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A New Methodological Paradigm to Face the Challenges of Intelligent, Self-Directed and Progressive Learning

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Learning in the 21st century faces the challenge of adapting to a globalized digital environment, which demands innovative methods that respond to the changing needs of students. The objective of this research was to expose a new interactive, self-guided and progressive methodological scheme that facilitates and adapts to the active learning needs of current generations of students. A descriptive study was developed, in which 14 teachers and 35 students of ISPEDIB Canelos participated. Based on the application of the VARK questionnaire and a structured interview, the main learning styles of the students were identified, as well as their perceptions about the reality and expectations regarding the implementation of new learning methods. The methodological scheme designed was implemented on the Árbol de aprendizaje technological platform and was applied during a three-month trial period. At the end of this phase, surveys were applied to both groups and a positive acceptance by teachers and students was identified. Respondents highlighted the effectiveness of the methodological scheme to promote active, autonomous and progressive learning, the development of essential competencies and the potential of its generalization.

Keywords: methodological paradigm, intelligent learning, intelligent education, active learning, self-directed learning.

1. Introduction

The contemporary learner, immersed in the postmodern era, demands an educational approach that is profoundly different from the traditional one. Motivation became dependent on more immersive and interactive experiences, which engage students in meaningful and relevant ways in their own learning. Instead of being a passive receiver, the student benefits from being an active agent in their learning process, which implies granting them the prerogative to explore and build their knowledge through collaborative, technological, and applied activities (Dean et al., 2024). The student of the 21st century demands a self-guided and adaptable learning process, in which they can progress in correspondence with their individual learning curve. This flexibility allows not only greater personalization, but also more effective attention to their needs and the effective use of various learning styles (Kemp et al., 2024;

Thuy & Trung, 2023).

This approach demands tools and methodologies that can be tailored to your preferences, provide visual, auditory, kinesthetic, or multimedia content as needed. In this way, learning ceases to be a rigid structure to become a dynamic experience, where self-management and adaptability become fundamental pillars. By creating spaces that respect and respond to individual differences, while integrating the use of new technologies, the education system achieves an environment in which the student feels more engaged, motivated and empowered to face the challenges of a constantly changing society.

Technology, although essential in contemporary education, does not guarantee the improvement of learning by itself; its effectiveness lies in how it is integrated into pedagogical models that respond to the needs of today's students. The key is to articulate it with active, digital and self-guided learning methodologies, adapted to the lifestyle and skills of the modern learner. To achieve this, it is vital to develop educational strategies that use technological resources not only as tools, but as means that enhance autonomy, interaction, and the active construction of knowledge (Taşkın Alkan & Tüzün, 2024). Designing learning models that intentionally incorporate technology allows students to experience a process adapted to their individual rhythms and styles, while developing practical and collaborative skills needed in a dynamic and digital environment.

Smart learning ecosystems offer innovative solutions to meet the challenges of modern education supported by technological elements, by aligning with the demands of interactivity, personalization and self-management of today's students. These environments integrate advanced technologies—such as artificial intelligence, learning analytics, and adaptive platforms—to create educational experiences that respond in real time to the specific needs of each student (Vargas-Murillo et al., 2023). Smart Learning or Smart Education comprises a fully articulated symbiosis between the technological, infrastructure and digital resources component, on the one hand, and a methodology based on motivational, interactive, adaptive mechanisms, with automated follow-ups, which focus on the active and self-guided training of the student (Oliveira et al., 2021; Alé-Ruiz et al., 2024).

The student's training will depend on a context of resources, instruments and content that allow them to improve their learning curve in a non-forced, intuitive, scalable way and without the constant need for a teacher in face-to-face mode. Smart Education should allow students to discover learning paths according to their profiles, backgrounds, and needs, receive feedback, and create spaces for collaboration (Wang et al., 2021). Therefore, the development of active methodologies that promote the integration of these ecosystems is needed.

Active methodologies allow for the creation of dynamic learning environments in which the student becomes the protagonist of his or her own training process. These methodologies promote experimentation, critical thinking, and problem-solving through activities that require constant and meaningful student participation, thus adapting to their own learning rhythms and styles (Alé-Ruiz et al., 2024). Through techniques such as project-based learning, discovery learning, and interactive simulations, an intuitive and scalable educational experience is fostered, in which the student can explore and apply concepts without the need to continuously rely on face-to-face instruction from the teacher (Naik et al., 2024).

Recent trends in active learning highlight the intensive use of technology and the restructuring of traditional models to maximize the interaction and personalization of learning. A key trend is the integration of digital tools and artificial intelligence platforms that, such as ChatGPT, have revolutionized the creation of more interactive and adaptive environments, allowing students learning experiences that respond in real time to their specific needs (Rodríguez-Sabiote et al., 2021; Lytras, 2023). Likewise, the flipped classroom model has gained ground, especially in computer science and discrete mathematics courses, where work outside the classroom allows classes to be dedicated to interactive problem-solving and the development of critical thinking skills (Cotterell et al., 2020).

