

# **A Comprehensive Analysis of Efficacy, Cost-Effectiveness, and User Perception for Implementing Automated Attendance Systems in Educational Institutions in Sinaloa, Mexico**

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**Abstract** Given the continued use of manual procedures for attendance registration and the persistence of compartmentalized views in the assessment of technological solutions, this work proposes a comprehensive and integrated evaluation of three fundamental axes: technical performance, financial sustainability, and user perception. Based on a systematic review of the academic corpus and the analysis of contextual information regarding the state of Sinaloa, Mexico, it is identified that feasibility depends on the harmonization of these elements. The findings reveal that, in environments subject to budgetary and infrastructural constraints, RFID-based platforms emerge as the most robust and enduring option, notable for their high accuracy, low cost threshold, autonomous operation without permanent connectivity, and a higher degree of acceptance within the educational community. Thus, the central contribution lies in a holistic evaluation framework that transcends partial analyses and provides a contextualized decision-making tool for selecting technologies aligned with the specific conditions of each institution.

**Keywords.** automated attendance control, RFID, educational institutions, technical efficacy, economic profitability, technology adoption, Sinaloa.

## **1. Introduction**

Over the past few years, the integration of information technologies in the educational field has evolved from being a supplementary resource to an indispensable element for improving academic and administrative procedures. Within this framework, the management of student attendance constitutes a crucial task, both due to its regulatory connection to evaluation and certification processes, and its significance as an early indicator of academic performance and the likelihood of dropout. However, in a great number of educational institutions, this procedure remains reliant on traditional manual techniques, which are prone to errors, inefficient in utilizing classroom time, and have a limited capacity to produce immediate and useful data for decision-making [1;2].

Given this scenario, automation through tools such as facial recognition, biometrics, near-field communication (RFID) technologies, and AI-powered smart environments emerge as an option with significant potential. Previous studies confirm the technical feasibility and functional advantages of these alternatives, highlighting increases in the accuracy of records, reductions in administrative tasks, and the generation of information suitable for analysis [3;4;5]. However, academic literature emphasizes that the mere introduction of technology is insufficient to ensure positive outcomes; aspects such as financial efficiency, suitability for the specific environment, and, fundamentally, the assessment and acceptance by end-users stand as decisive elements for the enduring and effective implementation of these platforms [6;7].

This study identifies a division in the segmented approaches prevalent in existing research, which tends to examine technical performance, economic aspects, or user interaction in isolation. Consequently, this work proposes a comprehensive evaluation that interrelates these facets (technical performance, economic viability, and user acceptance) to assess the implementation of automated attendance registration mechanisms in the education sector. Using the state of Sinaloa, Mexico, as the study setting, the aim is to develop an overall evaluation framework that can serve as a reference for institutional decision-making and for designing technological proposals adapted to the local context, sustainable over time, and focused on the needs of the user community [8;9;10;11].

## **2. Theoretical and Contextual Justification**

The study is grounded in a conceptual framework that converges approaches from the fields of software development, economic evaluation of educational technologies, and the social sciences related to pedagogy. This methodological convergence is essential to transcend the segmented perspectives that, on one hand, assess technical performance in isolation or, on the other, consider human aspects without addressing technological and financial feasibility. The research rationale is organized around two complementary components: the theoretical scaffolding that supports the study dimensions and the concrete setting that provides relevance and immediacy to the analysis undertaken.

From the field of systems engineering and information technology, the automation of administrative tasks finds its rationale in the possibility of increasing accuracy, reliability, and resource optimization. The development of applications intended for attendance recording must begin with a comprehensive evaluation of organizational workflows, ensuring that the technological proposal aligns consistently with institutional operations [1;2]. Recent research shows a transition towards more sophisticated options, such as facial recognition and biometric methods, which offer the prospect of complete automation and more secure identity verification [3;4]. However, the postulates of systems theory warn that the mere incorporation of technological tools, in the absence of proper alignment with procedures and human capital, can lead to rejection, deficient use, or, ultimately, the collapse of the implementation project.

The theoretical framework on technology incorporation in educational and non-profit environments emphasizes that, in addition to the initial expenditure, long-term sustainability depends on the balance between the investment made and the benefits gained in operational efficacy. The notion of "profitability through technological appropriation" illustrates how proposals based on affordable and widely available equipment can achieve effectiveness levels like those of more costly systems, thereby reducing barriers to their adoption in institutions with limited budgets [6]. This principle entails the need to evaluate, beyond the cost of equipment or licenses, periodic expenses for operation, maintenance, staff training, as well as the efficient utilization of teaching and administrative staff time.

