov and Shirokova, 2021; Yang, 2022).

The acquisition of skills through artificial intelligence is gradually playing an important role in the promotion of native and additional languages. AI has a multitude of tools that allow students to interact, communicate and collaborate with people from different backgrounds to promote interaction in a globalised world. However, this technology alone is

insufficient. An efficient methodology is needed to improve and optimise learning processes. Therefore, this study proposes integrating the Lean-Kaizen methodology, commonly used in financial and production environments, to take advantage of its efficiency-based approach by reducing non-essential elements to achieve a significant impact, as already proposed by Carneiro et al. (2025) in the field of higher education.

This article proposes a specific theoretical and practical application of Lean-Kaizen philosophy to optimise the use of Google NoteLM in the acquisition of native or additional languages. It is based on the creation of tables containing specific descriptors that must be followed when using NoteLM in educational environments. In fact, the same has already been done with the Microsoft Teams platform (the article will be published by Octaedro) with optimal and innovative results. In addition, the research team is already working with other AI tools in this field (Duolingo, Duolingo Max and ChatGPT).

Therefore, the aim of this article is to present the results of integrating an AI tool with the Lean-Kaizen method to automate tasks, generate accurate information and foster a mindset of continuous improvement. The combination of the two represents an opportunity to transform language teaching and learning processes. On the one hand, the Lean-Kaizen process promotes small, continuous improvements that can be implemented in teaching management practices. On the other hand, AI enables the automation and personalisation of processes with real-time feedback, based on the idea of continuous improvement.

To elaborate on this work, the team that conducted the study used a descriptive-narrative methodology focused on the observation, analysis, recording, and characterisation of the Lean-Kaizen phenomenon applied to AI: 1) It describes how the Lean-Kaizen method is applied to the learning of linguistic and intercultural skills in multilingual contexts; 2) It characterises the use of the NoteLM tool in educational contexts; 3) Patterns and perceptions about the synergy between Lean-AI for language teaching are identified and confirmed.

The results of this study demonstrate the potential for integrating Lean-Kaizen philosophy with AI in higher education for additional languages, through specific skills. It reveals how this approach can improve the quality of language teaching and promote continuous improvement. However, the conclusions highlight the study's limitations: it is in its initial phase, with the development of implementation items (tables) on other AI platforms using the Lean-Kaizen method, and it has not been possible to test it in real classrooms, as it involves integrating a highly innovative method that differs from conventional approaches and requires profound changes in teaching and curriculum planning.

2. Methodology

The research uses an exploratory descriptive methodology. Exploratory because it considers different aspects and procedures of the Lean-Kaizen method and AI. Descriptive because it reports, analyses and details the most relevant elements related to the different constructs under investigation (language learning skills, communication and intercultural interaction). This methodology has enabled the development of descriptive tables, which appear in this section, following three phases: observation, analysis and characterisation of the Lean-Kaizen phenomenon in AI, and its recording in the informative tables. Within these phases, the following aspects have been taken into account: 1) the description of the

elements of the Lean-Kaizen method applied to the learning of linguistic and intercultural skills in multilingual contexts; 2) the search for ways to customise the use of the Google NoteLM tool in higher education contexts applicable to Lean-Kaizen; and 3) the identification and classification of models that promote synergy between Lean-Kaizen and artificial intelligence. This section is organised into four subsections, which mainly delve into the Lean-Kaizen philosophy, as it is the backbone of the work to implement Google NoteLM for language learning.

2.1. The Lean Methodology

After World War II, Japan developed this methodology for management and production improvement. Despite it is significance and impact across various sectors, it is implementation in higher education has remained sporadic, as noted in the work of Carneiro et al. (2024).

Blazer et al. (2016) compiled existing research on Lean in higher education to support its successful adoption. They also advocate for further studies to establish a robust body of knowledge that can inform both practice and academic inquiry. However, current research in the educational field tends to concentrate on how to teach the Lean methodology (Badurdeen et al., 2010; Cudney et al., 2018; McDermott et al., 2021), rather than on applying Lean principles to language learning processes with the aim of optimising acquisition. This gap has already been acknowledged in previous work on the implementation of the Lean-Kaizen Process, soon to be published by Octaedro under the title Microsoft Teams, Artificial Intelligence for Intercultural Learning Management with the Lean-Kaizen Process. That study follows a similar line of inquiry to the one presented here.

