Reinventing Education: An Experience of Emotional Measurement with Artificial Intelligence and Playful Strategies in the Classroom.

Reinventando la Educación: Una experiencia de medición emocional con Inteligencia Artificial y estrategias lúdicas en el aula.

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Abstract

This article reports on an educational innovation experience carried out at Unidad Educativa Liceo Cristiano de Cuenca and Unidad Educativa Particular Carlos Crespi II, within the framework of the project "Reinventing Education." The intervention was conducted by master's students, who designed and implemented ludic strategies for School Projects, Religion, and Mathematics (logical-mathematical relations), with the aim of energizing learning and observing its emotional effects. An action research design was adopted, and a multimethod assessment was implemented: self-report through the Achievement Emotions Questionnaire (AEQ), administered before and after the sessions, and automatic emotion recognition with Emolive, recording emotions in the phases before, during, and after through a tripod-mounted camera. Data analysis was conducted in Python, integrating data processing and visualization, and triangulating results from both sources. The findings show a consistent increase in positive emotions (motivation, enjoyment, confidence) and a reduction of negative emotions (boredom, frustration, anger) after the intervention. Emolive allowed the observation of in-session dynamics, with a progressive decrease of negative states during the activity and predominance of positive emotions at the end, while the AEQ captured significant changes between the beginning and the end. These results suggest that the combination of ludic strategies with AI-supported emotional measurement contributes to a more favorable socio-emotional climate and supports informed teacher decision-making. Implications for formative assessment and future research lines integrating multimodal measurement and larger samples are discussed.

Keywords: Academic emotions, facial recognition, Emolive, AEQ, gamification, action research, formative assessment.

Resumen

Este artículo informa sobre una experiencia de innovación educativa llevada a cabo en la Unidad Educativa Liceo Cristiano de Cuenca y la Unidad Educativa Particular Carlos Crespi II, en el marco del proyecto "Reinventando la Educación". La intervención fue realizada por estudiantes de maestría, quienes diseñaron e implementaron estrategias lúdicas para Proyectos Escolares, Religión y Matemáticas (relaciones lógico-matemáticas), con el objetivo de dinamizar el aprendizaje y observar sus efectos emocionales. Se adoptó un diseño de investigación-acción y se implementó una evaluación multimétodo: autoinforme mediante el Cuestionario de Emociones de Logro (AEQ), administrado antes y después de las sesiones, y reconocimiento automático de emociones con Emolive, registrando las emociones en las fases antes, durante y después mediante una cámara montada en un trípode. El análisis de datos se realizó en Python, integrando el procesamiento y la

visualización de datos, y triangulando los resultados de ambas fuentes. Los hallazgos muestran un aumento constante de las emociones positivas (motivación, disfrute, confianza) y una reducción de las emociones negativas (aburrimiento, frustración, enojo) después de la intervención. Emolive permitió observar la dinámica de la sesión, con una disminución progresiva de los estados negativos durante la actividad y un predominio de emociones positivas al final, mientras que el AEQ captó cambios significativos entre el inicio y el final. Estos resultados sugieren que la combinación de estrategias lúdicas con la medición emocional basada en IA contribuye a un clima socioemocional más favorable y facilita la toma de decisiones informada del profesorado. Se discuten las implicaciones para la evaluación formativa y futuras líneas de investigación que integren la medición multimodal y muestras más amplias.

Palabras clave: Emociones académicas, reconocimiento facial, Emolive, AEQ, gamificación, investigación-acción, evaluación formativa.

1.   INTRODUCTION

Contemporary education faces the challenge of responding to the demands of a globalized, digital, and emotionally complex society. As UNESCO [14] points out, reinventing education is urgent in order to ensure an approach that prepares citizens capable of meeting the challenges of the 21st century, integrating both cognitive and socio-emotional development [1].

Within this framework, teaching and learning processes can no longer be limited to the mere transmission of content; they require active, innovative, and technology-mediated methodologies that enhance learning while simultaneously addressing students' emotional well-being [10]. Recent research has shown that the incorporation of digital tools and ludic strategies increases motivation, fosters interaction, and strengthens the development of cognitive and social competences [13].

Likewise, multiple authors agree that emotions directly influence learning by modulating attention, memory, and motivation [7]. Therefore, measuring and understanding the emotional component in the classroom becomes essential for designing more effective pedagogical strategies.

