VISUAL REVIEW | Vol. 18, No. 2, 2026 | ISSN 2695-9631
International Visual Culture Review / Revista Internacional de Cultura Visual
https://doi.org/10.62161/revvisual.v18.6527

VISUAL CULTURE AND LEARNING ANALYTICS: SEMIOTICS OF DASHBOARDS AND DATA INTERFACES IN UNIVERSITY TEACHER TRAINING

Cultura visual y analítica del aprendizaje: Semiótica de los dashboards e interfaces de datos en la formación docente universitaria

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RESUMEN
Introducción: La transformación digital en la educación superior exige que los docentes desarrollen competencias para interpretar datos y fundamentar decisiones pedagógicas, logrando la apropiación semiótica y crítica de la pantalla educativa. El objetivo de este estudio es diseñar un sistema de formación docente centrado en la apropiación semiótica y didáctica de los artefactos visuales de la analítica educativa. **Metodología**: partiendo del enfoque interdisciplinar de los Estudios Visuales y la Tecnología Educativa, se aplicó un diagnóstico de necesidades mediante un instrumento tipo Likert a una muestra de 104 docentes de la Universidad Bolivariana del Ecuador, seleccionados por muestreo probabilístico aleatorio simple. El instrumento aplicado fue validado mediante juicio de expertos. **Resultados**: se obtuvo una paradoja formativa: existe una alta disposición actitudinal hacia la Analítica del Aprendizaje (M=3,81), contrastada con déficits críticos en conocimiento (M=2,68), competencia analítica (M=2,28) y aplicación pedagógica (M=2,18). **Conclusiones**: el mayor desafío no es la recolección de datos, sino su traducción en intervenciones didácticas. El sistema propuesto se centra en la alfabetización en visualización de datos aplicada, el razonamiento pedagógico y los ciclos de reflexión y acción, con vistas a garantizar una apropiación crítica y contextualizada de los datos en la práctica docente.
Palabras clave: Analítica del Aprendizaje; formación docente; toma de decisiones pedagógicas; alfabetización de datos; educación superior.

ABSTRACT
Introduction: Digital transformation in higher education requires educators to develop competencies for interpreting data and grounding pedagogical decisions, thereby achieving a semiotic and critical appropriation of the educational screen. The objective of this study is to design a faculty development system focused on the semiotic and didactic appropriation of the visual artifacts used in learning analytics. **Methodology**: Drawing on an interdisciplinary approach—combining Visual Studies and Educational Technology—a needs assessment was conducted using a Likert-scale instrument. The sample consisted of 104 faculty members from the Universidad Bolivariana del Ecuador, selected via simple random sampling. The instrument was validated through expert judgment. **Results**: A "formative paradox" was identified: while there is a strong positive attitude toward Learning Analytics (M=3.81), this contrasts with critical deficits in knowledge (M=2.68), analytical competence (M=2.28), and pedagogical application (M=2.18). **Conclusions**: The primary challenge lies not in data collection, but in translating data into didactic interventions. The proposed system focuses on applied data visualization literacy, pedagogical reasoning, and cycles of reflection and action, with the aim of ensuring a critical and contextualized appropriation of data within teaching practice.
Keywords: Learning analytics; teacher training; pedagogical decision-making; data literacy; higher education.

1. Introduction

In contemporary digital culture, university classrooms have been reconfigured as hypermedia environments in which pedagogical action leaves behind a dense trail of images, graphs, and information flows. Digital transformation in higher education is

no longer reducible to the use of virtual platforms as mere document repositories; it requires an understanding that virtual environments produce a visual ecology of data. In this scenario, Learning Analytics (LA) emerges as a field whose relevance rests on its capacity to translate complex human interactions into visual artifacts: dashboards, scatter plots, heat maps, and temporal interaction maps (Michos *et al*., 2023; Ruipérez-Valiente, 2020). Studies such as those by Somabut *et al*. (2026) and Guevara *et al*. (2024) confirm that the personalization of professional development through LA can strengthen digital and pedagogical competencies; however, its effectiveness depends on integrating contextual needs and processes of continuous improvement.

Teacher training in digital environments requires the integration of pedagogical, technological, and professional competencies in order to respond to the transformations of higher education (Saltos-Rivas, 2023). In this context, LA makes it possible to use data on participation, performance, and interaction to support planning, monitoring, assessment, and feedback, favoring well-founded pedagogical decisions (Kotorov *et al*., 2024). The evidence confirms that data can strengthen teaching interventions; however, making good use of them does not depend exclusively on having analytical tools available, since it requires self-regulation capacities for interpreting information, diagnosing needs, and guiding relevant pedagogical actions (Huang *et al*., 2024; Huang *et al*., 2023) in complex, dynamic, and contextualized university settings.

Educational digitalization expands the availability of data, but does not guarantee transformations in teaching practices, since it requires capacities for interpreting and using evidence for educational purposes (Ifenthaler *et al*., 2020). This situation becomes evident when systems generate information about students, activities, and interactions whose usefulness depends on integrating it with pedagogical dynamics and contextualized needs (Leibur & Saks, 2025; Hernández Campos *et al*., 2026). A study by Morales Loor *et al*. (2025) confirms that having analytics interfaces available does not ensure that they are put to good use; effective use requires pedagogical knowledge, an understanding of data, and the capacity to relate them to learning needs. From this perspective, teacher training must provide conceptual and methodological tools that make it possible to move from an instrumental use of analytics interfaces to a pedagogical appropriation of the data generated in them. This means that the teacher is conceived not as a passive recipient of indicators, but as a professional capable of formulating questions about learning, selecting relevant evidence, interpreting patterns, and deciding on pedagogical interventions.

The incorporation of LA into higher education requires an understanding of how teaching staff interpret its usefulness and pedagogical relevance, since its adoption depends on professional and contextual conditions (Boroowa & Herodotou, 2022; Urco *et al*., 2026). Teachers' perceptions are not homogeneous: they are shaped by expected usefulness, the effort required, social influence, and the possibility of integrating analytical data with meaningful didactic decisions. Experience thus shows that technical mastery is insufficient when it is not combined with pedagogical knowledge and support for interpreting evidence (Morales Loor *et al*., 2025). These studies confirm that the acceptance of LA goes beyond technological availability and is related to competencies, support, and the capacity to transform data into contextualized educational decisions.

LA-mediated teacher training must therefore be understood as a process of professional development that brings together knowledge, skills, attitudes, reflective capacities, and volition in order to use educational data in a pedagogically grounded manner.

LA is becoming established as an emerging field of educational digital transformation, aimed at harnessing data to understand and improve learning processes (Gašević *et al*., 2015). Its deployment is linked to the growing availability of information generated through learning management systems, online courses, educational platforms, and other technological resources, whose interactions produce digital traces that can be analyzed to characterize trajectories, participation, and performance (Ruipérez-Valiente *et al*., 2020; Mittal *et al*., 2021). Nevertheless, recent contributions such as that of Ouhaichi *et al*. (2023) show that the value of this evidence does not depend solely on its volume: its contextual interpretation and the integration of multiple sources and modalities, avoiding the reduction of learning to observable digital records, are fundamental.

In higher education, owing to the specific characteristics of its teaching-learning process, these systems produce large volumes of information related to logins, participation, interaction, submission of activities, assessment results, use of resources, and feedback on learning. LA makes it possible to collect, process, analyze, and present these data in order to understand learning processes and support decision-making aimed at optimizing them, taking into account both academic and non-academic variables.

In line with this view, Jannah *et al*. (2026) identify as one of the challenges of the field the need to move beyond an orientation excessively centered on analytics in order to strengthen a properly educational understanding of learning.

This is especially relevant in the training of university teachers. When teachers draw on indicators without understanding where they come from, what they mean, or what their limitations are, there is a risk that they will apply them mechanically, without a proper pedagogical interpretation.

