Recibido: 01-07-2025 / Revisado: 27-09-2025
Aceptado: 30-09-2025 / Publicado: 31-07-2026

Impact of Digital Tools on Teaching Practices in Early and Primary Education in Paraguay

Impacto de las herramientas digitales en las prácticas de enseñanza en la educación inicial y primaria en Paraguay

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ABSTRACT. This study analyzes the use of digital tools in teaching practices at the early and primary education levels in Paraguay, focusing on six key areas: professional engagement, digital content, teaching and learning, assessment and feedback, student empowerment, and the development of digital competence. Using a causal model based on partial least squares structural equation modeling (PLS-SEM), a survey was administered to teachers working at these educational levels.

The results show that digital tools improve professional organization, foster collaboration, and increase teaching productivity. Advances were also observed in the selection and organization of appropriate digital content for the classroom. However, challenges remain in the assessment of learning and in teaching digital ethics and safety.

The study reveals a positive integration of technology into teaching practices and its impact on educational quality. Nonetheless, it emphasizes the need for greater support for teachers to ensure the ethical and safe use of digital tools.

This research provides a model for understanding the factors that facilitate the integration of technologies into teaching, and highlights the importance of continuous professional development in digital competencies. It underscores that maximizing the impact of technology in education requires addressing both emerging opportunities and technological challenges.

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KEYWORDS: Early childhood education, Primary education, Digital tools, Ethics and safety, Digital competencies, Teaching productivity.

PALABRAS CLAVE: Educación inicial, Educación primaria, Herramientas digitales, Ética y seguridad, Competencias digitales, Productividad docente.

Báez-Domínguez, M. R., Boumadan-Hamed, M., Gómez-García, M., & Fracchia-Ginzo, L. P. (2026). Impact of Digital Tools on Teaching Practices in Early and Primary Education in Paraguay. *Campus Virtuales*, 15(2), 173-189. https://doi.org/10.54988/cv.2026.2.1746

1. Introduction

Early and primary education in Paraguay faces constant challenges in a world marked by digital transformation and mass access to information. In this context, integrating digital tools into teaching practices becomes essential to meet the demands of the 21st century. However, this adaptation process faces obstacles such as limited technological infrastructure, insufficient teacher training, and resistance to innovation, which hinder the full adoption of information and communication technologies (ICT) in education.

The integration of digital tools into teaching involves more than just access to technology; it also requires the development of specific competencies for their effective use. These competencies enable teachers to organize their work, select relevant content, innovate teaching strategies, and conduct comprehensive student assessments. According to Mishra and Koehler (2006) and their TPACK model (Technological Pedagogical Content Knowledge), the impact of digital tools depends on how they are used to transform pedagogical practices. Complementarily, Fullan and Langworthy (2014) argue that teachers' attitudes toward technological innovation and the surrounding environment are decisive for the successful adoption of ICT.

In Paraguay, early and primary education has begun to incorporate digital tools; however, significant challenges persist. According to Martínez and Gómez (2019), many teachers lack sufficient training to use technologies ethically, creatively, and effectively in the classroom. Moreover, factors such as unequal access to technological resources and inadequate infrastructure negatively affect the implementation of these tools in the teaching-learning process.

López and Fernández (2021) emphasize that the use of technologies in primary education can enhance learning if properly integrated into teaching practices. In this regard, the present study analyzes the impact of digital tools in six key areas: professional engagement, digital content, teaching and learning, assessment and feedback, student empowerment, and development of digital competencies. For this purpose, the study employs partial least squares structural equation modeling (PLS-SEM), a methodology that enables the analysis of complex relationships and the evaluation of the impact of various variables on digital education.

One of the main benefits of using digital tools is the improvement in teaching productivity and the transformation of instructional methodologies. According to Rodríguez and Sánchez (2020), the effectiveness of these tools largely depends on the development of specific teacher competencies, such as the ability to organize content, foster active learning, and apply innovative assessment methods. These authors also highlight the importance of instilling ethical values in the use of technology to ensure responsible application.

The relationship between digital competencies and the integration of technologies in the classroom has been widely studied. Núñez, Castro, and Herrera (2021) point out that teachers in Paraguay demonstrate strengths in professional organization and the selection of appropriate digital content. However, deficiencies remain in student assessment and the teaching of digital ethics and safety—key aspects for the responsible use of ICT.

Another critical factor in the integration of digital tools is the external environment. According to Pérez and Ramírez (2018), deficient technological infrastructure and unequal access to devices limit teachers' capacity to implement innovative solutions uniformly. Furthermore, the lack of ongoing training in digital competencies poses a major challenge, as many teachers lack the necessary skills to fully leverage ICT in the classroom.

Theoretically, this study is grounded in principles that highlight the importance of teacher training and innovation in the educational context. As noted by Mishra and Koehler (2006) and Fullan and Langworthy (2014), successful adoption of technologies depends not only on teacher attitudes but also on environmental conditions. This implies that beyond providing access to technology, it is essential to foster a culture of continuous learning and an open mindset toward innovation.

This research underscores the importance of digital tools in improving educational quality, emphasizing that effective integration requires a comprehensive approach that combines teacher competency development, strengthening of technological infrastructure, and implementation of clear educational policies. The study not only provides a model to understand the factors influencing the adoption of technologies in early and primary education in Paraguay but also highlights the need for continuous professional development to ensure teachers are prepared to face emerging technological challenges.