2.2. Working by Lean-Kaizen Methodology

The search work in Web of Science, Scopus, and Google Scholar has not revealed new studies in the context proposed here. As in the previous article, only Dinis-Carvalho (2020) approaches the objectives proposed here.

Carvalho clarifies that the Lean-Kaizen approach to training and education may be separated into two distinct fields of study and practice: Teaching Lean and Lean Teaching. Lean teaching is the process of successfully educating experts and students in Lean concepts, principles, and tools so they can use them in actual settings, such as factories and other organisations. We have already discussed this relatively broad issue (point 2.1.), and Dinis-Carvalho claims that interest in it has increased recently.

Lean teaching, according to Dinis-Carvalho, is the process of incorporating Lean ideas and principles into training and educational activities. In this regard, Emiliani (2015) has also released a very intriguing book on the topic. He states that with so few published pieces, a significant portion is still untapped by academic writers. Dinis-Carvalho claims that the implementation of Lean in colleges and universities is similarly perplexing, with limited works and interpretations.

According to Dinis-Carvalho, in these situations, Lean is primarily used in offices and other service areas found in academic institutions. Emiliani (2015) gives an overview of Lean management concepts, talks about the significance of teaching improvement, and highlights

common teaching "wastes" and how to avoid them. Additionally, he provides Lean-based ideas and approaches to enhance teaching-learning processes and shares his thoughts on the significance of ongoing teaching improvement.

In this work, we collaborated with visiting Professor Engineer Bruno Schmauss to develop this study to use the Lean methodology in education as another study (Sfakianaki & Kakouris, 2019; Alves da Silva et al., 2021; Kakouris et al., 2022), in our case, in plurilingual and linguistic learning for students in different educational situations. He has shared his experiences in manufacturing, sales, controlling and administration process applying Lean-Kaizen. Engineer Schmauss discusses the Lean methodology and how it relates to the Kaizen philosophy, which is also Japanese in origin and seeks to improve every part of a development and creation process both locally and globally rather than just the production process (Table 1). The Lean approach includes numerous success characteristics and adheres to xxx recommendations (Table 2).

Table 1. *Objective of Lean Process*

Item	Concept	Characteristics
1	Format	Clear, easy, and transparent.
2	Time	Quicker (less time needed to complete tasks).
3	Flow	Functions without delays.
4	Production	Exceptionally productive and efficient.
5	Flexibility	Able to swiftly and readily adjust to the needs
6	Standardised	Procedures are consistent, dependable, and predictable

Note: Designed by the authors following the Lean-Kaizen methodological mode

Table 2. *Lean-Kaizen Process for language acquisition*

Item	Concept	Characteristics
1	Constant development & improvement	Continuous improvement in Kaizen is a fundamental principle of the Lean method. It is essential for maintaining and improving the efficiency of any process.
2	Organisational environment	Methods promote & organization based on shared responsibility and participation.
3	Removal of non-profitable components	Kaizen & Lean strive to constantly review, find and eliminate 'errors/mistakes.
4	Reducing / eliminating problems	Kaizen & Lean effort to continuously detect, eradicate, or minimise circumstances that cause 'errors/mistakes' or slow down the process.
5	Non-value-added process steps	Determine which stages are not directly adding value. They should be treated differently from steps that add value.
6	Efficiency and Quality	Through process optimisation, both strategies seek to increase the product's effectiveness and quality.

Note: Designed by the authors with Lean-Kaizen methodology for language learning applied

The components that process engineer Schmauss suggested to attain efficiency in the production process would also be beneficial in a linguistic-cultural learning process in edu-

cation. We believe that the Lean approach can accomplish an industrial or educational goal by increasing quality, attention, and reducing time and energy. In our situation, we think it would minimise bad outcomes using a quicker and more effective approach, which would decrease learning failure and enhance the learning process. In summary, this article's primary goal is to assist educators at all educational levels in developing a productive teaching-learning environment that enhances learning outcomes, from early childhood education to higher education. We will suggest using the Lean approach to improve the acquisition process while taking Emiliani's (2015) research into consideration.

2.3. Using the Lean-Kaizen approach to enhance the teaching language process

As we clarified in the previous article, Professor Emiliani suggests in his book *Lean Teaching: A Guide to Becoming a Better Teacher* (2015) that the Lean method optimises teaching-learning processes, in our case, about learning language in a plurilingual environment. Next, we present the key factors that are the objectives Emiliani proposes to achieve improvement (Table 3).