LA is a relevant field for educational decision-making through the analysis of data generated during learning processes (Jannah *et al*., 2026; de La Hoz-Ruiz *et al*., 2024; Hernández-de-Menéndez *et al*., 2022). In higher education, its applications make it possible to identify patterns of student participation, performance, and behavior, providing evidence to guide adjustments in teaching strategies and to favor timely interventions (Mukred *et al*., 2024; Kong *et al*., 2024). However, the proliferation of these graphical interfaces has revealed a gap in person-screen interaction: the lack of data *visualization literacy* among teaching staff (Pozdniakov *et al*., 2024; Liu *et al*., 2024). Having screens full of percentage bars or tracking lines does not guarantee didactic improvement if the teacher lacks the semiotic competence needed to decode what the image of the data communicates. When teachers face a *dashboard* without an adequate visual grammar, the information turns into cognitive overload or into mechanical indicators devoid of pedagogical meaning.

In this study, LA is conceived as an eclectic procedure aimed at measuring, counting, processing, analyzing, synthesizing, and interpreting data and data sets of greater or lesser complexity, by means of the most diverse techno-pedagogical resources, methods and techniques of research methodology, and the qualitative, individual and

collective examination of the educational community, or of particular groups or individuals within it, in order thereby to answer questions, formulate new ones, identify problems, offer new ideas, and seek transformative guidelines for the better functioning of the different elements that make up the systematic interactive process of the practices of the subjects involved in the teaching-learning process, of the so-called academic parameters and, last but not least, of the non-academic parameters. (López-Fernández *et al*., 2024)

2.1. The Semiotics of the Dashboard and Visual Literacy

Analytical dashboards (*learning analytics dashboards*) are technologies of visual representation. They do not show the student's reality neutrally; they construct it through a graphic syntax in which color (red dropout alerts, green completion bars), scale, and spatial hierarchy determine the educator's attention (Kaliisa *et al*., 2021; Farhood *et al*., 2025). As Liu *et al*. (2024) point out, *data storytelling* (the capacity to narrate with images of data) is the competence that allows the teacher to connect a color pattern on the screen with a didactic intervention in the classroom. These systems make it possible to visualize patterns of student participation, performance, and activity in order to support monitoring and inform pedagogical decisions (Boroowa & Herodotou, 2022). The evidence indicates that their usefulness also depends on the indicators being comprehensible, relevant, and linked to specific needs of teaching practice, which reinforces the need for teacher-centered designs, an element that is seldom analyzed in studies on LA (Farhood *et al*., 2025; Susnjak *et al*., 2022).

This orientation takes concrete form in two ways: on the one hand, teachers need to analyze and interpret data on the behavior and progress of their students in order to readjust their teaching strategies; on the other, students need to feel supported and to see significant progress in their learning that is suited to their possibilities. In studying the experiences of teachers in online higher education, the authors note that monitoring students is a complex task and that the information available can offer opportunities to adapt teaching to the needs observed (Van Leeuwen, 2023; Domínguez González & Serna Poot, 2021; Quiñonez Pech, 2025).

LA has evolved toward systems that, in addition to describing student learning, offer information to teaching staff to guide intervention (Kannan & Zapata-Rivera, 2022; Hardaker & Glenn, 2025). Teacher-facing dashboards integrate data, visualizations, and evidence of performance to facilitate the monitoring of learning processes; their value increases when the information is interpretable, timely, and linked to teaching decisions (Liu *et al*., 2025). This perspective is broadened by proposals for multimodal analytics that provide actionable indicators of participation and emotional states, helping the teacher to identify situations that require intervention (Hasnine *et al*., 2021). Consequently, the design of these systems must consider professional needs, capacities, and contexts, avoiding the reduction of analytics to a representation of data. The teacher must therefore be understood simultaneously as user, interpreter, evaluator, and decision-making agent within the LA process. The incorporation of LA into teacher training raises the need to develop a specific competence related to the pedagogical use of data.

Data visualization literacy can be understood as the capacity to access, understand, interpret, evaluate, and use information from different sources to inform decisions. In

education, this capacity takes on a pedagogical dimension when the teacher uses data to understand learning and modify their practices. (Picón, 2023)

2.2. The Paradox of the Teacher's Gaze in Cyberspace

The analytics cycle (Data → Information → Interpretation → Decision → Action) describes a progression of semiotic literacy. Technology mediates the gaze: the teacher moves from observing the student's physical gestures in person to interpreting their performance through interactive graphs. Teacher training should be oriented not toward handling the software, but toward the pedagogy of the digital gaze, equipping teachers with critical tools to detect biases, understand limitations, and read with cultural sensitivity the signs emitted by the screen.

This cycle makes it possible to differentiate LA from a mere statistical activity. The purpose is not only to produce indicators, but to use them to understand educational situations and act upon them.

Amarasinghe *et al*. (2022) show that data-driven solutions can support teachers in the design and orchestration of collaborative activities, allowing them to understand better how design decisions relate to student participation and behavior and to use that information to redesign future learning experiences.

In this way, LA can become a mechanism of professional development when it provides evidence that allows the teacher to question, review, and improve their practice.

Mediation implies that technology is not the end of the training process, but the means by which the teacher can observe their practice, analyze evidence, identify needs, and guide processes of improvement.

De La Hoz-Ruiz *et al*. (2024), in a systematic review specifically devoted to the use of LA to strengthen teachers' professional capital, identify the potential of this technology to assess and support dimensions related to teachers' professional development.

For example, if data analysis reveals difficulties in interpreting indicators of student participation, the training process can incorporate specific activities on visualization, analysis, and interpretation. If, on the other hand, the teacher has sufficient analytical competencies but has difficulty transforming results into didactic decisions, training should concentrate on pedagogical reasoning and intervention.

In this sense, LA makes it possible to move toward differentiated, progressive, and contextualized teacher training.

On the basis of the foregoing, LA-mediated teacher training can be conceptualized as: A systematic, continuous, and contextualized process of professional development through which teachers acquire knowledge, skills, attitudes, and reflective capacities to collect, interpret, and use educational data for the purpose of informing pedagogical decisions, improving their practice, and fostering student learning.

2.3. Foundations for the design of the teacher training model

The literature analyzed makes it possible to establish several principles that should guide the proposed model.

First principle: pedagogical orientation. Training should begin with educational problems and questions, not with technological tools. Data should be interpreted in light of learning objectives and specific needs.

Second principle: progressive development of competencies. The teacher should progress from basic data literacy to the capacity to carry out analyses and incorporate them into pedagogical decisions.
Third principle: contextualization. Training processes should use data and situations close to teachers' real practices. This increases the relevance of the training and facilitates transfer to practice.
Fourth principle: teacher participation. Teachers should take part in the selection of indicators, the interpretation of results, and the design of analytical solutions. Research on teacher-oriented systems shows that their participation is important for building tools suited to professional needs.
Fifth principle: reflection and action. The model should go beyond training centered on the acquisition of knowledge and promote cycles of analysis, reflection, intervention, and evaluation.
Sixth principle: ethics and responsibility. The use of educational data requires consideration of privacy, transparency, security, biases, and the limits of interpretation. Teacher training must therefore incorporate a cross-cutting ethical dimension.

These principles are consistent with the contemporary evolution of the field, which calls for greater integration between LA, learning theories, pedagogical design, and the participation of educational actors.
Consequently, the system proposed for the Universidad Bolivariana del Ecuador (UBE) must integrate the technological, analytical, pedagogical, reflective, and ethical dimensions. Its purpose will be to train teachers capable of moving from a descriptive use of data to an interpretive, critical, and pedagogically oriented use, strengthening the capacity to make evidence-based decisions.
The scientific problem of this study is therefore: how can university teachers be trained for decision-making mediated by LA and supported by digital environments?