Thus, it is reaffirmed that digital tools have a transformative impact on teaching, but their full potential can only be realized if both internal and external barriers faced by teachers are addressed collectively. Pérez and Ramírez (2018) argue that this requires a collective commitment among educational institutions, policymakers, and educators themselves to build a more innovative, inclusive, and ethical educational future. In this sense, collaboration among these actors is essential to overcome structural limitations and ensure the effective integration of technology in the classroom.

The PLS-SEM model used in this study allows for the analysis of how different variables—such as digital competencies, teacher attitudes, and external conditions—interact to determine the impact of digital tools on teaching. This methodology is particularly useful for identifying not only the factors that promote technology integration but also those that represent barriers.

2. Theoretical Framework

The conceptual model of this study is based on the evaluation of six key areas, which allow for a comprehensive analysis of the impact of digital tools on teaching practices in early and primary education in Paraguay. Each of these areas, as defined by the European DigCompEdu framework, is detailed below:

Professional Engagement:

Teachers' professional engagement is fundamental for the successful adoption of digital tools in teaching. In the context of early and primary education, teachers must use technologies not only to improve the organization of their work but also to strengthen their pedagogical strategies and motivate students. According to Ramírez et al. (2023), digital tools facilitate planning and teacher collaboration, enhancing teaching quality and allowing for more efficient classroom management. Furthermore, continuous learning in technology is essential to meet the challenges of education in the digital age (Fernández & Pérez, 2023).

Digital Content:

The selection and organization of digital content play a crucial role in educational quality, especially in early and primary education, where it is necessary to provide materials appropriate for each stage of child development. Research conducted in Paraguay identified that curating digital content allows for personalized teaching and better alignment with students' interests. According to Martínez & Suárez (2023), digital content should be selected for its relevance and its ability to foster interactive and autonomous learning. Teachers who integrate these resources into digital platforms offer their students flexible and equitable access to educational materials (Gutiérrez et al., 2023).

Teaching and Learning:

Teaching and learning in digital environments require pedagogical strategies that promote active student participation. In early and primary education, teachers have begun using methods such as game-based learning and digital collaboration to enhance children's motivation and performance. López et al. (2023) highlight that digital tools allow for the design of more flexible and participatory educational activities, promoting interaction between teachers and students. Moreover, online learning platforms facilitate the adaptation of teaching to each child's individual needs, improving educational inclusion (Torres & Ramírez, 2023).

Assessment and Feedback:

The use of digital tools transforms assessment and feedback in early and primary education by enabling more precise and continuous tracking of student learning. Pérez et al. (2023) note that digital assessments support a formative approach, where feedback is immediate and personalized, helping students correct mistakes and improve their performance. Additionally, digital platforms offer transparency in the assessment process, ensuring greater equity in grading.

Student Empowerment:

Empowering students in early and primary education involves providing them with digital tools that enable them to explore, learn, and develop their creativity autonomously. According to Gómez et al. (2023), digital technologies facilitate access to information, content creation, and collaboration among students, fostering more active and meaningful learning.

Development of Students' Digital Competence:

This process involves promoting skills ranging from the technical handling of tools to critical and ethical digital literacy. The development of digital competence is structured across various dimensions, such as technological fluency, learning-knowledge, and digital citizenship. Recent studies show significant progress in these areas through educational intervention projects, although the dimension of digital citizenship remains the most complex to address at early and primary education levels.

Causal Model and Relationship Between Factors:

In the proposed model (Figure 1), the analyzed factors are interconnected and mutually influential. Professional engagement and a positive attitude toward ICT foster the integration of digital content into teaching practice. The ability to manage digital tools enhances the teaching-learning process, improves assessment and feedback, and contributes to student empowerment. According to Venkatesh et al.'s (2003) intention-based model, a teacher's intention to incorporate ICT is a key factor in its effective adoption.

Studying these factors and their interaction will help to understand how teachers' digital competence impacts the quality of teaching in early and primary education, providing a foundation for designing strategies that promote the efficient use of technologies in the classroom.

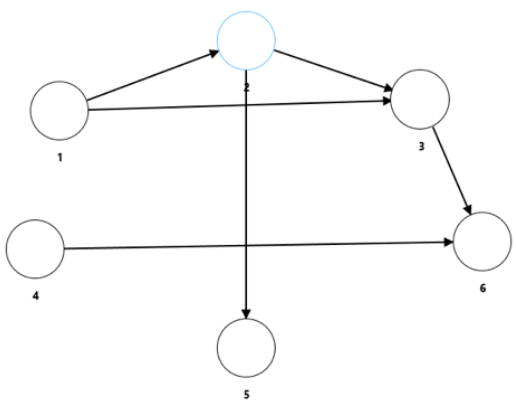

Figure 1. Proposed Hypothesis Model. Source: Own elaboration.

3. Method

This study adopts a non-experimental quantitative design based on a survey to examine the digital

competence of early education teachers in Paraguay. The sampling was non-probabilistic, and a group of 100 teachers was contacted through email addresses obtained from educational institutions within Paraguay's Educational System. In the end, a sample of 80 teachers was obtained, of which 58.6% (n = 42) were women and 47.4% (n = 38) were men. The average age of female teachers was 48.15 ± 9.57 years, and for male teachers, 49.61 ± 29.53 years.