Within this context, the research project "Reinventing Education" emerged, developed in the city of Cuenca, Ecuador, with the participation of Unidad Educativa Liceo Cristiano and Unidad Educativa Particular Carlos Crespi II. This project is grounded in action research [4], promoting educational transformation through reflective and collaborative practice.

The experience involved the participation of students from the Master's program in Educational Innovation at Universidad Politécnica Salesiana, who designed and implemented ludic tools for subjects such as Religion and Mathematics, with the purpose of energizing learning.

Complementarily, the tool Emolive, based on artificial intelligence, was used to measure students' emotions in real time through facial recognition. This resource made it possible to record and analyze how emotions evolved during the activities, providing objective data that enriched pedagogical reflection.

In summary, this experience constitutes an example of how pedagogical innovation, gamification, and artificial intelligence can be articulated in the same educational setting to promote meaningful learning, evaluate the emotional component of the classroom, and foster student well-being, contributing to the goal of reinventing education in Ecuador.

2.   PELIMINARIES.
2.1.   Emotions and Learning: Updated Theoretical Framework

Academic emotions not only accompany the learning process but also constitute an essential determinant of school performance. According to Control-Value Theory, when a student perceives that they have control over a task and that the task possesses personal or social value, positive emotions such as joy and hope are activated, fostering persistence, attention, and deeper learning [7]. Conversely, when the level of control or the perceived value decreases, negative emotions such as anxiety, frustration, or boredom increase, thereby limiting performance. Recent research has shown that intrinsic value judgments (related to enjoyment of the task itself) and extrinsic value judgments (associated with its usefulness in achieving external goals) more accurately predict the quality of academic performance, confirming the relevance of the affective dimension in teaching [11].

2.1 Affective Computing in Education: Measuring for Feedback

Affective computing has evolved as an interdisciplinary field that integrates artificial intelligence, cognitive sciences, and pedagogy, with the aim of understanding and responding to students' emotions. Automatic emotion recognition through computer vision has proven to be a reliable resource for obtaining continuous and objective measurements, which complement teacher observations and traditional self-report instruments [15]. More recent research in digital environments highlights the usefulness of combining multiple data sources, such as facial expressions, voice, and interactions, allowing for greater accuracy in emotion detection. At the same time, emphasis is placed on the need for ethical frameworks to regulate its application, considering aspects such as privacy, informed consent, and the minimization of algorithmic biases [16, 17].

2.2 Ludic Strategies and Gamification (with a Focus on Mathematics)

Gamification has shown consistent effects in increasing motivation, interest, and academic performance. Various studies have indicated that its effectiveness depends on the design, being more significant when it includes immediate feedback, clear rewards, and visible progression of achievements [5]. These elements allow students to maintain commitment and reduce the feeling of frustration when facing complex tasks. In the area of mathematics, the impact is especially relevant: it has been proven that gamification not only increases motivation but also facilitates conceptual understanding, the transfer of learning, and persistence in problem-solving activities that are often perceived as difficult [18].

2.3 Formative Assessment with Technologies

Digital formative assessment has transformed the way teachers and students interact with feedback. The use of digital platforms and tools makes it possible to quickly generate evidence and provide timely comments that students can immediately apply in their learning process. A recent systematic review points out that the most effective feedback is that which is specific, clear, and delivered at the right time, as it promotes self-regulation and the progressive construction of knowledge [12]. In parallel, research published in Computers & Education has shown how teachers process data from these tools, developing analysis strategies that allow them to identify patterns, detect frequent errors, and adjust instruction in short cycles, thereby strengthening the dynamic of continuous improvement in the classroom [2].

Action Research as a Methodological Framework

Action research has been consolidated as an appropriate methodological approach for school contexts, as it enables teachers to actively participate in the improvement of their practices. This approach articulates cycles of planning, action, observation, and reflection, with the aim of producing significant changes in teaching while simultaneously generating situated knowledge. Recent studies emphasize that action research not only promotes teachers' professional development but also strengthens the link between theory and practice, becoming an adequate framework for the implementation and analysis of pedagogical innovations that integrate emerging technologies and the evaluation of emotions [3].

3 METHODOLOGY
3.1 Research Design

The study was developed under an action research approach, in which the researchers implemented, observed, and reflected on the application of technological and psychometric tools in the classroom. This design made it possible to introduce pedagogical innovations in the school context while simultaneously analyzing their effects on the emotional dimension of learning.

