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PAPER

The Role of Interactive Learning Platforms in Enhancing Teaching Practices and Fostering Student Engagement among Secondary School Teachers

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ABSTRACT

The growing demand for interactive learning environments reflects a broader digital and social transformation in education. This study investigates how interactive learning platforms act as drivers of pedagogical innovation and social change, influencing teaching practices and student engagement among lower and upper secondary school teachers. Using a mixed-methods design, data were collected from 111 teachers through questionnaires and from 10 teachers via focus group interviews, while a Structural Equation Model (SEM) assessed the influence of the perceived integration of interactive platform elements on teaching practices, instructional quality, and student engagement. The findings reveal that platform integration enhances teaching quality and creativity, fosters inclusive and student-centered learning, and promotes greater engagement and learner autonomy. Teachers' narratives also highlight social and institutional challenges, including unequal access, limited digital competence, and lack of institutional support, which they address through collaboration and adaptive practices. Overall, interactive learning platforms emerge as socio-pedagogical catalysts, reshaping teaching identities and learning relationships while underscoring the need for equitable and sustainable digital integration in education.

KEYWORDS

interactive learning platforms, teaching practices, student engagement, digital education

1 INTRODUCTION

The quality of education remains a central concern globally, as it directly shapes social mobility, equity, and sustainable development. In an era of accelerating digital transformation, educational institutions are increasingly rethinking their pedagogical models to better align with ongoing social and technological change. Many have adopted development policies that prioritize the enhancement of teaching and learning processes, particularly through the improvement of instructional quality,

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student engagement, and learning outcomes [1, 2]. This shift reflects a wider recognition that the effectiveness of education depends not only on curriculum design but also on teachers' capacity to integrate technology meaningfully within their instructional practices.

Over the past two decades, the digitalization of education has evolved from a technical innovation into a social and institutional necessity [3, 4]. The ongoing shift toward interactive and personalized learning environments underscores a growing emphasis on participation, collaboration, and learner autonomy [5]. Interactive learning platforms such as learning management systems (LMS), virtual classrooms, and gamified learning applications have become key instruments in this transformation, enabling new forms of communication and engagement between teachers, students, and educational content [6]. Beyond improving academic outcomes, these platforms have the potential to reshape classroom social dynamics, redefine teachers' professional roles, and promote more inclusive and participatory learning cultures.

Despite the growing body of research on interactive learning platforms, most studies focus on higher education or technologically advanced contexts and examine isolated outcomes such as student engagement. Empirical research integrating teaching practices and teachers' perspectives within secondary education, particularly in technology and science-related subjects undergoing rapid digital transformation, remains limited.

Based on the requirements of the Kosovo Education Strategy 2022–2026 [7] for interactive learning through digital platforms, and considering the lack of empirical research on their impact on teaching practices, teaching quality, and student engagement, there is a clear need for this study.

Against this backdrop, the present study investigates teachers' attitudes toward the integration of interactive learning platforms, focusing on how these technologies influence pedagogical innovation, professional adaptation, and social equity within education. Accordingly, this study examines how interactive learning platforms influence teaching practices and student engagement from teachers' perspectives in secondary education. By combining quantitative and qualitative methods, the study seeks to provide a nuanced understanding of teachers' perceptions of interactive platforms as both technological and social agents of change. The findings aim to contribute to the broader discourse on digital transformation in education by illustrating how the adoption of interactive platforms supports equitable, innovative, and sustainable teaching practices in technology- and science-oriented secondary education contexts.

2 MATERIALS AND METHODS

2.1 Theoretical background and conceptual framework

The integration of interactive learning platforms represents a central dimension of contemporary digital transformation in education, with direct implications for teaching practices and student engagement. Interactive platforms enable instructional approaches grounded in active learning, collaboration, and personalization by providing tools for real-time feedback, multimedia content, structured interaction, and adaptive learning pathways.

From a theoretical perspective, the use of interactive platforms in teaching is informed by sociocultural and constructivist learning theories, which emphasize

knowledge construction through interaction, dialogue, and shared meaning-making. Frameworks such as social constructivism, communities of practice, and the Community of Inquiry (Col) model highlight the role of teaching presence, social presence, and cognitive engagement in shaping effective learning environments. Interactive platforms operationalize these dimensions by supporting communication, collaboration, and learner participation within structured digital environments.