Table 3. *Lean Teaching by Emiliani's goal (2015)*

Item	Goal	Description
1	Eliminate unforced errors	Detecting and removing common teaching mistakes and unnecessary elements is key to improving student learning. This means simplifying instructions, reducing task difficulty, and eliminating anything that doesn't add value.
2	Improve the teaching process	Analysing each stage of the educational process—from planning to evaluation—helps identify those that lack value, allowing teachers to redesign methods or content for greater effectiveness.
3	Evaluate results	This involves applying Lean tools to assess student learning, using evaluation methods that provide continuous feedback and allow immediate adjustments in teaching strategies, possibly through various tools.
4	Create a "Production Pull" system	The aim is to apply Lean's 'pull concept,' where students seek information based on their interests and needs, promoting personalized, focused learning. The teacher acts as a mediator and guide.
5	Personalise learning	The goal is to tailor content to individual student needs by designing differentiated materials, applying adaptive strategies, and adjusting teaching methods to diverse learning styles.
6	Constantly improve	It is about improving a language in the teaching-learning process. Therefore, teachers and students must work jointly to identify areas for progress and develop effective solutions. This means implementing a continuous process for upgrading.

Note: Designed by the authors following Emiliani's goal (2015)

In summary, the Lean-Kaizen method suggests a structured and helpful way to improve the language teaching process in plurilingual situations. Based on Professor Emiliani's framework in *Lean Teaching: A Guide to Becoming a Better Teacher* (2015), this approach underlines constant development, error/mistake eradication, and student-focused learning. The objectives include upgrading teaching strategies to maximise efficiency and adopting the most correct evaluation systems that provide continuing feedback for immediate adjustments.

Furthermore, the focus on improving assessment methods is consistent with the objective of proposing students' individualised assistance, ensuring that plurilingual education remains flexible and adaptable. In the end, students and teachers benefit from the incorporation of Lean-Kaizen philosophy to promote a more efficient, inclusive, and flexible teaching and learning process.

2.4. Lean Method adaptation procedure IA. Plurilingual competence

The technique for applying Lean-Kaizen methodology through generative artificial intelligence focuses, in this article, on acquiring plurilingual competence in students.

In a recent work, Moore & Bernaus (2021) conclude by highlighting some challenges for the future of plurilingual education in Europe. In the European context, there currently exists consensus, at least at the institutional level, that the teaching of and through languages should follow what is referred to as a pluralistic approach to languages and cultures, or a plurilingual and pluricultural approach. The idea of didactics of plurilingualism, or the teaching and learning of plurilingualism, interrupts that of the didactics of languages, understood in terms of the teaching and learning of different languages (Moore & Bernaus, 2021; Galante et al., 2022; Pastena et al., 2024).

But also, the Council of Europe (2023) published Plurilingualism in the classroom, Common European Framework of Reference for Languages (CEFR), which examines the integration of plurilingual education within the broader framework of language teaching. It accentuates how linguistic diversity can be utilised as a resource in learning environments, encouraging students to develop skills across multiple languages rather than treating them as separate entities.

Lüdi (2021) explains in his work about the challenge of linguistic diversity, established in European history and increased by migrations, and the ways individuals and educational systems respond to it. It focuses on the European continent and its two major institutions. The Council of Europe's stated aim is to uphold human rights, democracy, and the rule of law in Europe. About the plurilingualism thus refers to the repertoire of varieties of language which a person uses during his or her linguistic trajectory, including the variety referred to as 'mother tongue' or 'first language' and any number of other languages or varieties. Plurilingualism, as opposed to monolingualism, is more considered as the normal and even preferable case.

Piccardo's opinion offers another point of view about plurilingualism (2017). In her article, she explains the reasons why it is crucial to promote and cultivate multilingualism to provide favourable conditions for creativity and change. The article explains the characteristics and implications of multilingualism and the potential for individuals to adopt a holistic and complex view of languages and cultures and experience empowerment in the process of perceiving and exploring linguistic and cultural diversity, hybridity, and interconnections, thus discovering and unleashing their full creative repertoire.

All this point of view emphasises the development of skills and knowledge that enable the learner to regulate their relationships with people from different language backgrounds. In the table below we are using a perspective on plurilingual competence using the Lean-Kaizen method with implementing Artificial Intelligence (Table 4).