2. Objectives

In keeping with this research question, the objective is to design a teacher training system centered on the semiotic and didactic appropriation of the visual artifacts of educational analytics.

3. Methodology

From the interdisciplinary perspective of Visual Studies and Educational Technology, this article investigates the relationship between digital visual culture and teachers' decision-making at the UBE. On the basis of a rigorous quantitative diagnosis (N=104), it analyzes the "formative paradox" that separates attitudinal receptiveness to interfaces from the real capacity to read and interpret their graphic narratives. These findings provide the basis for the design of a teacher training system centered on the semiotic and didactic appropriation of the visual artifacts of educational analytics.

4.1. Introduction to the Diagnosis

The present diagnosis constitutes the initial empirical phase of the study and responds to the scientific problem: how can university teachers be trained for LA-mediated decision-making in digital environments? Its objective is to identify the training needs of UBE teachers in order to provide a basis for the design of an LA-mediated teacher

training system. This diagnosis makes it possible to move from an instrumental use of data toward a critical and contextualized pedagogical appropriation, in line with the arguments of López-Fernández *et al*. (2024) and Ifenthaler *et al*. (2020).

4.2. Population and sample

From a population of 141 teachers at the Universidad Bolivariana del Ecuador (UBE), a sample of 104 teachers was determined through simple random probability sampling, considering a 95% confidence level, an expected proportion of maximum variability (p = q = 0.50), and a 5% margin of error.

$$n = \frac{NZ^2pq}{e^2(N-1) + Z^2pq}$$

$$n = \frac{141(1.96)^2(0.5)(0.5)}{(0.05)^2(140) + (1.96)^2(0.5)(0.5)} = 103.9$$

Information was collected by means of a six-point Likert-type instrument (0 to 5), organized into four dimensions and 16 items, which were validated through expert judgment (12 experts) and whose reliability was verified beforehand.

4.3. Reliability results (expert judgment)

The Cronbach's alpha values showed a favorable assessment of the content of the instrument. (Table 1)

Table 1.
Overall Cronbach's alpha and by dimension.

Scale	Cronbach's alpha
Overall (16 items)	0.918647
Knowledge of LA	0.865158
Analytical competence and data literacy	0.866111
Pedagogical application and decision-making	0.843171
Attitude, disposition, and training needs	0.896836

The content validity of the questionnaire was examined using Aiken's V coefficient, considering the ratings of 12 expert judges on three criteria: relevance, clarity, and coherence of the items. The instrument consisted of 16 items grouped into four dimensions. An overall V of 0.9145 was obtained, while the coefficients by criterion ranged from 0.9076 to 0.9206. By dimension, the values lay between 0.9097 and 0.9219. These results exceed the indicative threshold of 0.80, which suggests a favorable assessment of the correspondence and wording of the items. (Table 2)

Table 2
Simulated results for Aiken's V.

Criterion	Aiken's V
Relevance	0.9076
Clarity	0.9206
Coherence	0.9154
Overall average	0.9145

Table 3
Results by dimension.

Dimension	Aiken's V
Knowledge of LA	0.9097
Analytical competence and data literacy	0.9132
Pedagogical application and decision-making	0.9132
Attitude, disposition, and training needs	0.9219

4.4. Dimensions of the Diagnosis

The diagnosis was structured around four dimensions covering the conceptual, procedural, applied, and attitudinal components of teaching competence in LA: (a) Knowledge of LA, (b) Analytical competence and data visualization literacy, (c) Pedagogical application and decision-making, and (d) Attitude, disposition, and training needs. This structure reflects the theoretical foundations of the study, which conceive of LA-mediated teacher training as a systematic process that brings together knowledge, skills, attitudes, and reflective capacities (López-Fernández *et al*., 2024).

4. Results

5.1. Overall analysis by Dimension of the Diagnosis

With regard to the results obtained in each of the dimensions assessed, a significant structural asymmetry was observed: the attitudinal dimension reached high values, while the conceptual, procedural, and applied dimensions showed critical training deficits. (Table 4)

Table 4.
Results by Dimension of the Diagnosis (N = 104)

Dimension	Mean (0–5)	SD	Responses 0–2 (%)	Responses 4–5 (%)
Knowledge of LA	2.68	1.37	44.71	29.81
Analytical competence and data visualization literacy	2.28	1.41	57.69	21.15
Pedagogical application and decision-making	2.18	1.43	61.06	19.71
Attitude, disposition, and training needs	3.81	1.42	18.99	69.23

These results reveal a formative paradox: while the dimension Attitude, disposition, and training needs reaches a mean of 3.81, with 69.23% of responses in the high range (4–5), the operational dimensions show critical deficits. Knowledge of LA (M = 2.68) is superficial, and Analytical competence (M = 2.28) and Pedagogical application (M = 2.18) are at insufficient levels. This finding confirms that the availability of infrastructure and data does not guarantee their educational use without capacities for self-regulation and interpretation (Ifenthaler *et al*., 2020), validating the relevance of the proposed training system.

5.2. Granular diagnosis by item and visual indicators

The granular analysis reveals that the most critical items correspond to Pedagogical application and Analytical competence. P13 (Adapts didactic strategies on the basis of analytical results, M = 2.07) and P12 (Bases assessment and feedback on evidence, M = 2.10) stand out, which indicates that the greatest shortcoming is not the collection of data but their translation into concrete didactic interventions. By contrast, items P16 (Willingness to take part in training, M = 4.44) and P17 (Need for a progressive and contextualized system, M = 4.48) show high receptiveness to training, which constitutes favorable capital for the design of the system. (Table 5)

Table 5.
Detailed Results by Item of the Diagnosis (N = 104)

Dimension / Item	**Mean**	**SD**	**0–2 n (%)**	**4–5 n (%)**
Knowledge of LA				
P2. Understands the concept and usefulness of LA	2.95	1.28	36 (34.6)	38 (36.5)
P3. Identifies sources of educational data	2.84	1.33	41 (39.4)	35 (33.7)
P4. Recognizes indicators of participation/interaction/performance	2.63	1.37	49 (47.1)	29 (27.9)
P5. Distinguishes descriptive, diagnostic, predictive, and prescriptive analysis	2.29	1.43	60 (57.7)	22 (21.2)
Analytical competence and data visualization literacy				
P6. Collects and organizes educational data	2.45	1.39	54 (51.9)	25 (24.0)
P7. Detects errors, incomplete data, and inconsistencies	2.19	1.41	63 (60.6)	20 (19.2)
P8. Interprets tables, graphs, and statistical indicators	2.32	1.42	59 (56.7)	23 (22.1)
P9. Identifies patterns and trends in educational data	2.15	1.43	64 (61.5)	20 (19.2)
Pedagogical application and decision-making				
P10. Adjusts planning using participation and performance data	2.15	1.43	64 (61.5)	20 (19.2)
P11. Identifies difficulties that require follow-up/intervention	2.38	1.4	57 (54.8)	24 (23.1)
P12. Bases assessment and feedback on evidence	2.1	1.44	66 (63.5)	19 (18.3)
P13. Adapts didactic strategies on the basis of analytical results	2.07	1.45	67 (64.4)	19 (18.3)
Attitude, disposition, and training needs				
P14. Considers that LA improves pedagogical decisions	4.15	1.05	8 (7.7)	83 (79.8)
P15. Feels prepared and confident to use data	2.18	1.42	63 (60.6)	20 (19.2)
P16. Willingness to take part in LA training	4.44	0.83	4 (3.8)	92 (88.5)
P17. Need for a progressive and contextualized system	4.48	0.82	4 (3.8)	93 (89.4)

These findings are consistent with Liu *et al*. (2024) and Boroowa & Herodotou (2022), who note that the acceptance of LA goes beyond technological availability and is related to competencies, support, and the capacity to transform data into contextualized educational decisions.