Building on this theoretical foundation, the present study conceptualizes interactive learning platforms as a set of pedagogical and technological elements that influence teaching practices and, indirectly, student engagement. Accordingly, the conceptual framework guiding this study examines the relationships between platform elements, teaching practices, perceived impact on teaching, and student engagement in secondary education. This framework provides the theoretical basis for the hypothesized relationships tested through structural equation modeling.

The impact of interactive platforms on teaching. Interactive platforms have significantly influenced teaching practices by enhancing communication, collaboration, and interaction between teachers and students across both formal and informal learning environments [8]. Recent studies also highlight that students perceive blended and collaborative learning environments as more engaging and supportive of active participation, particularly when interactive digital resources are integrated effectively [9]. Research on the adoption of e-learning systems indicates that individual factors such as computer experience and technology-related anxiety significantly influence users' intentions to adopt and effectively use digital learning platforms, highlighting the importance of user readiness in the successful integration of interactive educational technologies [10]. These platforms encompass LMS such as Moodle, Google Classroom, and Blackboard, as well as interactive tools like Microsoft Teams, Zoom, Kahoot!, Padlet, and Edmodo.

The integration of such platforms into instruction is grounded in several pedagogical and sociocultural learning theories, including social constructivism [11], the communities of practice model [12], and the CoI framework [13]. Collectively, these perspectives emphasize collaboration, dialogue, and shared knowledge construction as the foundation of effective learning. Online learning environments are shaped by three interrelated dimensions—social presence, cognitive presence, and teaching presence—which are central to effective online learning experiences [14]. Previous research highlights that the integration of information and communication technologies (ICT) significantly contributes to improving the quality of engineering education systems by enhancing instructional delivery, learner engagement, and access to educational resources [15]. Interactive platforms operationalize these dimensions by creating spaces that foster participation, interaction, and reciprocal support among learners and educators, factors widely recognized as essential for improving teaching effectiveness.

Learning has been conceptualized as a process of online participation, in which meaningful interaction and sustained engagement with others are central to learning [14]. Previous research has further shown that instructional design and professional development evolve through digital and networked learning environments [16], [17].

Teaching through interactive platforms provides greater flexibility and enables personalization of learning, accommodating diverse learner needs and fostering adaptive pedagogical environments. Adaptive systems enhance learner engagement by aligning instruction with individual learning styles [18], while interactive platforms enable immediate instructional support through personalized feedback [14]. Recent research on AI-based adaptive e-learning platforms suggests that intelligent

adaptive systems support personalized and responsive instruction, thereby fostering more flexible and learner-centered teaching environments [19]. Prompt feedback enabled by interactive tools has been shown to enhance learner motivation and learning outcomes [20]. Interactive technologies support communication and foster pedagogical reflection, enabling educators to continuously evaluate and adapt their teaching practices [21]. Research on teachers' perceptions indicates that educators recognize significant benefits from using online resources in their teaching, noting that such resources enhance lesson quality, increase attractiveness, and support student engagement [22].

Learning management system platforms, in particular, assist teachers in organizing coherent and sustainable instructional practices [14]. Recent studies indicate that LMS implemented through mobile applications facilitate continuous user interaction and enhance awareness of updates to learning materials [23]. In this context, research also indicates that open-source software offers a flexible and cost-effective alternative for implementing LMS-based blended learning environments [24]. Beyond improving instructional efficiency, they also contribute to building collaborative learning cultures. In practice, tools such as Microsoft Teams, Slack, and Padlet facilitate joint projects, peer communication, and reflective collaboration. Digital collaboration has been shown to play a key role in cultivating 21st-century competencies, including critical thinking, communication, and problem-solving skills [25].

The impact of interactive platforms on learning engagement and learning outcomes. Student engagement is widely recognized as a decisive factor in shaping learning outcomes and academic success, and identifying effective tools that enhance this engagement has been the focus of extensive research. Interactivity is a fundamental driver of student engagement, as it fosters both emotional and cognitive involvement through communication, collaboration, and active participation [26].

Interactive platform features such as multimedia content, synchronous communication, virtual laboratories, gamified activities, and real-time feedback are consistently identified as crucial factors promoting motivation, participation, and learner interaction [27–30]. Empirical research further supports these findings, indicating that the combination of gamification and social interaction in LMS environments such as Moodle substantially increases student motivation and performance [31]. These elements create immersive learning environments that encourage students to take ownership of their learning and collaborate more effectively with peers and instructors. As engagement and motivation increase, students demonstrate improved learning processes and deeper engagement.