From the fields of social psychology and user experience, the Technology Acceptance Model (TAM) and similar perspectives establish that the perceived usefulness and ease of use of a system significantly influence the successful implementation of a platform. To gain acceptance among the teaching staff, these tools must be conceived as resources for educational support, and not merely as administrative management instruments [5]. Likewise, research on school absenteeism shifts the focus from simple record-keeping to the substantive use of the information, emphasizing that its perceived value by educators, counselors, and administrators is linked to the system's ability to prompt timely and situation-specific educational interventions [7;12;13]. Considerations regarding privacy and ethics, particularly relevant in the case of biometric or facial identification solutions, also represent an essential component in this holistic evaluation.

The integration of these three foundations responds to the necessity of a holistic perspective that transcends exclusively numerical or technological approaches and includes the particular perspectives and circumstances of the end-users [14]. The main premise guiding this work posits that the effective and enduring implementation of an automated attendance management mechanism is only achieved when verifiable technical performance, demonstrable economic viability, and favorable, practical acceptance by the educational community harmoniously converge.

Consequently, the relevance of this comprehensive analysis is heightened by contextualizing it within a specific regional setting: the state of Sinaloa, Mexico. An examination of the state's statistical and geographical data provides a structural diagnosis that reveals particular conditions, which directly influence both the challenge of attendance and the feasibility of technological alternatives [8;9;10;11].

The demographic profile and geographic dispersion of Sinaloa pose specific challenges in terms of access and connectivity. Socioeconomic indicators, such as average household income and poverty rates, form a conditioning framework for assessing the cost-effectiveness of any technological investment by institutions, many of which are public. Economic pressure on families can be a risk factor for absenteeism, which transforms an effective attendance control system into not only an administrative tool but also an instrument for the early identification of vulnerable situations among students [7;13].

On the other hand, the available information regarding the number of schools and educational facilities in localities like Guasave provides a quantifiable reference point, enabling an estimation of the potential scope of any eventual implementation. This scenario necessitates considering proposals that are progressive in scope and flexible enough to adapt to dissimilar contexts, ranging from organizations with robust connectivity to those with deficiencies in their digital infrastructure. The real-world applicability of platforms requiring specialized, high-cost components must be rigorously weighed against the financial resources available to the education system, both at the state and municipal levels.

### **3. Methodology**

To operationalize this evaluative framework, the research procedural approach was structured to comprehensively assess the implementation of automated attendance registration mechanisms in educational centers by interrelating the domains of technical performance, financial sustainability, and user experience. To this end, an approach based on a systematic review of specialized literature and the processing of secondary statistical information was chosen. This methodological course of action enabled a global and situated understanding of the analyzed phenomenon without the need to undertake primary data generation, proving particularly suitable for delineating an evolving domain and for rigorously integrating pre-existing knowledge and context [15;16].

In continuity with the methodological approach, the research framework is situated within a qualitative paradigm, characterized by a prospective and delineating nature. This design modality is pertinent when the objective is to map a developing knowledge domain, discern determining elements, and build a

holistic appreciation of a multifaceted phenomenon (such as the incorporation of technology in educational settings), prior to undertaking verificative or experimental studies [17]. The prospective aspect promotes the formulation of hypotheses and the identification of significant variables; meanwhile, the delineating dimension focuses on methodically and thoroughly outlining the results obtained from the reviewed literature and accessible contextual indicators [18].

Regarding the concrete development of the study, its execution was based on two fundamental pillars. As the first component, a systematic examination of the academic literature pertaining to automated attendance recording systems and the phenomenon of school absenteeism was conducted. For this purpose, the ReSiste-CSH protocol, originally designed for the social sciences, was adapted. This protocol ensures rigor through methodical stages of exhaustive inquiry, critical appraisal, interpretation, and consolidation of diverse research [19]. Source collection was carried out in prestigious academic databases, such as Scopus, Web of Science, and SciELO, using a set of key terms linked to attendance management technologies and the dimensions of the analysis. The selected works underwent processing based on thematic qualitative content analysis, a recognized methodological procedure for handling secondary data that enabled their coding, classification, and integration to identify patterns, the most recurrent technological solutions, and areas of knowledge requiring further development [20;21].