The teachers came from various fields of knowledge, allowing for a broad and representative view of the use of digital technologies in early and primary education. The fields of knowledge were as follows:

Education Sciences: This field includes teacher training and the development of pedagogical strategies for teaching at early and primary levels. It involves specific didactics for each stage of child development, educational psychology, and school management. In Paraguay, the integration of digital technologies in this area is key for innovating teaching methodologies, enabling the creation of interactive materials and promoting more dynamic and participatory learning experiences for children.
Health and Wellness Sciences: This field comprises disciplines such as physical education, nutrition, and child psychology, which are essential for the comprehensive development of school-aged children. In Paraguay, digital tools have facilitated the teaching of healthy habits, promoting the physical and emotional well-being of students. Applications and interactive platforms allow teachers to address topics such as healthy eating, hygiene, and physical activity in a way that is attractive and accessible to children.
Exact and Natural Sciences: This field includes subjects like mathematics, natural sciences, and environmental knowledge. In early and primary education, digital technologies allow for the exploration of concepts through simulations, educational games, and visual resources that help students understand natural phenomena and mathematical principles. In Paraguay, incorporating these tools in the classroom has proven effective in motivating students and improving performance in these subjects.
Artistic and Creative Expression: This field includes music, dance, theater, visual arts, and design. Technology has opened new possibilities for the development of creativity in children, allowing them to experiment with different digital formats and tools. In early and primary education in Paraguay, teachers have incorporated applications for digital drawing, video editing, and music production, fostering artistic expression and creative skills from an early age.

The use of digital technologies in early and primary education in Paraguay has enriched teaching across various fields of knowledge, promoting more dynamic and inclusive learning experiences for students.

Ethical Considerations

Before completing the online questionnaire, participants were informed about the purpose of the study, ensuring the confidentiality and anonymity of their responses. Participation was completely voluntary, allowing teachers to decide whether to participate or withdraw at any time without consequence. To protect respondents' privacy, data collection was conducted anonymously, avoiding the collection of any information that could compromise their identity.

Instrument

The instrument used was designed to measure the digital competence of teachers in early and primary education within the context of their research work with ICT. A questionnaire was developed, including 42 questions distributed across 6 key dimensions (Table 1):

1. Professional engagement
2. Digital content
3. Teaching and learning
4. Assessment and feedback
5. Student empowerment

6. Development of students' digital competence

DIMENSIONS	Codes	Descriptions
DIMENSION 1. Professional Engagement	D1_1	I regularly use digital technologies to participate in professional development activities.
	D1_2	I frequently collaborate with colleagues using digital platforms to share ideas and educational resources.
	D1_3	I use digital tools to organize and plan my classes effectively.
	D1_4	I have a good understanding of practices to protect personal data in the digital environments I use.
	D1_5	Digital technologies have improved communication with my students' parents or guardians.
	D1_6	Digital tools have allowed me to increase my productivity in the educational field.
	D1_7	I consider digital technologies essential for my long-term professional development.
DIMENSION 2. Digital Content	D2_8	I select digital resources based on their relevance and suitability for my classes.
	D2_9	I frequently create or modify digital resources to suit the specific needs of my students.
	D2_10	I share digital resources with other teachers through online platforms or repositories.
	D2_11	I am aware of copyright and the licenses associated with the digital resources I use.
	D2_12	I use digital tools to efficiently organize and manage educational resources in my teaching.
	D2_13	I effectively integrate interactive digital resources, such as videos or simulations, into my classes.
	D2_14	I encounter few difficulties when adapting digital resources to meet my students' needs.
DIMENSION. 3. Teaching and Learning	D3_15	I regularly design teaching activities that integrate digital tools.
	D3_16	I use digital technologies to personalize my classes according to the individual needs of my students.
	D3_17	Digital tools allow me to encourage greater student participation in class.
	D3_18	I organize virtual learning environments that are accessible and motivating for my students.
	D3_19	I use digital platforms to effectively manage my students' assignments and projects.
	D3_20	Digital technologies have improved my ability to interact with my students outside the classroom.
	D3_21	I constantly evaluate the effectiveness of digital tools in improving my teaching practices.
DIMENSION. 4. Assessment and Feedback	D3_22	I regularly use digital tools to assess student progress.
	D3_23	I conduct both formative and summative assessments through digital platforms.
	D3_24	I provide feedback to students using digital tools.
	D3_25	I use data collected through digital assessments to improve my teaching methods.
	D3_26	My students engage in self-assessment or peer assessment processes using digital technologies.
	D3_27	I believe that digital assessments accurately reflect student progress.
	D3_28	Digital technologies have significantly facilitated my assessment processes.
DIMENSION. 5. Student Empowerment	D3_29	I use digital tools to promote student autonomy in their learning process.
	D3_30	Digital technologies allow me to adapt my teaching to the different learning paces and styles of my students.
	D3_31	I encourage collaboration among students through digital platforms.
	D3_32	I facilitate independent student work through the use of digital technologies.
	D3_33	I use digital tools to motivate students' active participation in classroom activities.
	D3_34	Digital technologies allow me to better support students with special educational needs or at risk of exclusion.
	D3_35	I assess that the use of digital technologies has increased student empowerment and motivation.