3.2 Context and Participants

The experience was carried out in the city of Cuenca, in two institutions: Unidad Educativa Liceo Cristiano and Unidad Educativa Particular Carlos Crespi II. Students from basic education participated in the area of School Projects, specifically in the subjects of Religion and Mathematics (logical-mathematical relations). Each class was accompanied by its respective teacher and by master's students from the Educational Innovation program at Universidad Politécnica Salesiana, who designed and applied the ludic strategies.

3.3 Procedure

The implementation was organized into three stages::

3.3.1 *Preparation*

• Students were informed about the objective of the research, with an explanation that their emotions would be recorded through a camera and questionnaires.

• A tripod-mounted camera was installed at the front of the classroom, connected to the Emolive software, to continuously capture facial expressions.

• Each teacher was provided with the Achievement Emotions Questionnaire (AEQ) for its administration at the designated moments.

3.3.2 *Initial Measurement*

• Before starting the ludic activities, students completed the AEQ questionnaire (pre-phase), which made it possible to identify their initial emotional state.

• At the same time, the camera began recording facial emotions through Emolive, generating a first block of reference data.

3.3.3 Intervention and Final Measurement

• The ludic activities designed for each subject were implemented. Throughout the entire session, the camera with Emolive continuously recorded emotions in real time, allowing for the analysis of emotional behavior across three phases: before, during, and after the activity.

• At the end of the experience, students completed the AEQ again (post-phase), complementing the information collected by Emolive.

3.4 Data Collection Instruments

• Emolive: software based on artificial intelligence for facial emotion recognition, which classifies expressions into categories such as joy, sadness, anger, surprise, fear, and neutrality.

• AEQ (Achievement Emotions Questionnaire): psychometric questionnaire that measures academic emotions before and after the activity.

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3.5 Data Analysis

The data obtained were processed in a complementary manner:

• The records from Emolive [9] allowed the observation of the temporal evolution of emotions during the activity.

• The responses to the AEQ [8] provided a comparative view of the emotional state before and after the experience.

• The triangulation of both sources made it possible to identify convergences and divergences between automatic measurement and student self-report, thereby enriching the analysis.

4 RESULTS

This section presents the findings obtained from the combined application of the AEQ questionnaire and the Emolive software in the subjects of School Projects, Mathematics, Religion, and Logical-Mathematical Relations. The AEQ made it possible to capture emotional states before and after the ludic intervention, while Emolive recorded emotions at three key moments: before, during, and after the activity. The triangulation of both sources provides a more comprehensive view of students' emotional behavior in response to the applied strategies.
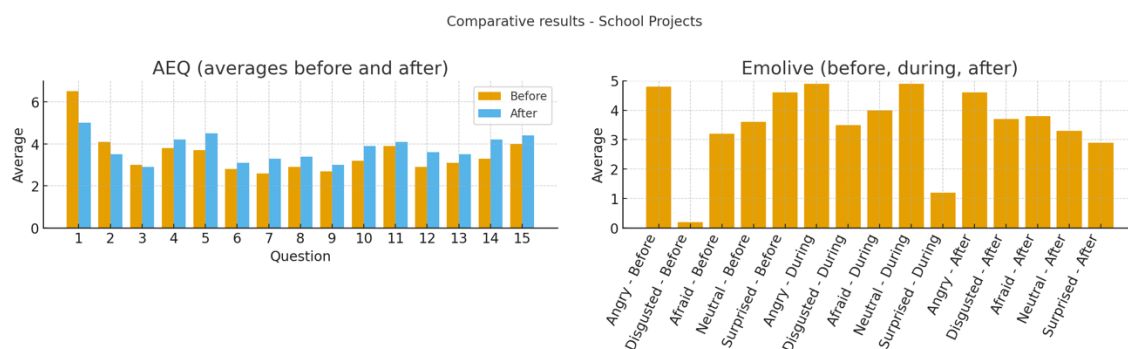
4.1 School Projects

In School Projects, the AEQ results show an increase in positive emotions after the activity, especially in items related to motivation and interest. In parallel, negative emotions such as anxiety and boredom decreased in the post-intervention records..

Fig. 1. Collaborative dynamics in open spaces

The analysis with Emolive revealed a slight reduction in expressions of anger and sadness during the activity, accompanied by a gradual increase in the emotion of happiness at the end of the session. These data suggest that the ludic dynamics fostered an environment of greater affective engagement.

**Fig. 2.** Comparative results – School Projects

4.2 Matemathics

In the case of Mathematics, the AEQ reflected an increase in confidence and enjoyment after the activities, with a notable decrease in emotions such as fear and frustration. This indicates that the ludic methodology helped students approach logical-mathematical relations with greater confidence.