Applications of active learning have successfully spread into disciplines such as STEM and health sciences, where they seek to improve academic outcomes and student engagement. In medical education, for example, active learning platforms and team learning (TBL) models have been implemented, using analytics dashboards to capture engagement data and improve learning efficiency (David & Maurer, 2022). However, associated challenges remain, such as the difficulty of implementing effective assessments and the risk of losing traditional academic skills, suggesting the need for a balanced approach that combines new and traditional skills, as well as multiple learning styles (Yajima et al., 2018; Santos et al., 2019; Oshifogun et al., 2024).

The purpose of this work is aimed at exposing a new interactive, self-guided and progressive methodological scheme that facilitates and adapts to the new active learning needs of current generations of students.

2. MATERIALS AND METHODS

The research was developed with a quantitative approach of descriptive and correlational type. In the process of implementing this interactive, self-guided and progressive methodological scheme, two software environments were designed to validate the methodology, as an articulating part of the technological infrastructure of the project called "Learning Tree" (Alejo & Estupiñán, 2024); installed in agreement with the Ministry of Higher Education, Science, Technology and Innovation (SENESCYT) at the Intercultural Bilingual Higher Pedagogical Institute (ISPEDIB Canelos), from the town of Canelos, Puyo canton, Pastaza province.

The first virtual learning environment was conceived from the diagnosis of the cognitive needs and learning styles of the students of ISPEDIB Canelos, both for their continuous training, comprehensive training, as well as to improve their academic performance in the careers of Higher Technology in Integral Child Development and Higher Technology in Bilingual Intercultural Education. To identify the students' learning styles, the VARK questionnaire (https://vark-learn.com) was applied, which was successfully used in similar studies such as those developed by Biswas et al. (2022), Maidin et al. (2023) and El-Saftawy et al. (2024).

As part of the diagnosis, an interview was developed in which the students openly issued criteria regarding their perceptions about the reality, limitations and expectations of their learning. The topics covered in the interview focused on 6 fundamental elements: specific

perceptions about the current learning process; preferences towards self-directed and intelligent learning; use of technology in learning; collaboration and interaction with colleagues; challenges in the learning process and overall satisfaction with learning.

Based on the results of the diagnosis and the review of the literature, an interactive, self-guided and progressive methodological scheme was designed, which required the development of virtual tools, which were incorporated into the platform associated with the Learning Tree technologies. Interactive modules were created for training, titling, training (simulators and games), AI interaction and global resources, which made it possible to measure interaction and comply with phase 2. Finally, an administrative panel was programmed to measure indicators of evaluation, interactivity and adaptation.

A second virtual learning environment was developed based on the Moodle platform to facilitate this self-guided and progressive process. In this educational environment, and depending on the methodological phases incorporated, two personalized interactive schemes were designed: (1) virtual classroom and (2) continuing education course. The virtual classroom was composed of academic units organized under five didactic sections: (a) concepts and relationships, (b) audiovisuals and tutorials, (c) recordings and educational resources, (d) interactive evaluation activities, and (e) simulation for the final exam. On the other hand, the continuing education course was structured by: (a) focus section, (b) interactive thematic videos, (c) interactive study material, and (d) evaluation environment.

To evaluate this proposal, 14 teachers and 35 students from ISPEDIB Canelos were trained; which constituted the selected sample. The sampling method was intentionally non-random, based on the willingness and commitment of the participants, given the predominantly exploratory nature of the research. In the case of teachers, the training was carried out during two intensive weeks, with the purpose of achieving competencies that would allow them to achieve a comprehensive basic management of the educational platform, the authorship of new content and the analysis of learning outcomes. For their part, the students were instructed in the access and effective use of learning resources, artificial intelligence and self-guided virtual environments.

The system was put in the test phase for three months, and two inquiries were carried out through the application of surveys to the focus groups, the first group framed in knowing the activity of the teacher, his perception and operability with the new methodology, in which the members of the sample participated. To this end, an instrument was applied consisting of statements to which the degree of agreement was answered using a Likert scale (1-Strongly disagree to 5-Strongly agree), which is summarized in Table 1.