5.3. Graphic representations of the Diagnosis

5.3.1. Multidimensional Profile of Competencies in Learning Analytics

The structural asymmetry of the profile can be seen below: the polygon expands markedly in the dimension Attitude and disposition (3.81), but contracts severely in Pedagogical application (2.18) and Analytical competence (2.28). This configuration reveals the implementation gap: teachers value LA, but lack the methodological

scaffolding to close the cycle data → information → pedagogical decision, as argued by López-Fernández *et al*. (2024) in underlining the need to bring together technological infrastructure, teacher interpretation, and pedagogical purpose. (Figure 1)

Figure 1.
Multidimensional Profile of Competencies in LA (Scale 0–5).

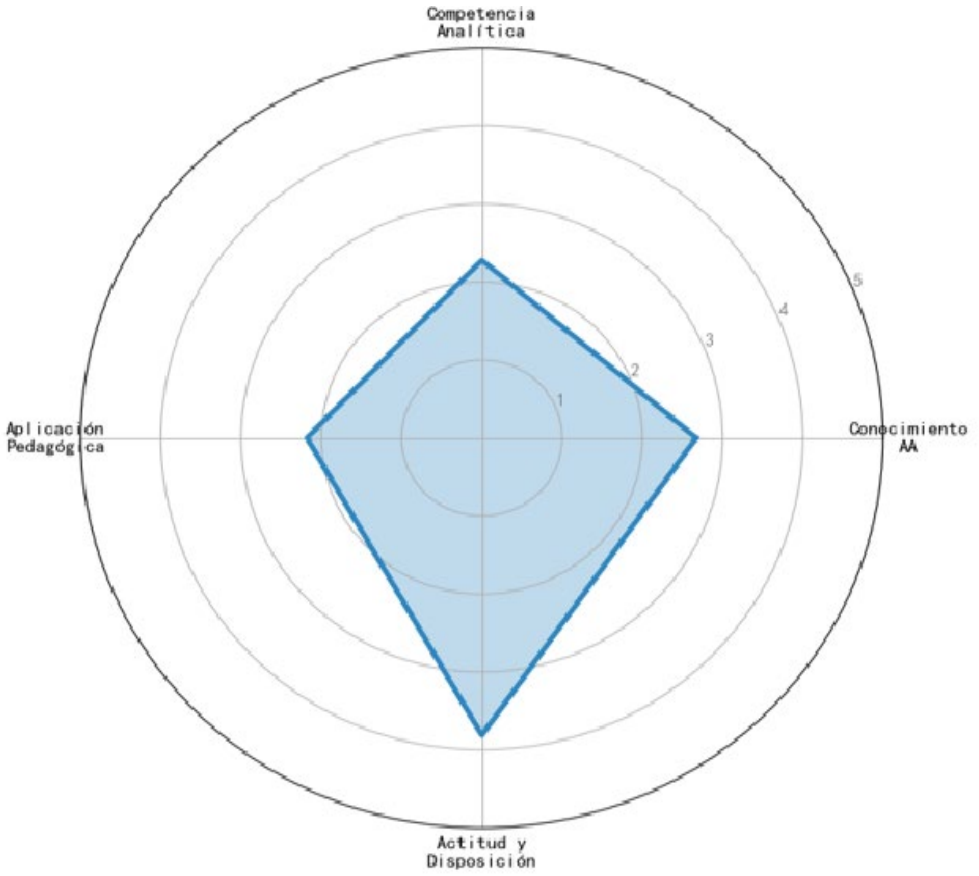
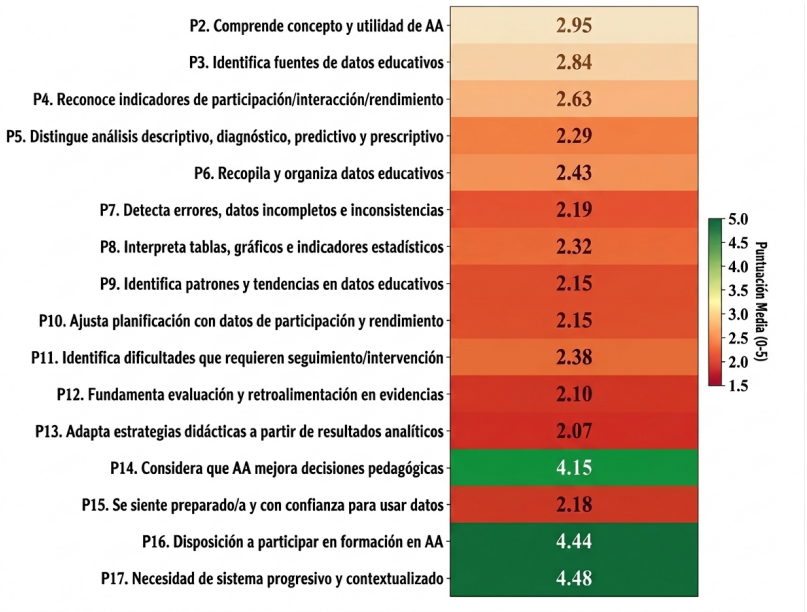


Figure 2 presents a heat map that color-codes the mean of each item assessed, allowing a rapid reading of the strengths and weaknesses of the training profile. The intense red tones are concentrated in items P12 (Bases assessment and feedback on evidence) and P13 (Adapts didactic strategies on the basis of analytical results), while the green tones are found in P14, P16, and P17, corresponding to the attitudinal dimension. This representation confirms that the greatest training challenge lies not in raising awareness of LA, but in developing the capacities to translate data into concrete pedagogical actions, in line with the eclectic approach proposed by López-Fernández *et al*. (2024), which integrates the quantitative and the qualitative in the interpretation of educational data.

Figure 2
Heat Map: Granular Diagnosis by Item (Scale 0–5)



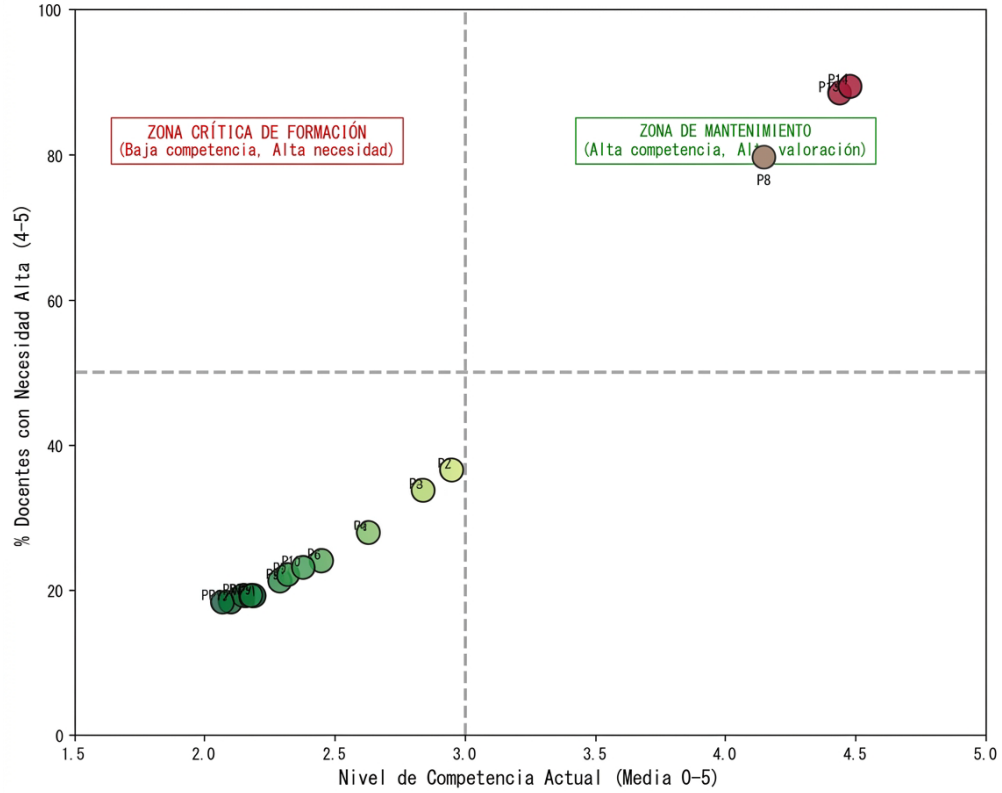
Note. Red tones indicate critical deficits and green tones indicate strengths.