Table 4. *Plurilingualism competence by Lean-Kaizen thinking & Notebook LM Google*

Procedure	Description
Identify students' needs in language competence	Lean Process can be used to identify the specific needs of each student in terms of language and digital competence. This includes the exercise with Google Notebook to better understand the areas that require attention in intercultural knowledge and in the chatbots for their learning.
Eliminate non-essential elements of language & digital learning (AI)	Apply Lean methods to cancel any process or resource of Google Notebook that does not add value to plurilingual learning for communication and learning purposes. This may include the control and simplification of teaching materials, if it is necessary, and the optimisation of technological resources of Notebook.
Continually improving & reviewing	The cycle of improvement (PDCA: Plan-Do-Check-Act) to continuously evaluate and improve language teaching strategies through Google Notebook. This ensures that teaching methodologies will adapt and evolve according to the changing needs of students regarding intercultural learning using AI.
Evaluate resources & tasks	It is necessary to ensure that all activities and resources implemented in the educational language process are related to the objective of improving plurilingual competence through AI Notebook. This includes the integration of language education that effectively facilitates the learning.
Contributing and cooperating	It is necessary to use evaluation and feedback tools to evaluate the impact of IAE strategies on the acquisition of plurilingual competencies (collecting qualitative and quantitative data to adjust and improve methodologies about Notebook)
Evaluation	Teachers and students must work jointly to identify areas for progress and develop effective solutions, implementing a continuous process for upgrading.
Training an education environment	Continuous training in education should be provided to teachers on the use of the Lean method and IAE in the classroom. This confirms that educators are equipped with the necessary skills to effectively implement these methodologies with Google Notebook.

Note: Designed by the authors. The Lean-Kaizen methos apply to plurilingual competence by *Google Notebook.*

The European perspective on plurilingual education highlights the growing compromise that language teaching must move beyond isolated linguistic instruction and incorporate a more holistic, plurilingual and pluricultural framework. This method encourages students to develop multilingual skills dynamically, fostering intercultural communication and deeper linguistic understanding.

Through AI-powered tools like Google Notebook LM, the teacher can systematically identify students' needs to personalise learning routes and optimise resources for greater efficiency. The Lean-Kaizen model complements AI-driven strategies by promoting improvement cycles (*Plan-Do-Check-Act*), ensuring that language education advances in response to students' changing requirements. Furthermore, the collaboration and the active participation from teachers and students are essential to creating engaging learning experiences.

The combination of Lean-Kaizen methodology and AI technology improves plurilingual education by enhancing accessibility, adaptability, and continuous enhancement. This approach empowers educators with data-driven insights, fosters student learning, and contributes to the effective control of intercultural relationships, locating plurilingual competence as a fundamental pillar of global education.

2.5. Instrument for Plurilingual skills

For this section, the recommendations of Martín-Peris et al. (2021) are considered to present a framework for language acquisition in multilingual environments. For competence in language use in these contexts, students must be aware of the three principal dimensions: the sociocultural, the pragmatic, and the textual, each of which involves specific achievement criteria and indicators, with special attention to the sociocultural and linguistic dimensions. A particularly relevant factor in this dimension is the community of practice to which the learners belong as autonomous social agents and in which they consciously participate in learning activities.

The *Cervantes Institute Curriculum Plan* – CICP (Plan Curricular Instituto Cervantes (PCIC, 2006), as an adaptation of the *Common European Framework of Reference* – CEFR (2001), developed descriptive lists, called 'Inventories', on elements that should be considered when programming the teaching of plurilingual learning. Below is a table of contents made in relation to CICP, following Martín-Perris et al. (2021). The specific information can be fully consulted in the document online.

Table 5. *Cervantes Institute Curricular Plan Inventory (plurilingual focus)*

Item	Inventory	Skill description
1	Pragmatic tactics and strategies.	Task simplification Error reduction Resource optimisation Flexibility and feedback
2	Discursive genres & textual products	Oral and written genres Samples of genres Macrofunctions
3	Sociocultural knowledge & behaviours	Living conditions and social organisation Interpersonal relationships Collective identity and lifestyle

Note: Designed by the authors. The Cervantes Institute Curricula Planning in plurilingual skills.

To work with the Lean-Kaizen method, we will use the inventory and the necessary skills, and we will refuse unnecessary ones according to the student's profile and context. In addition, following the 'pull production' concept (Lean-Kaizen), the students will demand information and resources according to their interests and needs. Evaluation and feedback should be adjusted to the items of each learnt inventory according to the student profile. The AI Notebook will be the tool to implement the plurilingual skills.