Table 1. Survey applied to teachers

Dimension	Survey Statement	Indicator
Diagnosis and Personalization	The initial assessment helped to properly identify the needs and prior knowledge of the students.	Initial diagnosis
	The personalization of study activities was effective for the self-management of student learning.	Personalization and self-guided learning
	Personalization of learning improved students' academic performance.	Performance Impact
	Personalization increased students' motivation in learning.	Student motivation

Use of Technology and Interactivity	The use of advanced technologies (AI, simulators) improved the experience based on intelligent teaching and learning.	Smart teaching and learning
	Interactive digital resources (educational games, videos) fostered greater participation and engagement.	Interactivity and engagement
	The technology implemented facilitated the development of digital skills in students.	Autonomous learning
AI Collaboration and Support	The methodology effectively promoted teamwork and collaboration among students.	Fostering collaboration
	Technology facilitated the process of collaboration between students and with teachers.	Collaboration Feasibility
	Virtual assistants were helpful in supporting the learning process.	Virtual Assistant Utility
	The use of artificial intelligence in learning facilitated my role as a teacher.	AI as teacher support
Continuous Assessment and Adaptability	The continuous assessment system was effective in monitoring and adjusting student progress.	Continuous Assessment Effectiveness
	The methodology was well adapted to the different learning styles and rhythms of the students.	Adaptability to styles
	The methodology allowed for greater student participation and integration compared to traditional methods.	Student Integration
Results and Reflection	The "Learning Tree" methodology facilitated the development of key skills in students.	Skill development
	The methodology promoted the development of critical thinking in students.	Promoting critical thinking
	The methodology favors active, self-guided and progressive learning.	Decision-making
	The methodology was, in general, more effective compared to other teaching methods that I have implemented.	Overall effectiveness
Satisfaction and Continuous Improvement	I felt prepared to manage the platform and content properly.	Teacher preparation
	The training I received was enough to implement the methodology effectively.	Adequacy of training
	I believe that the use of this methodology should be expanded to other educational institutions.	Recommended expansion

The reliability of the scale was measured from Guttman's Lambda 2 indicator, using the JASP version 0.19.1 software, which was used to develop all the statistical tests performed in this research. The analysis yielded a value of 0.928 of the estimated value of the indicator, with the lower limit of the confidence interval (95%) = 0.805 and the upper limit of the confidence interval (95%) = 0.964. These results showed a high correlation between the items measured and the consequent reliability of the scale used.

For the second group, of 35 students, the general objective was to know the user experience, electronic satisfaction and comparisons with the traditional methodological schemes they received in class. In which a survey was applied with a design similar to that applied to teachers, it was answered using the same scale. Table 2 shows the statements and indicators used.

Table 2. Survey applied to students

Dimension	Survey Statement	Indicator
User Experience	The methodology allowed me to learn in a more enriching way.	Educational Enrichment

	I felt more involved in my own learning process.	Involvement in learning
	The interactive and challenging activities kept me interested during the classes.	Interactivity and challenge
	The use of technological tools improved my learning experience.	Use of technology
Electronic Satisfaction	The flexibility of the methodology allowed me to adapt to my own learning pace.	Flexibility
	The methodology improved my understanding of difficult topics thanks to the resources and use of AI.	Understanding complex topics
	I was able to review materials at different times and delve into the topics.	Autonomy in revision
	The methodology generated greater satisfaction for me than traditional classes.	Comparative satisfaction
Comparison with Traditional Methods	I learned from my colleagues through collaborative work.	Collaborative learning
	I was able to exchange ideas and points of view with my colleagues.	Exchange of ideas
	I felt supported by my classmates and the teacher when solving doubts and challenges.	Mutual support
	I found the practical methodology more effective than the traditional method focused on exposure.	Practical effectiveness
Practical Application	Applying what I learned in practical activities improved my understanding of theoretical concepts.	Applied Understanding
	The methodology helped me to see the practical usefulness of knowledge in real situations.	Practical utility
	I was able to apply what I learned in simulations of real situations.	Application in simulations
	The activities helped me develop problem-solving skills.	Troubleshooting
Autonomy and Responsibility	I felt more autonomous in my learning process.	Development of autonomy
	The methodology allowed me to search for additional information independently.	Autonomous information search
	It helped me manage my own learning, boosting my confidence.	Self-management and trust
	I felt that I could adapt the activities according to my own learning needs.	Personal adaptability

The reliability analysis of the survey applied to the students showed positive values with a point estimate of the indicator of 0.95; while the interval estimate was framed in the range 0.901-0.972 of the 95% confidence interval.

3. RESULTS AND DISCUSSION

The results of the VARK questionnaire showed a considerable preference for combined learning styles among students, as can be seen in Table 3.