Fig 3. Ludic activity in outdoor settings

For its part, Emolive captured a reduction in negative emotions during the development of the exercises and a rebound in positive emotions at the end. The contrast between both measurements confirms that gamification in Mathematics not only supports conceptual understanding but also strengthens the socio-emotional dimension of learning..
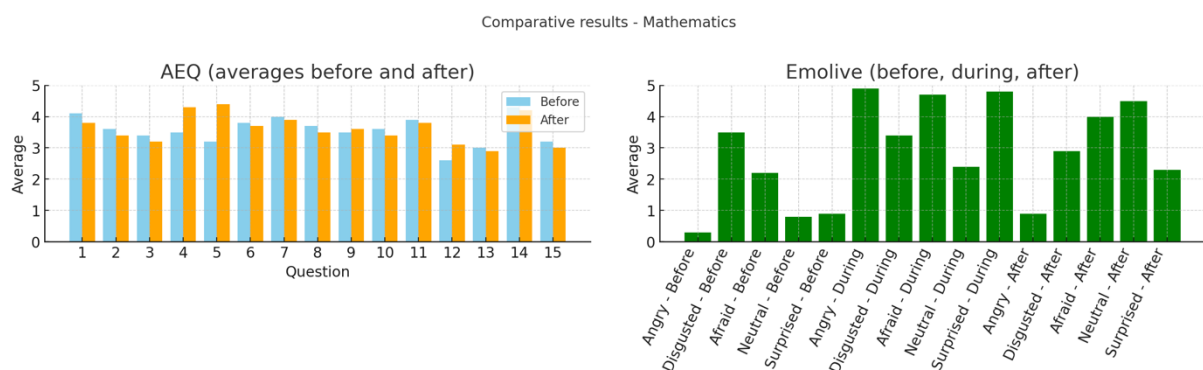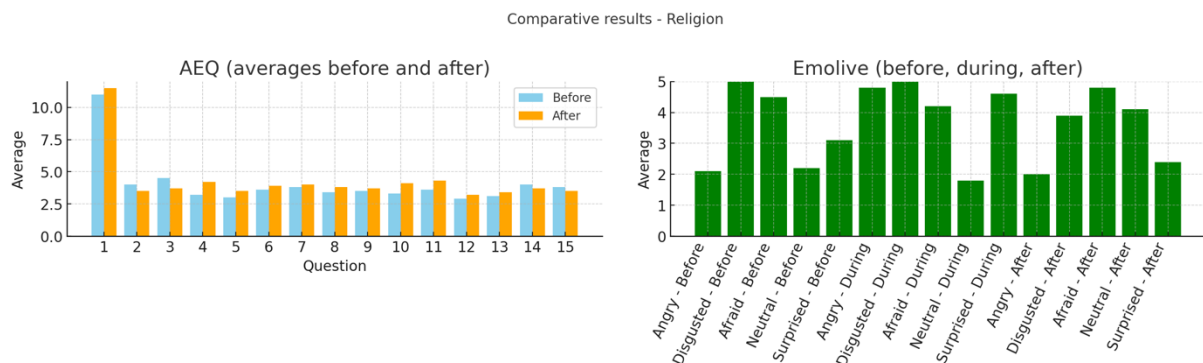

Fig. 4. Comparative results – Mathematics

4.3 Religion

In Religion, the AEQ results indicated an increase in emotions associated with calmness and satisfaction. Most students showed, in the post-phase, a greater positive disposition toward the subject, suggesting that the ludic approach fostered an environment of trust and active reflection.
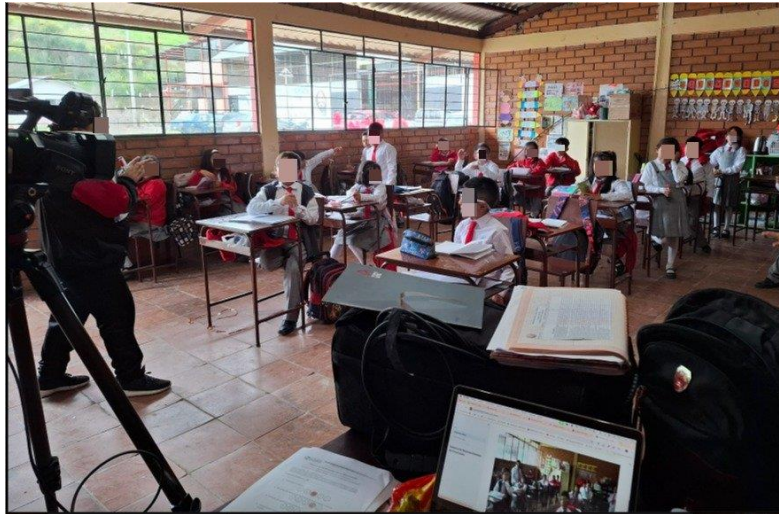
Figure 5. Students in the classroom