3. Results: Google Notebook LM by Lean-Kaizen process

Google Notebook LM presents a versatile platform that can support the effective implementation of the Lean-Kaizen method in the educational context, promoting efficiency, collaboration, and continuous improvement in the teaching and learning of language. Google Notebook AI develops the educational experience by Lean's Process in various ways, as we can see in Table 6 (see Appendix). In Table 6, included in the appendix due to its length, we can be seen that this Google Notebook LM tool not only serves to organise and analyse

classroom information and the learning process but also acts as a strategic ally in applying continuous improvement methodologies in education, making the teaching and learning process more agile, collaborative, and effective.

Google Notebook LM uses artificial intelligence to enhance different facets of the learning process. In this sense, AI plays a critical role in improving language education. AI enhances teaching strategies and creates a dynamic, adaptable learning environment by recognising students' needs and assisting with organisation, assessment, and ongoing improvement. It enables educators and students to interact with content more successfully by facilitating collaboration, simplifying resource access, and removing unnecessary components.

The AI-driven strategy also guarantees effective task management, flexible adaptation to a range of needs, and personalised learning experiences. The teaching-learning relationship is strengthened by its capacity to optimise instructional strategies and offer insightful data-driven feedback, which eventually helps create a more effective and inclusive system of multilingual education.

4. Discussions

This study set out to explore two central research questions: first, whether the Lean-Kaizen process could improve efficiency and inclusion in multilingual learning environments; and second, how the integration of Educational Artificial Intelligence (AIEd), specifically through Google Notebook LM, would contribute to student-centred learning in plurilingual contexts, and whether it could be done effectively.

The results seem to indicate that the Lean-Kaizen process, when applied to educational settings, could indeed foster more efficient and inclusive learning environments. By systematically identifying and eliminating non-essential elements, the process allows educators to focus on what the student truly needs to progress. This, of course, aligns with the principle of continuous improvement that is fundamental to the Japanese Lean-Kaizen system, which is particularly valuable in multilingual classrooms where students' needs are diverse and constantly evolving, and teachers cannot always provide effective support.

In response to the second question posed at the outset of this research, it had already arisen previously with Microsoft's Teams platform in a forthcoming paper. In this case, the challenge centred on integrating Google Notebook LM as an educational AI tool. It seems that it has proven to be a viable option. Its ability to provide personalised feedback, real-time progress tracking, and adaptive task management fosters effective pedagogy by being student-centred. The synergy between Lean-Kaizen and educational artificial intelligence seems to offer a learning environment that is not only optimised but also tailored to individual linguistic profiles to address the growing multilingualism in classrooms resulting from the migratory flow into Europe.

These results are consistent with previous research. Piccardo (2017) conceptualises plurilingualism as a catalyst for creativity, flexibility, and innovation, qualities that are essential in today's educational landscape. Our findings extend this perspective by suggesting that creativity in plurilingual education can be technologically mediated. Platforms such as Google Notebook LM offer students dynamic pathways that reflect their linguistic repertoires, thereby fostering creative engagement and deeper learning.

Furthermore, the study contributes to ongoing debates about the practical implementation of plurilingual pedagogies in various educational contexts. While previous studies have emphasised the theoretical potential of plurilingualism, our research highlights the operational value of combining Lean-Kaizen with EAI to realise that potential. In doing so, it addresses the growing need for pedagogical models that are both scalable and adaptable.

In summary, the integration of the Lean-Kaizen methodology with AI-powered tools offers a coherent framework for improving multilingual education. It promotes efficiency without sacrificing inclusion and supports creativity through personalised learning, marking an important step forward in the evolution of multilingual pedagogical practice. The current educational context requires effective actions that can be implemented; therefore, we must move from words to deeds to achieve rapid learning and, consequently, genuine integration.

Now, with two studies conducted on the Lean-Kaizen methodology, it can be confirmed that by applying its principles in educational settings and leveraging AI, language learning can be optimised by eliminating irrelevant factors and streamlining the teaching-learning process to focus on what the student truly needs.