Table 3. Results of the application of the VARK questionnaire

GOES	11,43%		
VR	8,57%	48,57%	Bimodal
VK	2,86%		

AR	11,43%		
AK	8,57%		
RK	5,71%		
VAR	20,00%	45,71%	Trimodal
VAK	11,43%		
VRK	2,86%		
ARK	11,43%		
VARK	5,71%	5,71%	Multimodal

The bimodal modality was slightly predominant, grouping 48.57% of the participants, with the Visual-Auditory (AV) combination as the most frequent in this group (11.43%). In contrast, bimodal styles such as Visual-Kinesthetic (VK) and Reader/Writer-Kinesthetic (RK) had a low representation, which highlights that not all bimodal combinations are adopted with equal preference among students. In contrast, the combination of the four styles observed the lowest frequency of the grouped combinations, with only 5.71% of relative frequency.

On the other hand, the trimodal preference was also significant, with 45.71% of the students, in which the combination of Visual-Auditory-Reader/Writer (VAR) styles was dominant, with 20%. The full multimodal modality, represented by VARK, was less common, with only 5.71% of preference, reflecting a minority of students with flexibility to use all learning styles. These results suggested the use of an adaptive didactic approach, which mainly incorporates visual, auditory and reading/writing strategies, would be the most effective to meet the preferences of the majority in this sample. Moreover, given the similarities observed in terms of frequencies by category, the proposal should be flexible enough to cover the widest spectrum of frequencies, so as to ensure effective customization.

Based on the structured interview conducted, the students expressed a critical perspective regarding their perceptions of their learning process and their preferences towards self-directed and alternative learning. In terms of the learning process, although the students valued the clarity of the teacher's explanations and considered that the academic content is useful for their development, they pointed out that the activities in class do not always align with their learning needs, nor do the evaluation methods adequately reflect their level of knowledge.

Therefore, the need for more adjusted and flexible evaluation methodologies is inferred. In relation to self-directed learning, students expressed a strong preference for having greater autonomy and flexibility in their educational process, with a positive predisposition towards the exploration and personalization of their studies as elements that strengthen their motivation and understanding. They also highlighted the value of using alternative resources, such as online courses and digital tools, which allow them to expand their knowledge independently and at their own learning paces.

Regarding the use of technology and collaboration, fundamental aspects in the learning experience of students, the interviewees indicated that the incorporation of technological tools would facilitate the associated processes. They also stressed that they prefer classes that integrate interactive digital platforms and resources, which they consider useful to personalize

content and reinforce individual learning. Likewise, collaborative activities enrich their understanding of the topics and help consolidate knowledge. The students stated that the exchange of ideas and teamwork improve learning and contribute to generating an environment of mutual support in which they feel more comfortable sharing their doubts and reflections. The assessment of these elements reflected a significant interest in learning environments where technology and group interaction complement individual study.

Likewise, with respect to the challenges of learning, the students indicated needs for improvement given the problems they face with the teaching models that are currently applied. They mentioned that the pace of classes can be difficult to follow when many topics are covered in a short time and that, sometimes, the content does not fully adapt to their learning style.

In addition, some find it challenging to actively participate in large classes and feel that current assessments do not reflect their true level of knowledge. However, in terms of overall satisfaction, most indicated feeling motivated and supported in their learning, although several mentioned that the methodological approach currently used could benefit from greater flexibility and customization to better prepare them for future challenges. Overall, the findings of the interview highlighted the need for a methodological scheme that responds to the challenges of intelligent, self-guided and progressive learning, aligned with the demands of modernity and the specific needs of students at ISPEDIB Canelos and similar centers.

Design of the methodological scheme

Based on the premises of active, intelligent and self-directed learning, as a solution to the problems and limitations of the students' learning process, considering the purpose of this work, a methodological model or scheme was designed aimed at promoting digital learning in an interactive, self-guided and progressive environment; all of which is defined from the scheme represented in Figure 1.

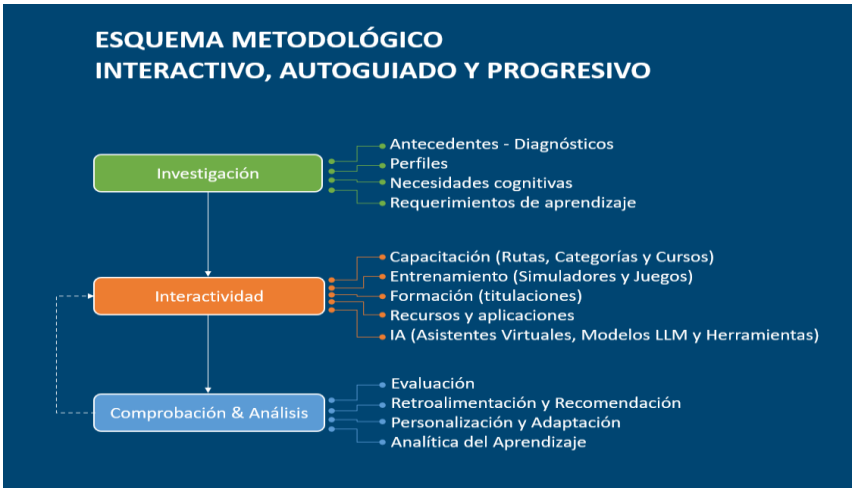

Figure 1. Methodological Scheme: Interactive, Self-Guided and Progressive. In original language Spanish

This methodological scheme integrates interactive, self-guided and progressive elements, aimed at optimizing the learning process through a personalized and adaptive experience. The methodology is divided into three stages, each with specific activities that allow continuous and directed learning.