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DIMENSION. 6. Development of Students' Digital Competence	D3_36	I help my students develop skills to search for, evaluate, and use information in digital environments.
	D3_37	I teach students about online safety and the protection of their personal data through digital tools.
	D3_38	I encourage my students to create and edit digital content.
	D3_39	I promote ethical and responsible behavior in students' use of digital technologies.
	D3_40	My students use digital technologies to solve technical problems and acquire new digital skills.
	D3_41	I organize activities in which students use technologies to communicate and share ideas effectively.
	D3_42	I monitor my students' progress in developing their digital competences.

Table 1. Dimensions, Codes and Descriptions. Source: Own elaboration.

Each item was rated using a 5-point Likert scale with the following response options:

- 1: Strongly agree
- 2: Agree
- 3: Neither agree nor disagree
- 4: Disagree
- 5: Strongly disagree

Examples of questions:

- For the Professional Engagement dimension:

I regularly use digital technologies to participate in professional development activities.

- For the Digital Content dimension:

"I believe that digital content improves the quality of the teaching and research I conduct."

- For the Teaching and Learning dimension:

"Digital technologies enhance my ability to teach and interact with students in the research context."

- For the Assessment and Feedback dimension:

"I use digital tools to assess students and provide feedback on research assignments."

- For the Student Empowerment dimension:

"I encourage students to develop their digital competencies through the use of ICT in research activities."

- For the Development of Students' Digital Competence dimension:

I help my students develop skills to search for, evaluate, and use information in digital environments.

Data Analysis Procedure and Techniques

Data analysis was conducted using the partial least squares (PLS) method, which is part of structural equation modeling. This approach allows for the analysis of both the measurement model (assessment of the reliability and validity of underlying factors) and the structural model (relationships between variables).

The steps followed were:

1. Internal consistency evaluation of the instrument:

The Cronbach's alpha coefficient was calculated to assess the reliability of each factor, with a minimum acceptable value of 0.70.

Composite reliability (CR) and item loadings were also evaluated, which should be above 0.707 to indicate good reliability.

2. Convergent validity:

The average variance extracted (AVE) was calculated for each factor. An AVE value above 0.50 indicates good convergent validity.

3. Discriminant validity:

Three types of analysis were used to assess discriminant validity:

▪ The Fornell-Larcker criterion, which states that the square root of the AVE of a factor should be greater than the correlation between that factor and others.

▪ The HTMT index (heterotrait-monotrait ratio of correlations), where a value below 0.85 is adequate.

▪ Analysis of item loadings to ensure that each item is correctly associated with its corresponding factor.

4. Structural model evaluation:

- The amount of variance explained in the endogenous variables (such as Professional Engagement, Digital Content, Teaching and Learning, Assessment and Feedback, Student Empowerment, and Development of Students' Digital Competence) was evaluated using the R^2 coefficient.

- Significance testing was performed using the bootstrap method, evaluating whether path coefficients were significantly different from zero using the Student's *t*-value.

- Finally, model fit was assessed using the standardized root mean square residual (SRMR), considered adequate if the value is below 0.08 (Hu & Bentler, 1999).

4. Results

Internal Consistency: Table 2 shows the factor loadings of the items, as well as the composite reliability of each resulting factor and their Cronbach's alpha coefficients. Considering the recommended thresholds and statistical values, the items that did not exceed the threshold were removed (D1_5; D1_7; D2_11).

Convergent Validity: Table 3 presents the AVE coefficients for the instrument's factors. As observed, the values obtained for each factor are greater than 0.50, indicating that more than 50% of the variance in teachers' scores on the instrument is explained by its indicators. Therefore, the AVE coefficients for the model factors provide an appropriate level of convergent validity, ranging between 0.635 and 0.735.

Dimension	Item	Loading	Composite Reliability	Cronbach's alpha of each factor
D1: Professional Engagement	D1_1	0.842	0.870	0.867
	D1_2	0.802		
	D1_3	0.874		
	D1_4	0.744		
	D1_6	0.777		
D2: Digital Content	D2_8	0.773	0.877	0.873
	D2_9	0.789		
	D2_10	0.756		
	D2_12	0.848		
	D2_13	0.776		
	D2_14	0.746		
D3: Teaching and Learning	D3_15	0.824	0.907	0.904
	D3_16	0.831		
	D3_17	0.752		
	D3_18	0.873		
	D3_19	0.786		
	D3_21	0.725		

Dimension	Item	Loading	Composite Reliability	Cronbach's alpha of each factor
D4: Assessment and Feedback	D4_22	0.796	0.908	0.901
	D4_23	0.780		
	D4_24	0.777		
	D4_25	0.875		
	D4_26	0.764		
	D4_27	0.726		
	D4_28	0.830		
D5: Student Empowerment	D5_29	0.849	0,942	0,940
	D5_30	0.858		
	D5_31	0.887		
	D5_32	0.904		
	D5_33	0.853		
	D5_34	0.817		
	D5_35	0.829		
D6: Development of Students' Digital Competence	D6_36	0.858	0,928	0,923
	D6_37	0.823		
	D6_38	0.884		
	D7_39	0.725		
	D7_40	0.801		
	D7_41	0.841		
	D7_42	0.857		

Table 2. Internal consistency reliability and composite reliability. Source: Own elaboration.