Complementing this, and with the aim of situating the study within a tangible context and granting it applied relevance, official secondary statistical information was processed. The primary reference source was the Statistical and Geographical Yearbook of Sinaloa, a publication that provides key structural variables essential for understanding the particularities of the state of Sinaloa, Mexico [10;11]. This contextualization exercise enabled the estimation of the potential scale of a future deployment, the assessment of existing infrastructure limitations, and the consideration of those socioeconomic aspects that directly impact the feasibility and cost-benefit balance of any technological initiative in that region.

In this regard, it is important to specify that the nature of this work is prospective and delineating. Its central purpose is not to establish causal relationships nor to formulate statistical generalizations, but to systematize and condense the body of available knowledge, with the aim of formulating a comprehensive evaluative framework. The primary limitation of this approach stems from its grounding in secondary sources and published literature, implying that the results constitute a representation of the knowledge recorded up to the period in which the review was conducted. Despite this, this methodological perspective is considered fully valid and accepted in the field of educational and social research, particularly for developing comprehensive frames of reference during the preliminary stages of analyzing complex problems [22;23].

Finally, the interpretive approach adopted culminated in a tripartite synthesis of the discoveries. The thematic findings, organized by core areas and obtained from the systematic review, were cross-referenced and complemented with the quantitative and qualitative indicators of the Sinaloan context. This intersection between the theoretical corpus and regional indicators enabled a situated assessment, as well as the development of concrete and feasible guidelines for deploying automated attendance management platforms in environments with analogous characteristics.

#### **4. Analysis of Results**

The presented analysis consolidates the results of the systematic literature review with the contextual information of the state of Sinaloa, interrelating the three core dimensions of the research: technical functionality, financial sustainability, and user acceptance level. This methodological cross-referencing reveals that the feasibility of automated attendance recording systems is not determined by a single factor, but by the balanced convergence of technical, economic, and human elements inherent to the educational setting where implementation is intended [14].

Regarding the dimension of technical functionality, the reviewed literature identifies radiofrequency identification and near-field communication (RFID) technologies as the most robust and suitable for heterogeneous educational contexts. Methodical research documents a detection accuracy exceeding 95% under favorable conditions, with an effective range between 9 and 40 centimeters, enabling immediate registration and eliminating the approximately 10 minutes per session typically required for traditional manual roll call [24]. This alternative allows for on-site information processing, reducing the need for permanent internet connectivity—a decisive quality in settings with precarious digital infrastructure [25]. Its technical feasibility is corroborated even in highly complex environments, such as special education, where its use with children diagnosed with Down syndrome recorded high rates of participation and efficacy [26]. In contrast, although options like facial recognition achieve equivalent or superior theoretical accuracy (>90%), their requirement for environments with controlled lighting, high bandwidth, and substantial computing capacity makes them less applicable in institutions with limited resources [3].

Concerning the realm of economic sustainability, this takes on a central role in a context like that of Sinaloa, characterized by financial constraints and social disparity. The scrutiny of expenditure reveals a pronounced economic differential in favor of RFID-based alternatives. The initial capital expenditure (CAPEX) is notably lower, with passive tags costing around USD 0.20 per unit and basic reader devices accessible for less than USD 200, which contrasts with the significantly higher amounts demanded by biometric or facial identification systems [24; 26]. This low initial investment requirement aligns with the principle of profitability through technological appropriation, which favors low-cost, easily accessible options that organizations can incorporate and sustain over time [6]. Statistics from the Mexican context underscore the relevance of this approach, as instruments like the National Survey of Household Income and Expenditure (ENIGH) reveal profound asymmetries in household spending on educational technology, highlighting that public policy initiatives must weigh both indirect costs and accessibility to ensure equitable conditions [27]. The efficiency of these systems transcends mere accounting; it is also manifested in a pedagogical benefit by redistributing teaching staff time towards substantive activities and, crucially, by enabling the timely identification of absenteeism trends associated with dropout risk, which facilitates more cost-effective prevention strategies [28].