1. Research

This initial stage focuses on diagnosing and customizing the learning process to each learner's individual context.

- Background and Diagnoses: An initial assessment is carried out to identify prior knowledge and possible gaps in learning.

- Profiles: The personal characteristics of the learner are examined, including their learning style, interests and preferences, in order to adapt the contents.

- Cognitive Needs: The specific cognitive skills and abilities necessary to achieve the proposed learning objectives are determined.

- Learning Requirements: The specific learning objectives are defined based on the results of the diagnosis and the learner's profile.

2. Interactivity

In this phase, the learner is actively involved in the process through resources and tools that encourage practical and personalized learning.

- Training: Diverse learning paths are presented, classified by levels or categories, for the learner to choose according to their needs and preferences.

- Training: Simulators, games and practical exercises are introduced to develop specific skills in a controlled and motivating environment.

- Training: Academic resources and educational materials are provided to support the attainment of formal certifications or qualifications.

- Resources and Applications: Digital tools and applications are offered to support learning and facilitate the organization of content.

- Artificial Intelligence (AI): AI enables a personalized experience through virtual assistants and language models that adapt to the learner's progress and queries in real time.

3. Testing and Analysis

The final phase is evaluative and reflective, in which the student's progress is analyzed to adjust the process and optimize future activities.

- Assessment: Understanding and knowledge gained is measured through assessments designed to reflect actual progress.

- Feedback and Recommendation: Immediate feedback is provided to the learner and new routes or areas of study are recommended based on their results and areas for improvement.

- Personalization and Adaptation: Based on the learner's progress, the learning process is adjusted, proposing activities that align with their pace and style.

- Learning Analytics: Data on learner behavior and performance is collected and analyzed, which allows methodological strategies to be improved and future learning experiences to be adapted.

This methodological scheme establishes a complete learning process that adapts to the styles and needs of the learner, facilitating an interactive and constantly evolving experience, based on personalization and the applicability of the knowledge acquired. The proposed methodology focuses on taking advantage of technology in an intelligent and strategic way to improve the teaching and learning process in Amazonian, rural and island areas, personalizing the educational experience and encouraging the self-guided and active participation of students.

Implementation and validation

The teachers agreed that the proposed methodology not only allowed an effective interaction between students and learning resources, but also fostered a more dynamic and participatory environment, as can be seen in Figure 2, which shows the results of the survey applied after the three months of the test phase.

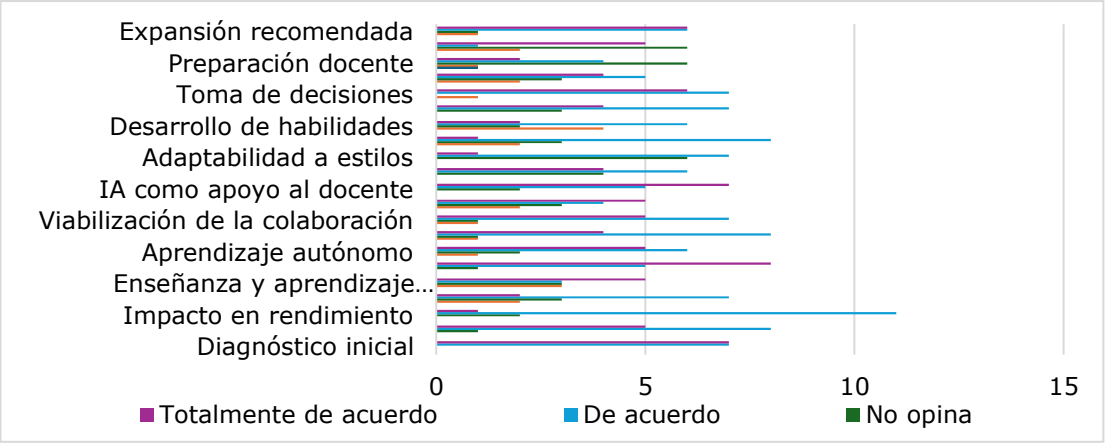

Figure 2. Results of the survey applied to teachers. In original language Spanish

As can be seen in the histogram, the survey applied to teachers showed generally positive results. The initial evaluation, according to the unanimous opinion, effectively fulfilled the identification of the needs and previous knowledge of the students, with two groups of 7 answers in the categories "agree" and "totally agree". The personalization of the study activities received an equally positive evaluation, evidenced by 8 responses in "agree" and 5 in "strongly agree", in relation to its impact on the self-management of learning. In addition, there was notable agreement regarding the influence on academic performance and motivation, with 11 responses in "agree" and 1 in "strongly agree", suggesting a favorable perception of personalization as a catalyst for student motivation.