Average Variance Extracted (AVE)	
Professional Engagement	0.655
Digital Content	0.612
Development of Students' Digital Competence	0.637
Student Empowerment	0.630
Teaching and Learning	0.735
Assessment and Feedback	0.686

Table 3. Convergent Validity. Source: Own elaboration.

Discriminant Validity: This was verified using the Fornell-Larcker criterion, which indicates the degree to which a factor differs from other factors in the instrument, as well as the HTMT ratio. Table 4 presents the first criterion analyzed, where the coefficients highlighted in gray (the square root of the AVE) are greater than the values appearing below the diagonal line.

	Engagement	Content	Competence Development	Empowerment	Teaching	Assessment
Engagement	0.809					
Content	0.793	0.820				
Competence Development	0.745	0.782	0.816			
Empowerment	0.712	0.701	0.811	0.883		
Teaching	0.741	0.722	0.798	0.794	0.866	
Assessment	0.723	0.719	0.782	0.789	0.857	0.828

Table 4. Fornell-Larcker-Criterion. Source: Own elaboration.

Table 5 shows the coefficients obtained for the second criterion analyzed (gray background), all of which exceed the value of 0.85. Both criteria provide further evidence of an appropriate discriminant value for the proposed model.

	Engagement	Content	Competence Development	Empowerment	Teaching	Assessment
Engagement						
Content	0.902					
Competence Development	0.835	0.916				
Empowerment	0.798	0.785	0.898			
Teaching	0.817	0.790	0.886	0.956		
Assessment	0.803	0.792	0.852	0.859	0.930	

Table 5. Heterotrait-Monotrait Ratio (HTMT). Source: Own elaboration.

Additionally, this validity was tested through an analysis of cross-loadings, examining how the items of one latent factor correlate with those of other latent factors, in order to ensure that each item loads significantly on its intended factor rather than on others. In Table 6, the items that correspond to their underlying factor are highlighted to distinguish them from the rest, demonstrating a strong correlation with their respective factor and a weak correlation with the others.

This hierarchical structure reinforces the internal consistency of the model and supports the validity of the instrument used, as the items are correctly grouped within the dimension to which they belong. This detailed analysis of factor loadings confirms that each dimension effectively represents the underlying theoretical constructs. Moreover, these findings contribute to the robustness of the analysis and the interpretation of results, providing a solid foundation for future research or practical applications.

Evaluation of the structural model: In order to determine whether the relationships between the latent factors are significant, the following questions were addressed:

(1) What percentage of the variance in the endogenous variables is explained by the exogenous variables in the proposed model?

(2) To what extent do the exogenous variables contribute to predicting the explained variance in the endogenous variables?

To answer the first question, the coefficient of determination (R^2) was used, while for the second, path coefficients were analyzed to assess the causal relationships between the variables.

Figure 2 shows that the latent factors included in the model explain:

– 80.09% of the variance in the Teaching variable,
– 80.06% of the variance in the Intention factor is explained by Empowerment,
– 62.07% of the variance in the Content factor,
– 69.03% of the variance in the Development of Competences variable,
– and finally, the Assessment factor explains 65.09% of the variance.

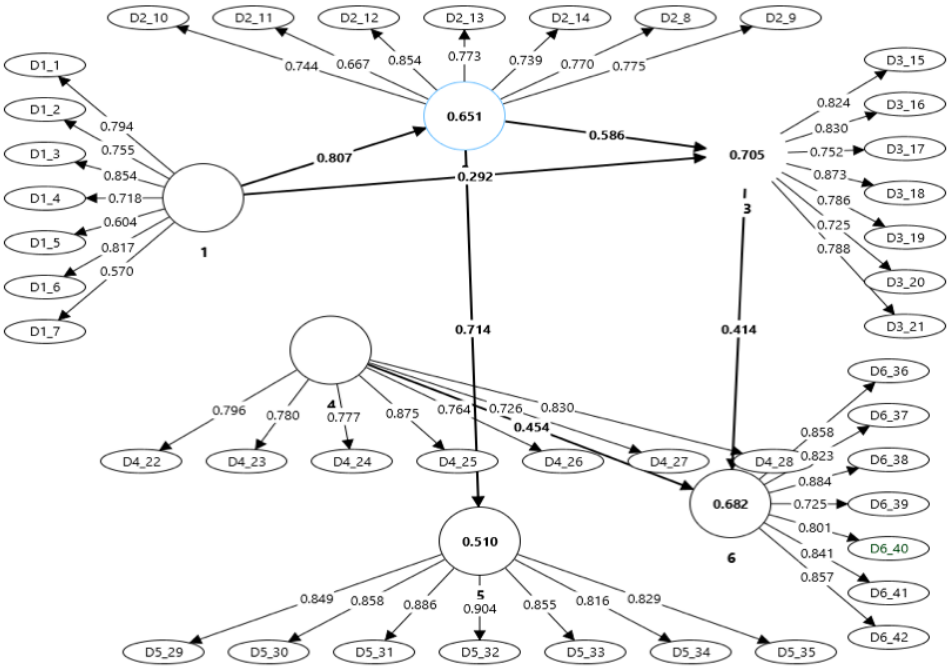

Figure 2. Hypothesized structural results. Source: Own elaboration.

Table 6 stands as a central element in the analysis of the proposed theoretical model, as it clearly and precisely synthesizes the empirical results regarding path weights, significance levels, and effect sizes associated with each hypothesis. This allows for a comprehensive understanding of how the variables are related and the magnitude of the impact each one exerts on the others.