The Emolive records coincided in showing an increase in neutral emotions and serenity at the end of the session, together with a decrease in expressions of sadness. This convergence of results demonstrates that the activities fostered an atmosphere of harmony and participation.



Fig. 5. Comparative results – Religion

4.4 Logical-Mathematical Relations

In Logical-Mathematical Relations, the AEQ showed a significant improvement in positive emotions after the intervention, especially in aspects related to motivation and enthusiasm toward complex tasks. At the same time, emotions of disinterest and anxiety decreased noticeably.

Figura 6. Students in the classroom

In the Emolive data, a reduction in expressions of anger and disgust was observed during the activity, accompanied by an increase in the emotions of surprise and happiness in the final phase. This reflects that the ludic dynamics succeeded in transforming an initially tense scenario into an environment with greater emotional openness.
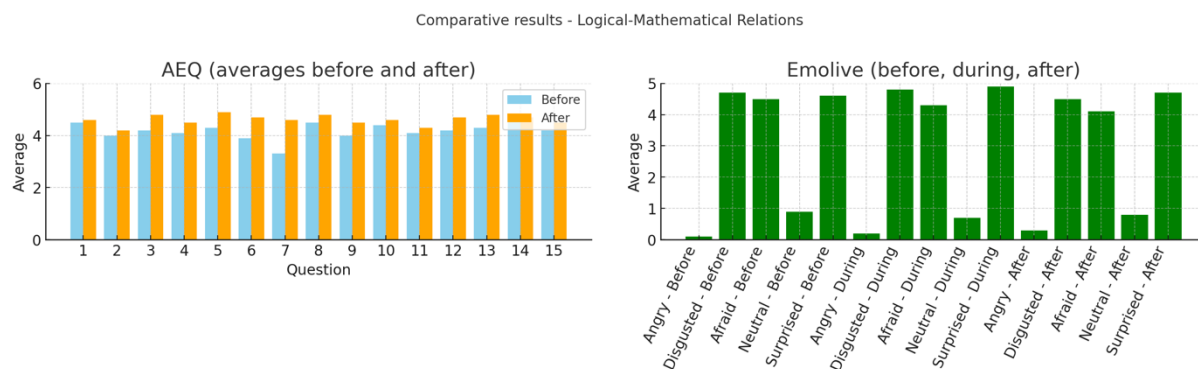
Fig. 7. Comparative results – Logical-Mathematical Relations

The integration of ludic strategies with emotional measurement, as measured by AEQ and Emolive, generated a positive impact on the students' learning climate. In all the subjects analyzed, a clear trend was observed toward an increase in favorable emotions, such as motivation, satisfaction, and enjoyment. In contrast, negative emotions, such as boredom, frustration, and anger, showed a notable decrease. The AEQ made it possible to identify these changes comparatively between the before and after of the activities. At the same time, Emolive provided a continuous record that revealed the transition of emotional states during the session, with a predominantly positive closure. This convergence between the two instruments confirms that pedagogical innovation based on ludic dynamics not only strengthens academic engagement but also contributes to a healthier and more favorable emotional environment for learning.

5   DISCUSSIONS
5.1   Emotios and learning

The results obtained show that positive emotions increased significantly after the intervention in all subjects. This finding is consistent with Control-Value Theory, which explains how the increase in perceived control and the value assigned to the task generates emotions of enjoyment and motivation, fostering persistence in learning [7, 11]. The decrease in negative emotions such as boredom or frustration reinforces the idea that the emotional component is a key mediator between teaching and academic performance.

5.2   Affective Computing as a Complement to Teacher Observation

The application of Emolive made it possible to capture the evolution of emotions in real time, showing that during the ludic activities the peaks of negative emotions were reduced and positive emotions progressively increased. This result is consistent with research on affective computing that highlights the value of continuous and multimodal measurement to enrich pedagogical feedback [15, 16]. In this way, the use of artificial intelligence-based tools does not replace the teacher but rather complements their ability to detect and respond to students' emotional needs.