This finding coincides with research that highlights the importance of evaluating the starting point of students to optimize adaptive learning processes. The teachers highlighted that the personalization of the activities facilitated the self-management of learning and enhanced the motivation of the students, which suggests that these approaches aligned with the individual

characteristics of each student allow greater autonomy and commitment. This is consistent with the literature that underlines that personalization in learning has a positive impact on academic performance and student interest (Graf, 2023).

In the area of technology use and interactivity, advanced digital resources, such as artificial intelligence and simulators, were favourably but discreetly received, with 5 responses in "strongly agree" and 3 in "agree", indicating an appreciation of their value in enriching the learning experience, although it should be treated as an element to be improved. Interactive resources, such as educational games and videos, stood out as drivers of student participation and engagement, with 8 responses in "strongly agree" and 5 in "agree." On the other hand, the development of digital skills, facilitated by technology, also received positive recognition, with 6 responses in "agree" and 5 in "strongly agree", suggesting that the methodological scheme helped to strengthen key digital competences in students.

The opinions reflected that these tools not only facilitated the understanding of the contents, but also promoted the development of digital skills, a key objective in contemporary education. This result is consistent with the studies of Lytras (2023), who states that the incorporation of AI and digital resources in active learning allows for a more interactive and personalized experience, benefiting both student performance and motivation.

The results obtained in the Collaboration and Assistance with AI dimension highlighted the effectiveness of the methodology in promoting teamwork and collaboration among students. There were 8 responses in "agree" and 4 in "strongly agree", indicating a clear perception that the methodology facilitated interaction and collaborative learning. In addition, teachers positively valued the role of technology in promoting collaboration, with 7 responses in "agree" and 5 in "strongly agree". Virtual assistants were also considered useful, with 4 teachers expressing "agreement" with their contribution to the learning process. Artificial intelligence was perceived as a significant support for educators, receiving 5 responses in "agree", suggesting that its integration facilitated the role of teachers in the classroom.

This is in line with previous studies that highlight the potential of AI to transform teaching and learning dynamics (Muñoz & González, 2024). The Collaboration and Assistance dimension revealed a high acceptance among students and teachers, who highlighted the impulse of technology in the promotion of interaction and teamwork, with a total of 12 positive responses that indicate a favorable perception towards collaborative learning. These findings are consistent with the statements of authors such as Muñoz & González (2024), who also argue that AI not only facilitates collaborative learning, but also creates environments that enhance active learning.

In turn, regarding continuous assessment and adaptability, the results revealed that the continuous assessment system was rated positively, with 6 teachers "agreeing" and 7 "strongly agreeing" in relation to its effectiveness in monitoring and adjusting student progress. This aspect reflects a consensus on the importance of continuous assessment to improve learning. The methodology showed adaptability to different learning styles and rhythms, obtaining 6 responses in "agree" and 4 in "strongly agree", which indicates that teachers consider that the methodology adjusts to the diverse needs of students. Finally, the methodology allowed for greater student participation and integration, with 8 responses in "agree", as evidence that this approach fosters a more inclusive learning environment compared to traditional methods.

The results obtained also indicated a significant impact on the development of fundamental skills in students, such as critical thinking and active learning. In the aspect of satisfaction and continuous improvement, it was observed that the methodology was perceived as superior compared to traditional methods, which suggests a high level of acceptance by teachers. In particular, 7 teachers positively valued the role of the methodology in promoting critical thinking and self-guided learning, while 6 expressed their agreement with its general effectiveness compared to other methods. This result is in line with research that argues that active methodologies promote greater retention and application of knowledge (Alé-Ruiz et al., 2024).

In relation to the preparation to manage the platform and the content, the teachers felt, for the most part, competent to implement it properly, which reflects the effectiveness of the training process received. Specifically, 6 responses indicated a favorable perception of the preparation provided, and 5 teachers stated that the training was sufficient to apply the methodology successfully. Likewise, regarding the projection of the methodology in other educational contexts, 6 teachers considered that its expansion to other institutions could be beneficial. This element highlights the potential of the methodological scheme to be implemented in diverse environments, and places it as an effective and adaptable approach for the development of active, self-directed and intelligent learning, through the use of technologies.