The significance level presented alongside each path is crucial for determining the reliability of the results. By establishing thresholds (such as $p < 0.05$ or $p < 0.01$), the probability that the findings are due to chance is evaluated. A relationship that meets an appropriate significance level provides strong support for accepting the corresponding hypothesis, thereby reinforcing the statistical validity of the model. This indicator not only confirms the existence of the relationship but also helps to rule out possible random fluctuations in the data.

	Engagement	Content	Competence Development	Empowerment	Teaching	Assessment
D1_1	0.842	0.620	0.584	0.533	0.528	0.523
D1_2	0.802	0.560	0.516	0.574	0.622	0.582
D1_3	0.874	0.700	0.634	0.609	0.662	0.641
D1_4	0.744	0.649	0.618	0.554	0.547	0.615
D1_6	0.777	0.660	0.642	0.603	0.632	0.555
D2_8	0.660	0.773	0.590	0.535	0.570	0.561
D2_9	0.551	0.789	0.645	0.484	0.503	0.510
D2_10	0.647	0.756	0.579	0.487	0.545	0.617
D2_12	0.695	0.848	0.712	0.605	0.642	0.617
D2_13	0.642	0.776	0.707	0.612	0.617	0.574
D2_14	0.506	0.746	0.601	0.553	0.490	0.481
D3_15	0.609	0.705	0.824	0.682	0.625	0.613
D3_16	0.542	0.674	0.831	0.610	0.654	0.640
D3_17	0.548	0.610	0.752	0.550	0.604	0.564
D3_18	0.621	0.725	0.873	0.625	0.666	0.640
D3_19	0.617	0.706	0.786	0.626	0.605	0.591
D3_20	0.517	0.475	0.725	0.688	0.666	0.624
D3_21	0.693	0.659	0.788	0.749	0.738	0.694
D4_22	0.648	0.630	0.695	0.796	0.726	0.641
D4_23	0.497	0.487	0.634	0.780	0.645	0.542
D4_24	0.507	0.529	0.678	0.777	0.649	0.595
D4_25	0.693	0.639	0.751	0.875	0.826	0.742
D4_26	0.494	0.542	0.591	0.764	0.662	0.574
D4_27	0.514	0.523	0.578	0.726	0.641	0.593
D4_28	0.567	0.526	0.570	0.830	0.731	0.669
D5_29	0.629	0.652	0.709	0.776	0.849	0.687
D5_30	0.619	0.631	0.743	0.771	0.858	0.678
D5_31	0.737	0.674	0.699	0.736	0.887	0.759
D5_32	0.683	0.642	0.699	0.785	0.904	0.769
D5_33	0.646	0.598	0.736	0.758	0.853	0.801
D5_34	0.571	0.547	0.637	0.716	0.817	0.744
D5_35	0.542	0.574	0.671	0.760	0.829	0.771
D6_36	0.684	0.659	0.734	0.714	0.800	0.858
D6_37	0.551	0.530	0.637	0.606	0.664	0.823
D6_38	0.644	0.640	0.697	0.676	0.736	0.884
D6_39	0.477	0.409	0.503	0.569	0.609	0.725
D6_40	0.592	0.656	0.606	0.668	0.716	0.801
D6_41	0.578	0.580	0.619	0.653	0.736	0.841
D6_42	0.640	0.659	0.707	0.678	0.742	0.857

Table 6. Cross loadings. Source: Own elaboration.

As shown in Table 7, all the hypothesized relationships between the factors proved to be significant. To evaluate the strength of these relationships, the effect size coefficient (f^2) was used, following the procedure proposed by Cohen (1988). This coefficient allows for the interpretation of the magnitude of the effect using the following criteria: a value equal to or less than 0.02 indicates a small effect; a value of 0.15 reflects a medium effect; and a value of 0.35 corresponds to a large effect. In the PLS-SEM analysis, the obtained f^2 values ranged between 0.01 and 0.08, indicating that all observed effects were small. The specific details of the effect sizes for each relationship are presented in Table 7.

Additionally, the model was evaluated using the SRMR criterion (Standardized Root Mean Square Residual), which yielded a coefficient of 0.78—a value below the recommended threshold of 0.8, according to the criteria established by Hu and Bentler (1999). This result suggests that the model demonstrates a good overall fit.

Hypothesis		Path coefficient (β)	t-value	*Significance (p-Value)*	Effect size (f^2)
H1	1 -> 2	0.793	28.115	0.000	0.08
H2	1 -> 3	0.255	2.373	0.018	0.02
H3	2 -> 3	0.617	5.992	0.000	0.05
H4	2 -> 5	0.722	15.686	0.000	0.08
H5	3 -> 6	0.414	3.950	0.000	0.03

Table 7. Summary of hypothesis testing. Source: Own elaboration.

5. Discussion

The results obtained in this study represent an opportunity to deepen the analysis of the impact of digital competences on teaching practices in Early Childhood and Primary Education levels in Paraguay. This research was based on the development and validation of a specific instrument composed of 39 items distributed across six fundamental dimensions. The instrument was designed through an extensive review of the literature, which allowed the identification of key factors influencing the integration of digital technologies in the classroom and provided a robust theoretical foundation for measuring these competences.