Complementarily, user acceptance constitutes the third essential foundation for effective and lasting implementation. The observed results support the postulates of the Technology Acceptance Model (TAM), a theoretical framework which posits that perceived usefulness and ease of use predict real-world adoption [29; 30]. From this perspective, RFID solutions have recorded a high degree of favorable reception. Teaching staff positively acknowledges their value, not only as a management tool but also as a didactic resource that strengthens communication with homes and generates reports automatically [26]. In turn, students, particularly through physical interfaces, exhibit high levels of participation and satisfaction. It should be noted, however, that this level of acceptance is nuanced by contextual variables incorporated into TAM extensions, such as enabling factors (institutional support, resource availability) and users' confidence in their own abilities [31]. Furthermore, the perception of privacy is a crucial element; options like facial recognition tend to elicit greater resistance due to ethical considerations, whereas RFID technology, by avoiding the capture of sensitive biometric information, is generally considered less intrusive, provided the purpose of the data processing is explained clearly and openly.

Placing this analysis within the context of Sinaloa consolidates and contrasts the previously examined dimensions. The statistical and geographical data for Sinaloa delineate a landscape of marked territorial heterogeneity (urban-rural), deficiencies in connectivity, and socioeconomic tensions that directly impact school attendance rates [13]. This reality makes alternatives requiring significant technological sophistication and expenditure difficult to implement. Conversely, a platform based on RFID, due to its autonomous operation without permanent connection, its capacity for gradual scaling, and its low cost, aligns with the state's infrastructural and financial capabilities. The relevance of this option gains further

weight when recognizing its utility not only for record-keeping but also as a component of an early warning mechanism to address school dropout, a priority issue in the region.

The implementation of technological solutions in the school context requires an analysis that transcends mere technical performance. A one-sided evaluation focused solely on accuracy or functional capabilities can lead to the adoption of systems whose complexity or cost prove unsustainable in the medium term, or that face resistance among end-users. Consequently, a multidimensional evaluation framework structured around three equally weighted axes is proposed: Technical Functionality (TF), Economic Sustainability (ES), and Degree of Acceptance (DA). This model aims to provide a holistic perspective that ensures the real and lasting viability of any technological initiative in the region's schools.

The Technical Functionality (TF) dimension examines whether the technology meets fundamental operational requirements, evaluating parameters such as accuracy above 85% and a detection range suitable for school facilities. Concurrently, Economic Sustainability (ES) analyzes financial feasibility, considering accessible capital expenditure (CAPEX), sustainable annual operating expenses (OPEX), and a positive return on investment (ROI) within a five-year horizon. Complementarily, the Degree of Acceptance (DA) investigates the perceived usefulness and ease of use by the educational community, assesses contextual factors such as institutional support and social norms, and considers the need for training to manage individual differences. Each of these dimensions receives a quantitative score on a scale of 0 to 100.

For a solution to be considered viable in the specific context of Sinaloa, it must achieve a minimum threshold of 65 points in each of the three dimensions separately. This strict criterion, based on individual scores and not an overall average, is fundamental: poor performance in any one area, regardless of strength in the others, is considered indicative of unviability, as the risk of implementation failure or premature abandonment is deemed too high.

Table 1. Comprehensive Technology Evaluation Matrix

<b>Technology</b>	<b>Technical Functionality (TF)</b>	<b>Economic Sustainability (ES)</b>	<b>Degree of Acceptance (DA)</b>	<b>Average</b>	<b>Feasibility Status</b>
<b>RFID</b>	85	92	80	<b>85.7</b>	<b>FEASIBLE</b> (Exceeds the threshold on all axes)
<b>Fingerprint Biometrics</b>	92	55	70	<b>72.3</b>	<b>UNFEASIBLE</b> (ES below 65)
<b>Facial Recognition</b>	78	30	45	<b>51.0</b>	<b>UNFEASIBLE</b> (ES and DA below 65)

Source: Own elaboration

Applying this evaluation framework to common technologies yields fundamental insights. For example, an RFID-based system demonstrates robust feasibility, with balanced scores (TF:85, ES:92, DA:80) that comfortably exceed the minimum threshold across all dimensions, reflecting a good balance between technical capability, cost-effectiveness, and acceptance. In contrast, a fingerprint biometric solution, while exhibiting high technical performance (TF:92), shows critical economic unsustainability (ES:55) and moderate acceptance (DA:70), placing it in a risk zone due to its failure to meet the minimum economic criterion. Finally, technologies like facial recognition, despite having acceptable technical functionality (TF:78), are revealed as unfeasible due to prohibitive economic costs (ES:30) and low acceptance (DA:45)—factors that collectively and irreversibly compromise their successful implementation. The results validate the effectiveness of the evaluation framework in determining the viability of various technological proposals with differing success potentials within the regional educational ecosystem.