An equally positive assessment could be seen from the students. Figure 3 summarizes the relative frequencies of the results of the survey implementation.

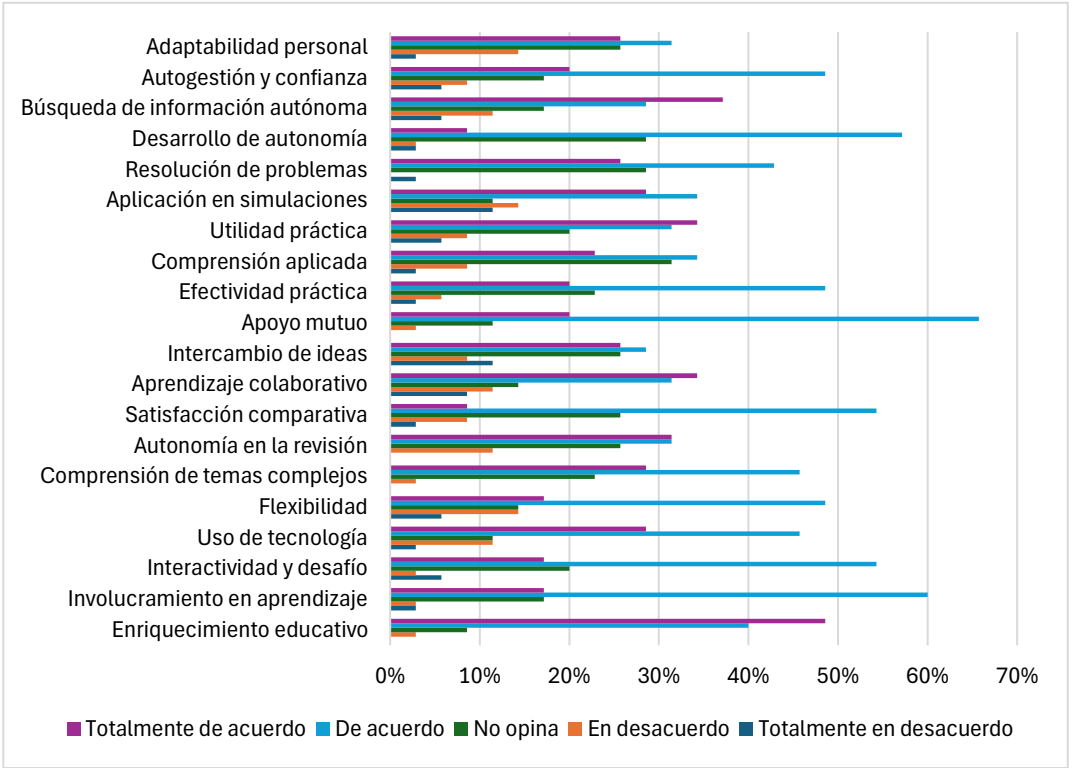

Figure 3. Results of the survey applied to students. In original language Spanish

The evaluation of the methodology revealed a positive impact on key areas of learning, especially those related to educational enrichment, engagement in learning, and interactivity. The high levels of agreement on educational enrichment (88.57%) suggest that students perceived this approach as a means to deepen their learning, aligning with studies that highlight the value of innovative methodologies to improve the quality of the educational experience (Salimovich, 2024). This result emphasizes the potential of the methodology to promote a broader and more meaningful understanding of the contents, allowing students a greater connection with the concepts learned.

Involvement in learning, with an acceptance of 77.14%, indicated that it was possible to capture the attention and commitment of students, a fundamental aspect to achieve lasting and meaningful learning. High participation may be related to opportunities for self-guided learning and responsibility in their own process, characteristics that, according to Jaffar et al. (2022), increase intrinsic motivation and interest in content.

In terms of interactivity and challenge, 71.43% of the students valued this aspect positively, which indicates that interactive activities not only maintain the interest of the students, but also stimulate higher-order cognitive skills, such as resolution. of problems and critical thinking (Fernández & López, 2023). This result confirms that the inclusion of challenging activities, when presented interactively, can increase the depth of learning and foster an environment of active participation in the classroom.

The dimension of the use of technology had a significant acceptance (74.28%), suggesting that students recognize the added value of digital resources in their learning process. Recent literature argues that the use of technological tools facilitates dynamic and student-centered learning, as it allows more direct and intuitive access to study materials (Alé-Ruiz et al., 2024). Thus, these findings reinforce the notion that technology, when strategically integrated, can improve the quality of learning.