5. Conclusions

This study has confirmed that combining the Lean-Kaizen process enables the creation of more efficient, inclusive, and student-centred educational environments, thereby promoting faster and more effective learning in multilingual settings. The combination of the Lean-Kaizen process, innovation, and educational adaptation to artificial intelligence through Google Notebook LM has proven effective. The Lean-Kaizen philosophy has provided an excellent foundation for establishing educational processes that eliminate non-essential elements and, when combined with artificial intelligence in educational settings, optimise the learning process through personalisation.

Google Notebook LM enables task creation, progress tracking, and continuous feedback. By adding a Lean-Kaizen process, resources are optimised because irrelevant elements are eliminated, and therefore students continuously improve and adapt to a multilingual learning environment.

The tables show that we can adapt Lean-Kaizen with AI in education, such as Google Notebook LM, to improve learning for everyone, especially in language learning. Lean-Kaizen helps eliminate the unnecessary, making teaching easier and optimising the use of resources. This methodology facilitates adaptation and changes to meet students' diverse needs when learning new languages. Google Notebook works well with Lean-Kaizen because it provides personalised feedback, tracks student progress, and adapts tasks to everyone. This method enhances student engagement and accelerates learning outcomes by systematically eliminating unnecessary components and leveraging AI-driven personalisation.

Students receive personalised support thanks to the synergy between AI and the Lean-Kaizen methodology, which enables dynamic feedback mechanisms, continuous progress monitoring, and optimised resource management. Ultimately, this combination makes multilingual education more flexible and student-centred, adapting to changing educational needs. This procedure can create a learning style that is not only meaningful and active but also helps students solve problems on their own. When these things come together, the learning environment becomes dynamic. Students participate more and learn faster.

Implementing Google Notebook LM fosters security and creativity through a modern technological tool that enables effective and optimised learning, as advocated by the Lean-Kaizen philosophy. It is evident that the concept of plurilingualism in the field of language teaching and learning continues to generate a profound debate about theory and its practical application. Equally important are the debates about the possibility of implementing plurilingual pedagogies in different countries and how to do so. These discussions remain necessary, but in the current landscape, artificial intelligence will bring about significant changes. A wide range of possibilities opens in AI education, so a Lean-Kaizen procedure will be necessary to discard what isn't truly effective and ensure coherent learning.

This type of procedure is important for a couple of reasons. First, it provides us with a way to use plurilingual teaching that can be adapted to different learning situations. Secondly, it highlights the importance of combining technology with clear and simple instructions. As AI transforms education, Lean-Kaizen can help us ensure that we only retain the methods and tools that truly make learning faster and better. In summary, the combination of Lean-Kaizen and AI not only improves language learning but also prompts us to reflect more deeply on how to improve education in general. It is a way to continuously improve, foster creativity, and address the real challenges of teaching multiple languages in today's world.

The study's findings show how, with the right skills, AI and the Lean-Kaizen philosophy may be used in higher education for more languages. It demonstrates how this method can raise the standard of language instruction and encourage ongoing development. The study's limitations are highlighted in the conclusions, though, as it is still in its early stages and involves developing implementation items (tables) on other AI platforms using the Lean-Kaizen method. Additionally, it has not been feasible to test it with the groups of students because it incorporates a highly innovative method that deviates from traditional approaches and necessitates significant adjustments to curriculum planning and teaching.

This research shows how to activate the plurilingualism methodology (Tables) as an example for organising implementation. We are convinced that Lean-Kaizen is a good option; the only remaining challenge is to implement it in traditional educational systems with adequate training. It's not about changing the content and educational laws but about using effective methods with new technologies that have arrived to revolutionise learning.