This evaluative framework emphasizes the interconnection between the analytical axes: favorable financial balance fosters administrative support and operational deployment, which, in turn, creates the conditions to demonstrate the system's utility and validate its operational effectiveness. In the case of Sinaloa, where budgetary limitations and the urgent need for tools to prevent school dropout are priorities, the integrated model not only identifies RFID technology as the most suitable option but also provides a clear and inclusive decision-making instrument. This enables educational institutions to assess, deploy, and adjust technological proposals aligned with their specific circumstances, ensuring that these are operationally robust, financially sustainable, and widely adopted by the community they serve.

## **5. Discussions**

Based on the above, this research aimed to comprehensively assess the implementation of automated attendance recording mechanisms in the educational setting by interrelating the criteria of technical performance, financial sustainability, and user acceptance. The results confirm that the feasibility of such tools is subject to the harmonization of technical, economic, and human elements inherent to each educational environment. In the specific case of Sinaloa, distinguished by its geographical diversity and recorded socioeconomic constraints, the examination conducted determines that RFID-based platforms emerge as the most robust option, achieving a superior overall evaluation compared to other technological alternatives under a framework that assigns equal importance to the three considered dimensions [10;11]. This result reaffirms the relevance of having a decision-making instrument capable of overcoming the segmented approaches that still predominate in studies in this field.

Regarding operational performance, the findings of this work corroborate previous studies on the robustness and efficacy of RFID, while introducing a crucial contextual nuance [24;25]. Although options like facial recognition exhibit high theoretical accuracy, their requirement for advanced digital infrastructure limits their applicability in settings like Sinaloa, where technological resources are often scarce [3]. This interpretation enriches strictly technological approaches by integrating variables related to compatibility with available infrastructure, thereby supporting the postulates of systems theory, which emphasizes aligning technology with organizational processes and the human factor [1]. Consequently, technical effectiveness must be assessed not only against ideal parameters but within real-world deployment circumstances, as illustrated by its successful use even in special education contexts [26].

On the economic front, the analysis conducted supports the notion of profitability through technological appropriation [6]. The significantly lower expenditure required for RFID solutions contrasts with the investment demanded by biometric or facial identification systems, demonstrating that low-cost alternatives can achieve similar levels of effectiveness [4]. This finding gains greater relevance when linked to evidence of asymmetries in educational technology investment within Mexico, which reveals that official indicators fail to capture the full extent of the economic effort borne by families [27]. The

economic efficiency of these platforms extends beyond accounting balance, as it facilitates the early identification of absenteeism trends associated with dropout risk, thereby generating pedagogical and collective benefits through more effective and economical preventive actions [7;13].

Regarding user receptivity, the conclusions of this work reaffirm the robustness of the Technology Acceptance Model in Latin American settings, while introducing key aspects for its interpretation [29;30]. Elements such as organizational support, collective norms, and confidence in one's own abilities act as moderating variables in the relationship between technical specifications and actual adoption [31]. The favorable reception of RFID among teaching staff, who highlight its value as a didactic resource complementary to its administrative function, reinforces the premise that these tools should be conceived as comprehensive educational supports [5;26]. Adding to this is its less invasive profile in terms of privacy compared to biometric options, which constitutes a relevant advantage in environments where institutional credibility is paramount.

As a result of the analysis conducted, the core conceptual contribution of this research lies in its unifying perspective, which interrelates dimensions typically examined in isolation. The proposed comprehensive framework responds to the call for methodological diversity in evaluating educational initiatives by merging frameworks from the fields of engineering, economic analysis, and the social sciences [14]. The identified interconnection between the different axes confirms the fundamental thesis that successful implementation requires the balanced convergence of satisfactory technical performance, demonstrable financial sustainability, and a favorable assessment by the educational community. This framework transcends the binary divisions between sophisticated technology and appropriate technology by recognizing that the suitability of a technological solution is inherently multifaceted and closely dependent on the application context.

In terms of its transfer to the practical domain, the applied impact of this work is significant. For educational centers in Sinaloa and similar environments, RFID is established as the most suitable option, though its deployment should be accompanied by training actions that highlight its didactic value and by clarity in handling the collected information. At the level of educational policy, it is recommended to consider indirect costs, favor solutions allowing for progressive implementation, and link monitoring mechanisms with comprehensive plans for preventing school dropout [27;28]. From a methodological perspective, the research reaffirms the relevance of prospective and delineating approaches supported by systematic reviews and the cross-referencing of information sources for addressing complex problems during the initial stages of inquiry [15;17;19].