On the other hand, flexibility was appreciated by 65.71% of the students, who highlighted that the methodology adapts to different learning rhythms and needs. This ability to adapt is considered essential in diverse educational contexts, as it allows students to advance at their own pace and explore content according to their preferences, which is supported by studies that defend the personalization of learning as the key to its effectiveness. On the other hand, the result observed in autonomy in the review (62.86%) and collaborative learning (65.72%) underlined that the methodology promotes both independence in study and teamwork.

In the applied comprehension dimension, 57.15% of the students agreed or totally agreed that the methodology helped them to apply theoretical concepts in real situations. This finding is consistent with the literature that highlights active learning as an approach that facilitates the transfer of knowledge to practical contexts, thus consolidating students' understanding. Practical utility received an acceptance of 65.72%, indicating that students perceived the value of the knowledge acquired for real-world situations. This aspect is fundamental, since the applicability of concepts in real contexts fosters more meaningful learning and prepares students to face problems outside the school environment (Rivas, 2024).

Regarding the application in simulations, 62.86% of the students valued this aspect positively. Simulations are an effective tool for students to experience problem-solving in a safe

environment, which allows them to strengthen their practical skills without the risk of error in a real environment. The problem-solving skill showed a high degree of acceptance (68.57%), indicating that the methodology was effective in developing this competence in students. Recent studies suggest that problem-based learning is essential to equip students with the skills needed to face complex challenges, thereby promoting the development of skills and knowledge (González-Argote & Castillo-González, 2024).

The development of autonomy stood out with 65.71% of responses in "agree" and "strongly agree", suggesting that the methodology promotes independent and self-managed learning. This autonomy is a key component in modern learning, as students become active agents of their own process, a characteristic valued by innovative educational models.

The search for information was also positively valued, with 54.29% of the students expressing that the methodology encouraged them to investigate and deepen the topics on their own. In relation to self-management and confidence, 68.57% of the students perceived that the methodology promoted these competencies. This indicates that the methodology, by giving space for personal learning management, strengthens students' self-efficacy, a factor that, according to Al-Abyadh & Azeem (2022), is crucial for effective learning.

Finally, personal adaptability obtained 57.14% of positive responses. This aspect reflects that the methodology allows students to adjust the learning process to their own needs, which is essential in an educational context that demands flexibility and personalization. Taken together, these results reflect that the methodology fosters autonomous, hands-on, and adaptable learning, qualities that are considered essential to prepare students in a changing and challenging world. These findings suggest that the methodology is effective not only in the transmission of theoretical knowledge, but also in the development of practical competencies and transversal skills, reaffirming its potential as a comprehensive and high-impact educational tool.

4. CONCLUSIONS

The results of the diagnostic analysis carried out on the students revealed a considerable diversity in learning preferences, with a marked inclination towards bimodal (48.57%) and trimodal (45.71%) styles. He highlighted the preference for the combination of VA within bimodal styles and VAR in trimodal styles, which highlighted the need to integrate flexible, customizable methodological approaches that encourage active learning. In addition, structured interviews indicate that, although students value the clarity and usefulness of the content taught, there is a demand for assessment methods and activities that are better suited to their learning styles and that offer them greater autonomy and flexibility. Students express a strong preference for the use of technological resources and collaborative activities, which they perceive as facilitators to personalize their learning and enrich their understanding through the exchange of ideas and mutual support.

The responses provided by teachers suggest that the methodology is widely perceived as effective in developing core competencies and in fostering active, autonomous, and adaptive learning. The general satisfaction with the methodology is evidenced in its positive assessment in key aspects such as continuous assessment, adaptability to different learning

styles and support for collaboration and teamwork, where the use of technology and personalized artificial intelligence plays a motivational role. Likewise, the training provided was considered adequate to implement the system, which reinforces the feasibility of expanding this methodology to other institutions.

The survey applied to the students showed that the methodology implemented significantly favors active learning and the development of essential skills, such as autonomy, teamwork, problem solving and the practical applicability of knowledge. The results highlighted that students perceive this methodology as a means to deepen their learning, facilitating an applied understanding and the use of technological tools that enrich the educational experience. Likewise, the methodology encourages collaboration and the exchange of ideas, which strengthens community learning and promotes self-management. The high valuation of the indicators related to practical usefulness and adaptation to different learning rhythms underlined the effectiveness of the methodology to adjust to the individual needs of the students, allowing them to advance at their own pace and deepen the contents.

This personalized and experiential learning approach aligns with the demands of a contemporary educational context, where adaptability and preparation to face real problems are crucial skills. The findings confirm that the methodology is effective in fostering active, self-directed and progressive learning, as well as the effective adaptation of intelligent teaching and learning, for the development of fundamental competencies in the twenty-first century, which UE highlights its potential to become an educational model that can be replicated in various institutions. This reinforces the need to continue promoting active and technological methodologies that respond to the expectations and challenges of students in a constantly changing world.

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