5.3.2. Prioritization Matrix: Gap between Competence and Training Need

Figure 3 presents a prioritization matrix that crosses the current level of competence for each item with the percentage of teachers who perceive a high training need. Most of the operational items (P5 to P13) are located in the upper left quadrant, called the Critical training zone, where low competence and high perceived need converge. Only items P14, P16, and P17 are located in the Maintenance zone, characterized by high appreciation and willingness. This visualization leads to the conclusion that the training system should not devote resources to convincing teachers of the usefulness of LA, but to developing applied data visualization literacy and pedagogical reasoning, in line with the principles of pedagogical orientation, progressive development of competencies, and contextualization set out in the foundations of the model (López-Fernández *et al*., 2024).

Figure 3

Prioritization Matrix: Competence vs. Training Need Gap



Note: X-axis: current level of competence (mean 0–5). Y-axis: percentage of teachers reporting a high training need (responses 4–5).

5. Discussion

The results of the diagnosis make it possible to identify three central findings that underpin the design of the LA-mediated teacher training system. First, they confirm the existence of a structural gap between the positive appreciation of LA and the effective competencies for its pedagogical use, which coincides with what has been reported by Ifenthaler *et al*. (2020) and Li *et al*. (2023), who note that the availability of analytical tools does not ensure their educational use. Second, the most pronounced deficits are concentrated in the translation of data into pedagogical decisions (P12 and P13), which validates the relevance of the fifth principle of the model (reflection and action) and of the cycle of interpretation and action proposed in the theoretical foundations. Third, the high willingness to undertake training (P16 and P17) constitutes favorable capital that should be harnessed through a progressive, contextualized, and participatory system, as argued by Boroowa & Herodotou (2022) and Susnjak *et al*. (2022) in underlining the need for teacher-centered designs.

These findings also confirm that LA-mediated teacher training cannot be reduced to technical mastery of visual artifacts, but must bring together the conceptual, procedural, applied, and attitudinal dimensions, in line with the definition adopted in this study (López-Fernández *et al*., 2024). Likewise, data analysis must be subordinated to pedagogical questions and not the other way round, a guiding principle of the proposed training system.

6.1. Conclusions of the Diagnosis

The results of the diagnosis confirm the existence of a structural asymmetry of a semiotic and formative nature among university teaching staff. While the attitudinal disposition toward the visuality of analytics reaches notable levels (M=3.81, with 79.8% positive ratings on P14), the dimensions of analytical competence (M=2.28) and didactic application (M=2.18) register a pronounced deficit. Teachers express an explicit desire to rely on the image of the data, but experience interpretive paralysis in front of the screen.

The analysis of the heat map (Figure 2) and the prioritization matrix (Figure 3) illustrates this gap with chromatic clarity: the items with the greatest deficiencies are the adaptation of didactic strategies on the basis of analytical results (P13: M=2.07) and the grounding of feedback in evidence (P12: M=2.10). These data corroborate the conclusions of Ifenthaler *et al*. (2020) and Pozdniakov *et al*. (2024): data visualization is not self-explanatory. A bar chart or a heat map does not generate automatic educational improvement if the teacher lacks the visual grammar to transform those iconic patterns into dialogic learning plans.

In response to this scenario, the system proposed for the UBE (Figure 4 and Figure 5) is constituted as a comprehensive pedagogical and iconographic device. By bringing together six guiding principles, with special emphasis on pedagogical orientation and cycles of reflection and action, the model shifts the focus from software to critical visual literacy. In this way, learning analytics is consolidated as a mediating practice in the visual culture of higher education, enabling teachers to interrogate critically the visual artifacts of cyberspace and to orient teaching toward a transformative praxis.

6.2. Pedagogical Justification of the Learning Analytics-Mediated Teacher Training System

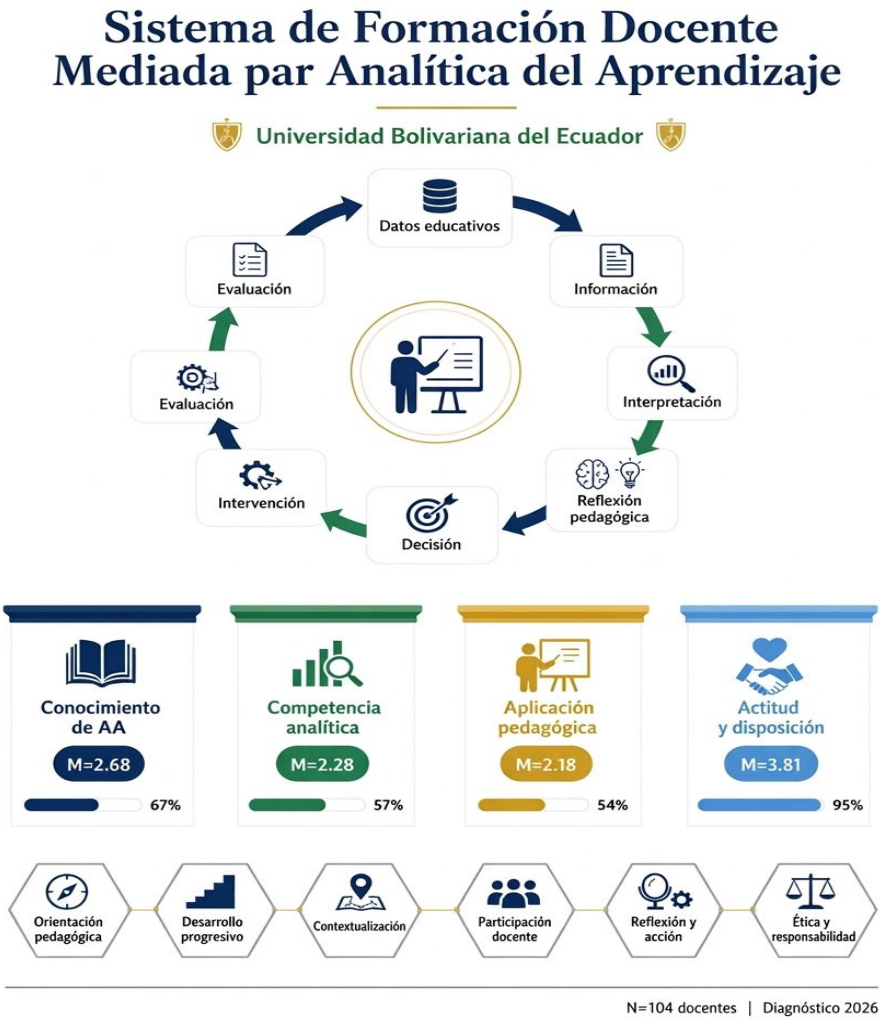
5.2.1 General Rationale

The design of the Learning Analytics (LA)-mediated teacher training system for the Universidad Bolivariana del Ecuador (UBE) is justified pedagogically by the confluence of three kinds of reasons: the empirical evidence derived from the diagnosis, coherence with the dimensions that structure teaching competence in LA, and articulation with the guiding principles of the model. This justification is not limited to demonstrating the technical relevance of the system; it also grounds its necessity as a response to a formative paradox identified among contemporary university teaching staff: the coexistence of a high attitudinal appreciation of LA with critical deficits in its conceptual, procedural, and applied dimensions.