5.3 Ludic Strategies and Gamification

Gamification applied in Mathematics and Logical-Mathematical Relations showed a particularly positive impact. This effect confirms recent meta-analyses indicating that gamification increases motivation and persistence, especially in areas perceived as difficult [6, 18]. Students not only experienced a greater emotional disposition but also a reduction in anxiety when facing cognitive challenges, which reinforces the relevance of incorporating ludic dynamics into the teaching of complex content.

5.4 Formative Assessment and Feedback

The combination of AEQ and Emolive offers a novel way to enrich formative assessment. The AEQ made it possible to contrast emotional states before and after the sessions, while Emolive showed how they evolved during the activity. This dual perspective is consistent with the literature that underscores the need for timely and specific feedback to promote self-regulation and improve learning [2, 12]. In this regard, the analysis conducted with Python facilitated the systematization of the data, generating visualizations that add value both to research and to teaching practice.

5.5 Action Research and Pedagogical Innovation

The methodological design based on action research made it possible to implement and evaluate strategies in a real classroom context, ensuring the relevance and applicability of the results. This approach reaffirms the importance of teachers' critical reflection on their practice and the integration of educational technologies as a means to enhance learning [3]. The findings suggest that pedagogical innovation does not depend solely on the incorporation of technology, but rather on its articulation with active, student-centered methodologies.

5.6 Integrating Neutrosophy into Emotion Measurement and Interpretation

A promising avenue for future research is the integration of Neutrosophic Logic into the measurement and interpretation of emotions in educational contexts. Unlike classical or fuzzy approaches, neutrosophy allows for simultaneously representing degrees of truth, falsity, and indeterminacy, which is particularly relevant when dealing with the ambiguity and subjectivity of affective states [19]. For instance, a student's facial expression may convey enjoyment (truth), conceal subtle frustration (falsity), or remain ambiguous due to contextual or cultural factors (indeterminacy). By incorporating neutrosophic sets into tools such as Emolive and self-report questionnaires like the AEQ, researchers could generate more nuanced models of emotional dynamics in the classroom, reducing biases from binary or purely probabilistic categorizations. This line of inquiry would not only enhance the precision of emotional assessment but also support the design of adaptive and inclusive

pedagogical strategies, reinforcing the overarching goal of reinventing education through innovation grounded in both artificial intelligence and human complexity.

5.7 Limitations and Future Directions

Despite the positive results, certain limitations must be acknowledged. The sample size was restricted to two institutions, and data collection was carried out in specific contexts. The measurement with Emolive was limited to facial recognition, without including other modalities such as voice or gestures. In addition, students' posture occasionally hindered data capture, as keeping their heads down made it difficult for Emolive to recognize emotions, and in open spaces, lighting conditions posed a minor but noticeable challenge. Another limitation was related to the AEQ: for the youngest students, completing the questionnaire took considerable time, as it had to be done with the teacher's assistance, which introduced a potential source of bias. Future research could expand the sample, diversify contexts, and explore multimodal systems that integrate AI with psychometric questionnaires in adaptive learning platforms.

6   CONCLUSSIONS

The present study demonstrates that integrating ludic strategies with emotional measurement tools based on artificial intelligence contributes to transforming the classroom learning environment. In all the subjects analyzed, an increase in positive emotions, such as motivation, enjoyment, and confidence, was observed, accompanied by a decrease in negative emotions, including boredom, frustration, and anger.

The triangulation between the AEQ questionnaire and the Emolive software enabled the comparison of complementary perspectives: while the AEQ provided a reflective measurement of emotions before and after the activities, Emolive captured the real-time emotional dynamics during the session. This convergence of instruments confirms that the combined analysis of self-reports and facial recognition technologies provides a more comprehensive view of the learning process.

Furthermore, action research proved to be a relevant approach for evaluating pedagogical innovations, as it enabled interventions to be adapted to the school context and to generate situated knowledge. The use of Python for data analysis allowed for the rigorous systematization of the information obtained and the production of visualizations that facilitated the interpretation of the findings.

As a projection, it is necessary to expand the sample to more institutions and diversify contexts, as well as to explore the potential of multimodal systems that integrate AI, psychometric questionnaires, and immediate feedback. In this way, it would be possible to design more adaptive educational proposals that can simultaneously address the cognitive and emotional dimensions of learning.

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