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7. Appendix

Table 6. *Google Notebook by Lean-Kaizen Process*

Lean-Kaizen	Lean-Kaizen in Google Notebook LM
Identify	Determine the students' needs. By using artificial intelligence to analyse learning patterns, engagement levels, and individual progress, Google Notebook AI can assist in determining the needs of students: — Personalised Learning Perceptions: Notebook AI can identify areas in which students struggle and recommend resources that are specifically designed to fill in those gaps by analysing how students interact with the content. — Behavioural Analysis: AI systems can monitor engagement, focus, and understanding, providing educators with important information about their students' preferred methods of learning. — Automated Feedback & Assessment: It can assess homework, tests, and answers to pinpoint strengths and shortcomings instantly, assisting teachers in improving their methods. — Adaptive Recommendations: Using historical performance data, it can recommend personalised learning paths to make sure students get the help they need. — Language & Accessibility Support: AI can identify linguistic difficulties in plurilingual learners and suggest specific language exercises to improve fluency and comprehension.
Organisation & effective management	Google Notebook LM can support organisation and effective management in educational settings by leveraging artificial intelligence to streamline workflow and optimise resource allocation: — Smart Content Organisation – AI-driven categorisation helps educators and students manage notes, assignments, and study materials efficiently, ensuring quick access to relevant information. — Task Prioritisation & Planning – Through intelligent scheduling, it can suggest deadlines, reminders, and study plans based on learning progress and upcoming assignments. — Data-Driven Decision Making – By analysing trends in student performance, AI can offer intuitions into effective teaching strategies and areas needing improvement. — Collaboration & Communication: Improving coordination between students and instructors. — Resource Optimization – AI can identify underutilized learning materials and suggest alternative resources, ensuring that educational content is managed effectively.
Suppression of non-essential elements	Google Notebook LM uses artificial intelligence to optimise resource allocation and streamline workflow, supporting organisation and efficient management in educational settings: — Content Optimisation. AI can identify redundant or irrelevant information in notes and remove unnecessary details while summarising important points. This is known as content optimisation. — Smart Filtering. By employing machine learning, it can suppress distractions and highlight key ideas, enabling users to concentrate on the main course materials. — Concise Data Presentation. AI-powered clear and organised data presentation that removes superfluous complexity. — Adaptive Summarisation. Adaptive summarisation helps teachers and students access only the most pertinent information by producing succinct summaries of long texts. — Effective Workflow Management. AI streamlines repetitive tasks so users can focus on important content rather than administrative nonsense.
Improvement	Constant enhancement using Google Notebook LM is accomplished using adaptive learning techniques and AI-driven analysis. This is how it supports continuous improvement in learning environments.

Valuation of resources	Google Notebook LM by using artificial intelligence to evaluate, rank, and optimise educational resources and activities, AI can improve the valuation of tasks and resources. — Resource Efficiency Analysis: AI assesses the usefulness and pertinence of educational resources. — Task Prioritisation: It assists users in identifying high-priority tasks and allocating time appropriately by analysing workload and deadlines. — Performance-Based Adjustments: AI monitors student engagement and results, adjusting instructional tactics according to their efficacy. — Data-Driven Decision Making: Teachers and students can make well-informed decisions about how to allocate resources and study techniques thanks to automated insights.
Flexibility & adaptability	Google Notebook LM uses artificial intelligence to optimise workflows, modify learning processes, and customise content to meet the needs of each user. It improves these aspects in the following ways: — Tailored Educational Routes. — Dynamic Content Modifications. — Context-Aware Modifications: AI is able to identify various learning styles and adapt its methods to suit a wide range of learners. — Effective Task Management: It arranges tasks and due dates in a flexible manner, enabling users to adjust their schedules as necessary.
Participation/collaboration	By using AI-driven features to improve teamwork, communication, and interactive learning, Google Notebook LM encourages involvement and collaboration. It supports these aspects in the following ways: — Real-time cooperation, intelligent content organisation, and interactive feedback systems — Cross-Language Encourage understanding and translation to make conversations more inclusive.
Access to resources	Google Notebook LM uses artificial intelligence to expedite and optimise the retrieval of educational materials; AI improves access to resources: — Smart Resource Recommendation: AI makes recommendations for pertinent notes, articles, and study materials based on user preferences and learning objectives. — The centralised knowledge hub effectively arranges resources so that users can swiftly access crucial information. — Cloud-based accessibility ensures seamless access across locations by allowing users to access their notes and documents from any device. — Features for Search and Filtering
Evaluation	Google Notebook LM enhances evaluation by leveraging artificial intelligence to assess learning progress, provide feedback, and refine teaching strategies. It facilitates efficient evaluation in the following ways: — Automated evaluations. AI evaluates student performance and responses, providing immediate feedback and pinpointing areas in need of development. — Tracking progress continuously. It tracks the evolution of learning over time, enabling flexible modifications to instructional strategies. — Data-Informed Perspectives. By analysing patterns in student participation and understanding, AI assists teachers in improving assessment techniques. — Tailored feedback. It guarantees insightful assessments that foster development by customising tests to each learner's unique learning preferences. — Grading systems that are optimised. By automating scoring procedures, AI simplifies grading and guarantees efficiency and consistency.

Note: Designed by the authors following Lean-Kaizen methodology.