As López-Fernández *et al*. (2024) point out, LA-mediated teacher training must be conceived as a "systematic, continuous, and contextualized process of professional development through which teachers acquire knowledge, skills, attitudes, and reflective capacities to collect, interpret, and use educational data for the purpose of informing pedagogical decisions" (p. 15). This conception requires the proposed system to go beyond mere instrumental training and to be constituted as a comprehensive pedagogical device, capable of linking the critical interpretation of data with the transformation of teaching practice.

Figure 4

Diagram of the teacher training system of the Universidad Bolivariana del Ecuador.



Note: Diagram prepared with the fundamental elements with which the learning analytics-mediated teacher training system was designed.

6.3. Justification from the Empirical Evidence of the Diagnosis

The first source of pedagogical justification for the system comes from the diagnosis carried out with 104 UBE teachers, which revealed a structural asymmetry that calls for a specific training intervention. While the dimension of attitude, disposition, and training needs reaches a mean of 3.81 (with 69.23% of responses in the high range, 4–5), the operational dimensions present critical deficits: knowledge of LA (M = 2.68), analytical competence and data visualization literacy (M = 2.28), and pedagogical application and decision-making (M = 2.18).

This empirical configuration validates the arguments of Ifenthaler *et al*. (2020) and Li *et al*. (2023), who maintain that the availability of technological infrastructure and analytical tools does not in itself guarantee their educational use. The diagnosis confirms that UBE teachers value LA positively (P14: M = 4.15) and show a high willingness to undertake training (P16: M = 4.44; P17: M = 4.48), but lack the methodological scaffolding needed to close the cycle data → information → interpretation → pedagogical decision → intervention. The critical bottlenecks are concentrated in the grounding of assessment in evidence (P12: M = 2.10) and in the adaptation of didactic strategies on the basis of analytical results (P13: M = 2.07), which

shows that the greatest challenge lies not in the collection of data but in their translation into relevant pedagogical interventions.
The training system is therefore justified as a response to this implementation gap, aimed at transforming the high attitudinal disposition, which constitutes favorable capital, into effective competencies for the pedagogical use of data.

6.4. Justification from the Dimensions of the Diagnosis

The second source of justification derives from the four dimensions that structure teaching competence in LA and that, in turn, organize the training system. Each dimension provides a specific pedagogical foundation:
Dimension 1: Knowledge of Learning Analytics. This dimension, which obtained a mean of 2.68, justifies the need for the system to provide conceptual tools that allow the teacher to understand LA not as a set of isolated indicators, but as an eclectic procedure aimed at "measuring, counting, processing, analyzing, synthesizing, and interpreting data and data sets" for a pedagogical purpose (López-Fernández *et al*., 2024, p. 10). Training must go beyond a superficial appropriation of the concept and ensure that the teacher understands the types of analysis (descriptive, diagnostic, predictive, and prescriptive), the sources of educational data, and the indicators of participation, interaction, and performance, avoiding the risk of applying indicators mechanically without understanding their origin, meaning, and limitations.
Dimension 2: Analytical competence and data visualization literacy. With a mean of 2.28, this dimension justifies the development of capacities to access, organize, interpret, and evaluate information from diverse sources. Within the system, data visualization literacy takes on a specific pedagogical dimension, since the teacher must use data as a means and not as an end, in order to understand learning and modify their practices. The deficits identified in the detection of errors and inconsistencies (P7: M = 2.19) and in the identification of patterns and trends (P9: M = 2.15) confirm the need for a training component aimed at developing literacy in data visualization and statistical interpretation, in line with Liu *et al*. (2024).
Dimension 3: Pedagogical application and decision-making. This dimension, with the lowest mean in the diagnosis (M = 2.18), constitutes the core of the pedagogical justification of the system. The results show that the greatest difficulty lies in translating data into concrete didactic interventions. As part of its functionality, the system must articulate a cycle of interpretation and action (educational data → information → interpretation → pedagogical reflection → decision → intervention → evaluation) that allows the teacher to move from a descriptive use of data to an interpretive, critical, and pedagogically oriented use. This dimension validates the principle that "data analysis must be subordinated to pedagogical questions and not the reverse," a guiding principle of the proposed system.
Dimension 4: Attitude, disposition, and training needs. With a mean of 3.81 and the highest scores on items P16 (M = 4.44) and P17 (M = 4.48), this dimension justifies the system in terms of teachers' receptiveness. The high willingness to undertake training constitutes favorable capital that should be harnessed through a progressive, contextualized, and participatory design. As Boroowa & Herodotou (2022) and Susnjak *et al*. (2022) point out, the acceptance of LA goes beyond technological availability and is related to competencies, support, and the capacity to transform data

into contextualized educational decisions. The system is therefore justified as a response to an explicit demand from UBE teaching staff.

6.5. Justification from the Guiding Principles of the Model

The third source of justification comes from the six principles that guide the design of the system, which guarantee its pedagogical coherence and contextual relevance:

First principle: pedagogical orientation. The system is justified by the need for training to begin with educational problems and questions, not with visual artifacts. Data must be interpreted in light of the learning objectives and specific needs of university students. This principle prevents the reduction of LA to a statistical activity and ensures that data analysis is always subordinated to the pedagogical purpose.

Second principle: progressive development of competencies. The diagnosis shows that teachers present heterogeneous levels of competence, from basic data literacy to advanced pedagogical application. The system is justified by the need to offer a progressive training pathway that accompanies the teacher from the interpretation of simple indicators to the performance of complex analyses and their incorporation into well-founded pedagogical decisions, reducing cognitive load and strengthening perceived confidence (P15: M = 2.18).

Third principle: contextualization. The relevance of the system rests on the use of data and situations close to the real practices of UBE teachers. As Leibur and Saks (2025) point out, the usefulness of the information generated by systems depends on integrating it with pedagogical dynamics and contextualized needs. The system is therefore justified by the use of real UBE data to simulate pedagogical interventions, increasing the transfer of training to practice.

Fourth principle: teacher participation. The justification for this principle derives from the evidence that teacher-oriented analytical systems are more effective when teachers take part in the selection of indicators, the interpretation of results, and the design of analytical solutions. The proposed system is justified by the need to build means suited to the professional needs of UBE teaching staff, avoiding technocentric designs that are alien to pedagogical reality.

Fifth principle: reflection and action. This principle is the articulating axis of the system and is justified by the need to go beyond training centered on the acquisition of knowledge. The diagnosis shows that the most pronounced deficits are concentrated in the translation of data into pedagogical decisions (P12 and P13), which validates the relevance of promoting cycles of analysis, reflection, intervention, and evaluation. The system is therefore justified as a mechanism of professional development that allows the teacher to question, review, and improve their practice on the basis of evidence.

Sixth principle: ethics and responsibility. The use of educational data requires consideration of privacy, transparency, security, biases, and the limits of interpretation. The system is justified by the need to incorporate a cross-cutting ethical dimension that guarantees the responsible use of the information generated by students, in line with the contemporary evolution of the field, which calls for greater integration between LA, learning theories, pedagogical design, and the participation of educational actors.

6.6. Theoretical Justification

The pedagogical justification of the system is completed by its articulation with the theoretical foundations adopted in the study. The definition of LA adopted, as an eclectic procedure that integrates techno-pedagogical resources, research methods, and individual and collective qualitative examination (López-Fernández *et al*., 2024), requires a training system that overcomes the dichotomy between the quantitative and the qualitative, integrating both perspectives in the interpretation of educational data. In addition, the conception of the teacher as "user, interpreter, evaluator, and decision-making agent within the Learning Analytics process" (Kannan & Zapata-Rivera, 2022; Liu *et al*., 2025) justifies a system that does not reduce teachers to passive recipients of indicators but, on the contrary, empowers them and trains them as professionals capable of formulating questions about learning, selecting relevant evidence, interpreting patterns, and deciding on well-founded pedagogical interventions.