The statistical validation of the instrument—supported by criteria of discriminant and convergent validity—ensured the relevance and reliability of the questionnaire. These aspects are aligned with the findings of Fernández and Gómez (2023) and Pérez et al. (2024), offering a valuable resource for both future research and the design of educational policies aimed at strengthening teacher training and practice. Furthermore, this methodological approach has made it possible to grasp the complexity of the technological integration process in education, emphasizing the need for continuous professional development and innovative strategies that respond to the challenges of the digital age.

The results of the study reveal that teachers' professional commitment emerges as a key factor in the adoption and effective use of digital technologies in the classroom. This is evidenced by the positive relationship between teachers' willingness to incorporate technological tools and the effectiveness of these strategies in the teaching-learning process. This finding is consistent with what has been reported by Rodríguez and Martínez (2022) and Gutiérrez et al. (2023), who have pointed out that teachers' attitudes and intentions are fundamental predictors of ICT integration in the educational environment. Intrinsic motivation and the willingness to innovate—even in contexts with infrastructure limitations—enable teachers to overcome technological barriers and transform pedagogical practices, thereby strengthening the teaching process and contributing to the creation of dynamic and adaptive learning environments.

The analysis of the dimension related to digital content and its integration into teaching practices indicates that the appropriate use of technological resources not only facilitates access to updated and diverse information, but also promotes more interactive and participatory pedagogical strategies that foster critical thinking and creativity among students. This is supported by studies such as those by García (2021) and Jiménez and López (2023), which emphasize the importance of combining coherent pedagogical planning with the use of digital tools to transform the educational environment. In this way, the teacher is no longer merely a transmitter of knowledge, but becomes a facilitator of learning. This integration of digital content into teaching is complemented by the need for ongoing training that enables educators to stay current with

technological innovations and to apply methodologies that respond to the challenges of the 21st century.

The study also revealed the positive influence of digital competencies on student empowerment, as the use of technological tools in the classroom fosters the development of essential skills such as autonomy, creativity, and critical thinking. This aligns with research by Vega et al. (2022) and Morales (2023), which highlight that the integration of ICT acts as a catalyst for more meaningful and participatory learning. It allows students to actively engage in the process of knowledge construction while encouraging collaborative interaction with content and the development of competencies that prepare them to face the challenges of an increasingly digital society. This underscores the importance of teacher training not only addressing technical aspects, but also incorporating innovative, student-centered pedagogical strategies.

Data analysis suggests that while teacher commitment and motivation are crucial for ICT integration, contextual and structural factors—such as access to technological resources and available infrastructure—play a significant role in the implementation of digital practices in the classroom. This has been confirmed by studies conducted by Ramírez et al. (2020) and Sánchez and Álvarez (2022) in Latin American contexts. Although the lack of resources can be a challenge, investment in training and ongoing professional development programs is essential for educators to make the most of the opportunities offered by digital technologies. In turn, this drives transformative change in pedagogical practice and contributes to improving educational quality in environments with various limitations. Thus, teacher training becomes a strategic factor that not only helps overcome technical barriers but also fosters a proactive attitude toward innovation and continuous improvement in the teaching process.

Comparing our findings with research from other contexts reveals that the integration of digital competencies into educational practice is a complex phenomenon that involves both individual and structural factors. Studies conducted in European and Asian countries, as well as in various regions of Latin America, have shown that the adoption of ICT in the classroom depends on a combination of teachers' positive attitudes, adequate technological infrastructure, and institutional policies that support ongoing training. This is evidenced in the work of Martínez et al. (2020) and López et al. (2023), who advocate for an integral and multidimensional approach. At the same time, research by Ramírez et al. (2020) and Sánchez and Álvarez (2022) emphasizes the importance of considering socioeconomic and contextual factors to understand variations in the implementation of digital practices. This suggests that the Paraguayan experience is part of a global trend that calls for sustained investment in training and the creation of educational environments that promote the effective use of technology.

It is also important to consider the recommendations of international organizations such as the World Health Organization (WHO) and UNICEF regarding the use of technology in educational settings. These organizations advocate for a balance between the use of digital tools and the need to encourage activities that promote social interaction, play, and experiential learning in children—especially relevant in Early Childhood Education. In this regard, international guidelines stress the importance of regulating screen exposure and designing pedagogical strategies that integrate technology as a complement to traditional methods. This ensures a holistic and balanced development of students and highlights the need for teacher training to include not only technical skills but also pedagogical approaches that enable the ethical and responsible use of ICT in the classroom, contributing to meaningful learning aligned with the challenges of a digital society.

The results of the integration of digital competencies into teaching practice show that it is a complex process which, according to Mishra and Koehler (2006), Puentedura (2006), and Shulman (1986), requires the synergistic combination of content knowledge, pedagogy, and technology. Continuous professional development and strong professional commitment are essential to overcoming technical and structural limitations. These authors compare their findings and emphasize the need for a comprehensive approach that empowers both teachers and students. Recent research, such as that proposed within the TPACK framework and the SAMR model, demonstrates that educational transformation can only be achieved through deep integration that fosters essential 21st-century skills.