It is important to acknowledge that this work faces certain limitations inherent to its methodological design. Its prospective and delineating nature does not allow for the inference of causal links or statistically representative generalizations. Furthermore, the analysis is constructed upon pre-existing interpretations, as it relies on secondary sources. On the other hand, the focus on the Sinaloan context restricts its immediate extrapolation to other settings, and the dynamics of technological innovation introduce an element of obsolescence to some findings. As potential lines for future inquiry, it is proposed to develop field studies on its practical implementation, long-term monitoring of the educational impact of the investment, comparative exercises across different regions, and research focused on the associated ethical and privacy dilemmas. Furthermore, the constant evolution of the technological landscape recommends conducting systematic literature reviews at regular intervals to keep the available knowledge updated.

## **6. Conclusions**

As a result of this process, the research has enabled a unified assessment of the implementation of automated attendance management mechanisms in the education sector by interrelating three fundamental axes: technical functionality, economic sustainability, and degree of user acceptance. The

findings confirm that the feasibility of these tools is not based solely on their operational performance, but on the contextual harmonization of economic and human elements [14]. In the specific setting of the state of Sinaloa, Mexico (characterized by its territorial diversity, precarious digital infrastructure, and documented budgetary constraints) RFID-based technology stands out as the most robust alternative, achieving a superior overall evaluation compared to other options such as biometric or facial recognition systems [10;11].

In the area of operational performance, RFID platforms not only exhibit high reliability in recording (above 95%) and the ability to function autonomously without permanent connectivity, but have also proven their robustness in a variety of educational settings, including those catering to special educational needs [24;26]. Conversely, alternatives such as facial recognition, while theoretically accurate, demonstrate less flexibility in adapting to environments with basic technological resources or intermittent connectivity [3].

From the perspective of financial sustainability, the results confirm that RFID alternatives exhibit a pronounced differential concerning initial capital expenditure and recurring operational costs, aligning with the principle of profitability through technological appropriation [6]. This economic affordability proves crucial in areas with marked disparities in investment dedicated to educational technology and enables institutions to redirect funds toward pedagogical reinforcement initiatives and school dropout prevention [7;13;27].

In relation to receptivity from the user community, the obtained conclusions endorse the Technology Acceptance Model (TAM), a framework in which perceived usefulness and operational simplicity stand as key factors for effective adoption [29;30]. RFID platforms received a positive evaluation from both teaching staff and students, partly due to their less intrusive nature regarding privacy compared to biometric options, and their ability to function as a complementary resource in both administrative management and the teaching-learning process [5;26].

Thus, the central conceptual contribution of this research lies in the design of a comprehensive evaluation framework that integrates the three aforementioned axes, thereby transcending the compartmentalized approaches still common in specialized studies. This instrument emphasizes the existing interrelation between technical performance, economic sustainability, and the level of acceptance, and serves as a valuable tool for grounding institutional decision-making processes in evidence adapted to the specific context.

Regarding its methodological scope, the study acknowledges its exploratory-descriptive design as a limitation, being based on the examination of a documentary corpus and secondary information, which does not allow for inferring causalities or statistically extrapolating results. Furthermore, the rapid evolution of the technological field necessitates continuous reviews to keep knowledge on the topic current..

The following future lines of research are recommended:

1. Undertake field studies on its implementation in Sinaloan institutions, to verify the results under real-world conditions.
2. Conduct long-term follow-up analyses assessing the educational return on investment and its effect on reducing dropout rates.
3. Perform comparative investigations between different regions with contrasting socioeconomic conditions.
4. Delve into the ethical and data protection dilemmas associated with using attendance monitoring technologies, with special attention to vulnerable educational settings.

In conclusion, the findings of this work underscore the importance of using comprehensive and contextualized evaluation frameworks when assessing technological tools in education. For educational centers in conditions similar to those in Sinaloa, deploying RFID systems (complemented with training initiatives, procedural clarity, and a clear connection to pedagogical objectives) emerges as a feasible alternative for modernizing attendance tracking, streamlining fund usage, and aiding in the prevention of school dropout.

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