Finally, the understanding of LA as a mediator of professional development (De La Hoz-Ruiz *et al*., 2024) justifies a system in which technology is not the end of the training process, but the means by which the teacher can observe their practice, analyze evidence, identify needs, and guide processes of improvement. This mediation makes it possible to move toward differentiated, progressive, and contextualized teacher training, in which LA acts as a catalyst for pedagogical reflection and the transformation of practice.

6.7. Contextual Justification: Relevance for the UBE

The system is ultimately justified by its specific relevance for the UBE. Its postgraduate model trains teachers who work in technologically mediated settings, where the availability of data on participation, performance, and interaction is particularly high. The digital transformation of higher education redefines teaching practice and demands specific competencies for interpreting evidence and converting it into well-founded pedagogical decisions. (Qazi & Pachler, 2025; De Giusti, 2023).

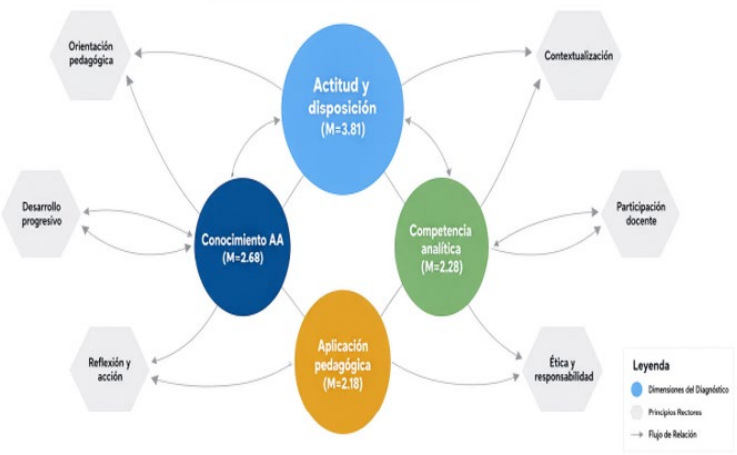
The diagnosis carried out with the 104 UBE teachers confirms that, despite having technological infrastructure and access to analytics interfaces, teachers present critical deficits in the interpretation and pedagogical use of data. The proposed system is therefore justified as a contextualized response to this need, aimed at strengthening the capacity of UBE teachers to make evidence-based decisions, improve their practice, and foster their students' learning.

6.8. Integrative Synthesis

The pedagogical justification of this teacher training system rests on the articulation of three lines of argument: (a) the empirical evidence of the diagnosis, which reveals a formative paradox between high attitudinal disposition and critical deficits in operational competencies; (b) coherence with the four dimensions that structure teaching competence in LA (knowledge, analytical competence, pedagogical application, and attitude), each of which provides a specific training foundation; and (c) articulation with the six guiding principles of the model (pedagogical orientation, progressive development, contextualization, teacher participation, reflection and action, and ethics), which guarantee the pedagogical and contextual relevance of the system. (Figure 5)

Figure 5

Interrelationship between the results of the diagnosis, the dimensions, and the principles



This justification confirms that the system is not reducible to a proposal for technical training; on the contrary, it constitutes a comprehensive pedagogical device, aimed at training teachers capable of moving from an instrumental use of analytics interfaces toward a critical and contextualized pedagogical appropriation of data, strengthening the capacity to make evidence-based decisions and to transform teaching and learning processes in the digital environments of contemporary higher education.

6. Conclusions

The training system designed is not reducible to technical or instrumental training. It is constituted as a comprehensive pedagogical device, structured around four dimensions and six guiding principles (pedagogical orientation, progressive development, contextualization, teacher participation, reflection and action, and ethics), aimed at training teachers capable of moving toward a critical appropriation of data, in which analysis is always subordinated to pedagogical questions and needs.

7. References

Amarasinghe, I., Michos, K., Crespi, F., & Hernández-Leo, D. (2024). Learning analytics support to teachers' design and orchestrating tasks. *Journal of Computer Assisted Learning, 40*(6), 2416–2431. https://doi.org/10.1111/jcal.12711

Boroowa, A. & Herodotou, C. (2022). Learning Analytics in Open and Distance Higher Education: The Case of the Open University UK. In: Prinsloo, P.; Slade, S. and Khalil, M. eds. *Learning Analytics in Open and Distributed Learning* (pp. 46–62). Springer,. DOI: https://doi.org/10.1007/978-981-19-0786-9_4P

de La Hoz-Ruiz, J., Khalil, M., Domingo Segovia, J., & Liu, Q. (2024). Learning analytics for enhanced professional capital development: A systematic review. *Frontiers in Psychology, 15*, 1302658. https://doi.org/10.3389/fpsyg.2024.1302658

De Giusti, A. E. (2023). Transformación digital en educación superior: posibilidades y desafíos. *TE & ET*, (35), 9-15. https://doi.org/10.24215/18509959.35.e1

Domínguez González, N., & Serna Poot, D. (2021). Competencias docentes para la educación en línea. RIDE. *Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 11*(22), e083. https://doi.org/10.23913/ride.v11i22.968.

Farhood, H., Nyden, M., & Beheshti, A. (2025). Artificial intelligence-based personalised learning in education: A systematic literature review. *Discover Artificial Intelligence, 5*, 331. https://doi.org/10.1007/s44163-025-00598-x

Gašević, D., & Dawson, S. && Siemens, G. (2015). Let's not forget: Learning analytics are about learning. *TechTrends, 59*, 64-71. https://doi.org/10.1007/s11528-014-0822-x

Guevara, N. E. O., Ventura, C. D. J. M., Becerra, M. N. A., Saiz, M. I. L., & Paredes, O. L. M. (2024). Analítica del aprendizaje y big data en la transversalidad del curso Algoritmos de programación en plataforma e-learning con estudiantes universitarios. *RHS-Revista Humanismo y Sociedad, 12*(1), e7-1. https://doi.org/10.22209/rhs.v12n1a07

Hardaker, G., & Glenn, L. E. (2025). Artificial intelligence for personalized learning: A systematic literature review. *International Journal of Information and Learning Technology, 42*(1), 1–14. https://doi.org/10.1108/IJILT-07-2024-0160

Hasnine, M. N., Bui, H. T., Tran, T. T. T., Nguyen, H. T., Akçapınar, G., & Ueda, H. (2021). Students' emotion extraction and visualization for engagement detection in online learning. *Procedia Computer Science, 192*, 3423-3431.

Hernández-Campos, M., Hilliger, I., & García-Peñalvo, F. J. (2026). Aseguramiento de la calidad y mejora continua en educación superior: estudio de casos múltiples sobre analítica curricular en universidades latinoamericanas. *Calidad en la educación*, (64), 102-146. http://dx.doi.org/10.31619/caledu.n64.1733

Hernández-de-Menéndez, M., Morales-Menendez, R., Escobar, C. A., & Ramírez Mendoza, R. A. (2022). Learning analytics: State of the art. *International Journal on Interactive Design and Manufacturing, 16*(3), 1209-1230. https://doi.org/10.1007/s12008-022-00930-0

Huang, L., Doleck, T., Chen, B., Huang, X., Tan, C., Lajoie, S. P., & Wang, M. (2023). Multimodal learning analytics for assessing teachers' self-regulated learning in planning technology-integrated lessons in a computer-based environment. *Education and Information Technologies, 28*(12), 15823–15843. https://doi.org/10.1007/s10639-023-11804-7

Huang, L., Zheng, J., Lajoie, S.P. Chen, Y., Hmelo-Silver C. E., & Wang, M. (2024). Examining university teachers' self-regulation in using a learning analytics dashboard for online collaboration. *Education and Information Technologies, 29*, 8523–8547. https://doi.org/10.1007/s10639-023-12131-7

Ifenthaler, D., Yau, J.YK. (2020). Utilising learning analytics to support study success in higher education: a systematic review. *Educational Technology Research and Development, 68*, 1961–1990. https://doi.org/10.1007/s11423-020-09788-z

Jannah, Z. F., Nitasari, N., & Aditya, A. Y. (2026). Learning Analytics in Higher Education: Opportunities and Challenges for Student Success. *Nusantara Education Studies, 4*(1), 1-19. https://doi.org/10.63208/21011-672

Kaliisa, R., Gillespie, A., Herodotou, C., Kluge, A., & Rienties, B. (2021). Teachers' Perspectives on the Promises, Needs and Challenges of Learning Analytics Dashboards: Insights from Institutions Offering Blended and Distance Learning. In Sahin, M., & Ifenthaler, D. (Eds), *Visualizations and Dashboards for Learning Analytics* (pp. 351-370). Springer, Cham.