Báez-Domínguez, M. R., Boumadan-Hamed, M., Gómez-García, M., & Fracchia-Ginzo, L. P. (2026). Impact of Digital Tools on Teaching Practices in Early and Primary Education in Paraguay. *Campus Virtuales,* 15(2), 173-189. https://doi.org/10.54988/cv.2026.2.1746

From a theoretical standpoint, Mishra and Koehler (2008), Puentedura (2006), and UNESCO (2008) highlight that while the TPACK model emphasizes the intersection of technological, pedagogical, and content knowledge, the SAMR model classifies the use of ICT into levels ranging from substitution to redefinition, focusing on the profound transformation of teaching practices. These theoretical frameworks enable progression from basic technology use to a transformative integration in the classroom. This comprehensive approach shows that investment in infrastructure and ongoing professional development is key to personalizing and modernizing learning.

Furthermore, studies by Niess (2005), Shulman (1986), and Puentedura (2006) show that teacher collaboration and the use of self-assessment tools based on frameworks such as TPACK and DigCompEdu help identify strengths and areas for improvement, enabling educators to adapt and optimize their pedagogical methods. These studies compare various training methodologies and underline the importance of collaborative strategies for professional growth. Empirical evidence supports that collaborative and evaluative training leads to more personalized and effective teaching in increasingly digitalized educational environments.

Finally, experts such as Desmurget (2019), Saavedra (2025), and Ramis Assens (2025) emphasize that innovation in education must be ethical and balanced, comparing excessive use of technology with traditional methods to ensure the holistic development of students. These thinkers agree that redefining the role of the teacher through the strategic integration of digital competencies is essential to address the challenges of the digital age. Thus, the combination of training strategies, adequate infrastructure, and comprehensive policies forms the foundation for transforming education and promoting quality learning in the 21st century.

6. Conclusions

This research highlights the importance of digital assessment and feedback in the teaching-learning process, as these strategies allow instruction to be adapted to the individual pace of students, fostering their autonomy and strengthening their formative process by enabling timely and personalized responses to each student's needs. This translates into a more dynamic and student-centered learning environment, which in turn enhances their ability to explore, interact, and actively construct knowledge within a structured framework guided by the teacher. In doing so, a synergy is established between technology and pedagogy that promotes the holistic development of children and constitutes one of the fundamental pillars of quality education in the 21st century.

In this regard, the intentional and appropriate implementation of digital tools for assessment and feedback emerges as an essential mechanism to identify areas for improvement, adjust teaching strategies, and promote effective communication between teacher and student. These elements, when combined, not only enrich the educational process but also foster an environment conducive to autonomous and collaborative learning. This has been demonstrated in several studies that highlight the importance of digitalization in modern education.

However, the findings of this research also reveal significant challenges that must be addressed to achieve effective integration of these technologies. Chief among them is the need for ongoing and specialized training for teachers, as continuous updating in digital competencies is essential for educators to fully leverage the potential of technological tools and to adopt innovative methodologies that respond to the evolving demands of an ever-changing educational environment.

The limited availability of technological infrastructure in some educational institutions constitutes another critical challenge. Without adequate access to devices and quality internet connections, even the most well-founded digital strategies may be compromised. This underscores the importance of public policies and education policymakers investing in the modernization and expansion of technological resources in schools to ensure equity and support the implementation of technology-based pedagogical practices at all levels—especially in Early Childhood and Primary Education.

Additionally, the use of a non-probabilistic sample in the present study limits the generalizability of the

findings, which opens the door for future research that broadens the scope of analysis by including more representative samples and employing inferential statistical analyses. This would enable a more accurate assessment of the impact of digital competencies on teaching and provide results applicable to diverse educational contexts, thereby reinforcing the validity of the conclusions and offering a strong framework for the development of teacher training policies.

It is essential to recognize that, in a context where the demands of the digital society are becoming increasingly complex, educational institutions and public policy makers must prioritize training in digital competencies. They must ensure that teachers possess the knowledge, strategies, and resources necessary to apply technology appropriately and effectively in the classroom. This not only contributes to improving the quality of education but also fosters the development of essential student skills such as critical thinking, creativity, and problem-solving—abilities that have become indispensable in today's world.

The consolidation of a technology-based educational culture requires a joint commitment involving all actors in the educational system, from authorities and school administrators to teachers and families, with the goal of creating an ecosystem that promotes pedagogical innovation and adaptation to the challenges of the 21st century, where the integration of ICT becomes a driver of change and educational transformation.

This research highlights that digital assessment and feedback are crucial components in adapting teaching to the individual needs of each student, while also strengthening the learning process and empowering children through the intentional use of technological tools. This represents a significant advantage for the holistic development of students. However, in order for these strategies to reach their full potential, it is essential to address challenges related to teacher training and technological infrastructure. A clear and sustained commitment is needed from both educational institutions and policy makers to ensure that the integration of digital competencies becomes a central component of early childhood and primary education in Paraguay, contributing decisively to the construction of a high-quality, innovative educational system adapted to the demands of contemporary society.

Acknowledgments

This scientific article is part of my doctoral thesis, within the Doctoral Program in Education at the Autonomous University of Madrid.

Funding

This research did not receive external funding.

Cómo citar este artículo / How to cite this paper

Báez-Domínguez, M. R., Boumadan-Hamed, M., Gómez-García, M., & Fracchia-Ginzo, L. P. (2026). Impact of Digital Tools on Teaching Practices in Early and Primary Education in Paraguay. *Campus Virtuales*, 15(2), 173-189. https://doi.org/10.54988/cv.2026.2.1746

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