Kannan P & Zapata-Rivera D. (2022). Facilitating the Use of Data From Multiple Sources for Formative Learning in the Context of Digital Assessments: Informing the Design and Development of Learning Analytic Dashboards. *Frontier Education, 7*:913594. doi: 10.3389/feduc.2022.913594

Kong, S. C., cheung, W. M. Y., lam, S. M. S., Jin, M., Lam, W. M. W., Yuen, C.-N., & Yang, y. N. (2024). Using learning analytics to facilitate pedagogical decision-making in higher education: A multiple case study. In *Conference Proceedings (English Paper) of the 28th Global Chinese Conference on Computers in Education (GCCCE 2024)* (pp. 103-110). Global Chinese Conference on Computers in Education.

Kotorov, I., Krasylnykova, Y., Pérez-Sanagustín, M., Mansilla, F., & Broisin, J. (2024). Supporting Decision-Making for Promoting Teaching and Learning Innovation: A Multiple Case Study. *Journal of Learning Analytics, 11*(1), 21-36. https://doi.org/10.18608/jla.2024.8131

Leibur, T. & Saks, K. (2025) Leveraging learning analytics to support teachers' professional development: insights from a digital application. *Frontiers in Education, 10*, 1639217. doi: 10.3389/feduc.2025.1639217

Li, Y., Zhou, C., Wu, D., & Chen, M. (2023). Evaluation of teachers' information literacy based on information of behavioral data in online learning and teaching platforms: an empirical study of China. *Library Hi Tech, 41*(4), 1039-1062. https://doi.org/10.1108/LHT-01-2021-0034

Liu, Y., Pozdniakov, S., & Martinez-Maldonado, R. (2024). The effects of visualisation literacy and data storytelling dashboards on teachers' cognitive load. *Australasian Journal of Educational Technology, 40*(1), 78–93. https://doi.org/10.14742/ajet.8988

Liu, Y., Wang, W., & Xu, E. (2025). The effectiveness of learning analytics-based interventions in enhancing students' learning effect: A meta-analysis of empirical studies. *Sage Open, 15*(2), 21582440251336707

López-Fernández, R., Sánchez Gálvez, S., Quintana Álvarez, M. R., & Gómez Rodríguez, V. G. (2024). Valoraciones teóricas sobre el concepto de analítica del aprendizaje. *Mendive, 22*(1), Artículo e3699. https://mendive.upr.edu.cu/index.php/MendiveUPR/article/view/3699

Michos, K., Schmitz, ML. & Petko, D. (2023). Teachers' data literacy for learning analytics: a central predictor for digital data use in upper secondary schools. *Education and Information Technologies, 28*, 14453–14471 (2023). https://doi.org/10.1007/s10639-023-11772-y

Mittal, P.C., Srivastava, M. & Garg S. (2021). The Role of Learning Analytics in Higher Education: A Strategy towards Sustainability, En: *2021 International Conference on Computational Performance Evaluation (ComPE), Shillong, India* (pp. 614-618). doi: 10.1109/ComPE53109.2021.9752233.

Morales Loor, K.P., Romero Amores, N. V., Bayas Jaramillo, C. M., & Vasco Delgado, J. C. (2025). Integración de la tecnología en la formación docente: Tendencias y desafíos: Integration of technology in teacher education: Trends and challenges. *Multidisciplinary Latin American Journal, 3*(1), 448-467. https://mlaj-revista.org/index.php/journal/article/view/69/195'

Mukred, M., Mokhtar, U. A., Hawash, B., AlSalman, H., & Zohaib, M. (2024). The adoption and use of learning analytics tools to improve decision making in higher learning institutions: An extension of technology acceptance model. *Heliyon, 10*(4), e26315. https://doi.org/10.1016/j.heliyon.2024.e26315

Ouhaichi, H., Spikol, D., & Vogel, B. (2023). Research trends in multimodal learning analytics: A systematic mapping study. *Computers and Education: Artificial Intelligence, 4*, Article 100136. https://doi.org/10.1016/j.caeai.2023.100136

Picón, G. A. (2023). La alfabetización de datos. *Revista de Investigación Científica y Tecnológica, 7*(1), 1-5.

Pozdniakov, S., Martinez-Maldonado, R., Tsai, Y-S., Echeverria, V., Swiecki, Z., & Gaševi´ D. (2024). Investigating the Effect of Visualization Literacy and Guidance on Teachers' Dashboard Interpretation. *Journal of Learning Analytics, 12*(1), 367–390. https://doi.org/10.18608/jla.2024.8471

Qazi, A. G., & Pachler, N. (2025). Conceptualising a data analytics framework to support targeted teacher professional development. Professional *Development in Education, 51*(3), 495–518. https://doi.org/10.1080/19415257.2024.2422066

Quiñonez Pech, S. H. (2025). Autopercepción de la competencia para la educación en línea en docentes del nivel superior. RIDE. *Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 16*(31), e922. https://doi.org/10.23913/ride.v16i31.2508.

Ruipérez-Valiente, J. A. (2020). El Proceso de Implementación de Analíticas de Aprendizaje. *Revista Iberoamericana de Educación a Distancia, 23*(2), 85-101. https://revistas.uned.es/index.php/ried/article/view/26283/21098

Saltos-Rivas, M. (2023). *La competencia digital en la educación superior*[Tesis]. Universidad de Córdoba (ESP). https://dialnet.unirioja.es/servlet/tesis?codigo=327137

Somabut, P., Tuamsuk, K., Samat, C., Lowatcharin, G., Traiyarach, S., & Kwangmuang, P. (2026). Personalizing teacher professional development through learning analytics: Evidence from the smart teacher trainin. *Teaching and Teacher Education, 173*, 105425. https://doi.org/10.1016/j.tate.2026.105425

Susnjak, T., Ramaswami, G.S. & Mathrani, A. (2022). Learning analytics dashboard: a tool for providing actionable insights to learners. *International Journal of Educational Technology in Higher Education, 19*. https://doi.org/10.1186/s41239-021-00313-7

Urco, E. J. C., Naranjo, L., & Rosero, R. S. A. (2026). Analítica del aprendizaje en educación superior: revisión de aplicaciones. *Revista de Investigación Educativa Niveles, 3*(1), 92-102. https://doi.org/10.61347/rien.v3i1.89

Van Leeuwen, A. (2023). Teachers' experiences of monitoring their students in online higher education: recommendations for course design and opportunities for learning analytics. *Technology, Pedagogy and Education, 32*(5), 589–604. https://doi.org/10.1080/1475939X.2023.2254297

CONTRIBUCIONES DE AUTORES, FINANCIACIÓN Y AGRADECIMIENTOS

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Financiación: Esta investigación recibió o no financiamiento externo.
Agradecimientos: Esta investigación se genera en un proyecto de investigación sobre Analítica del Aprendizaje de la Universidad Bolivariana del Ecuador y como resultado de una tesis doctoral con la Universidad de Cienfuegos.
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