A meta-analysis conducted by [32] found that learning activities implemented through online interactive platforms significantly enhance content acquisition compared to traditional methods. Interactive features such as real-time quizzes and collaborative group tasks were shown to support the development of more durable and transferable knowledge. Similarly, students using interactive platforms exhibit higher engagement and motivation, largely due to the integration of gamified and interactive instructional methods [3].

Further evidence confirms that interactive platforms contribute to improved learning performance by promoting active involvement and ensuring easier access to learning materials [33]. In this way, the use of interactive platforms aligns pedagogical innovation with learner empowerment, supporting environments in which students can construct knowledge actively and collaboratively while fostering deeper and more sustainable learning outcomes.

2.2 Research design

This study adopts an explanatory sequential mixed-methods design, in which the quantitative component constitutes the primary strand. The quantitative phase employed a survey-based approach and structural equation modeling (SEM) to examine the relationships among the study constructs.

To complement and contextualize the quantitative findings, a qualitative phase was subsequently conducted through focus group interviews with a purposive subsample of teachers. The qualitative data were used to deepen the interpretation of the quantitative results, particularly by exploring teachers' perceptions, experiences, and challenges related to the integration of interactive learning platforms in instructional practice.

The integration of quantitative and qualitative data enabled a more comprehensive understanding of the research problem by combining statistical relationships among key constructs with contextualized insights from teachers' lived experiences. This mixed-methods design therefore supports both theory testing and interpretive depth within the secondary education context examined.

2.3 Research questions

Building on the theoretical background and the conceptual framework of the study, this study aims to examine the role of interactive learning platforms in shaping teaching practices and student engagement in secondary education. To address this aim, the study is guided by the following research questions:

RQ1: How does the use of interactive platforms contribute to the improvement of teaching practices, according to teachers?
RQ2: What are teachers' perceptions of the impact of interactive platforms on student engagement during the learning process?
RQ3: What challenges do teachers face when integrating interactive learning platforms into their teaching practices?

2.4 Research hypotheses

Based on the theoretical background, the following hypotheses were formulated to guide the structural equation modeling analysis:

H1: According to teachers, there is a statistically significant positive relationship between the use of interactive learning platforms and the improvement of teaching practices.
H2: There is a statistically significant positive relationship between the use of interactive learning platforms and student engagement.
H3: Teachers face technical challenges and a lack of digital skills when integrating interactive learning platforms into their teaching practices.

2.5 Participants

The sample consisted of 111 subject area teachers from lower and upper secondary schools in the Republic of Kosovo who responded to the questionnaire and

10 additional teachers who participated in the focus group interview. Purposeful sampling was used to select in-service teachers who were either current master's students in the STEM department of subject teaching or graduates from this department in the Faculty of Education at the University of Pristina. All participants had completed coursework related to the use of interactive technologies in education.

2.6 Instruments

For the purposes of this study, it is important to provide an operational definition of "interactive learning platforms." In this study, interactive learning platforms are defined as digital educational platforms that support active learning and teaching through structured pedagogical features, including real-time feedback and assessment, gamification and interactive activities (e.g., quizzes, badges), collaboration tools (e.g., discussion forums, group work), access to multimedia content (e.g., videos, simulations), progress tracking and personalized learning paths, as well as integration of external learning resources and tools. The use of these platforms is measured through engagement indicators, including the number of completed activities, time spent on the platform, frequency of interactions, and online assessment results. This operational definition informs the construct of "platform elements" in the questionnaire and represents the independent variable in the SEM model, while teachers' perceptions regarding student engagements and teaching practices represent the dependent variables.

The questionnaire was designed in a structured format and comprised four main categories of questions.

1. Demographic information about participants;
2. Types and frequency of interactive platform use;
3. Teachers' perceptions of the impact of interactive platforms and their key components on teaching quality, instructional practices, student learning outcomes, and learner engagement;
4. Challenges and barriers related to integrating interactive platforms into instructional activities.

The focus group interview complemented the survey data by exploring participants' lived experiences, opinions, and challenges in greater depth.

2.7 Demographic data

The demographic characteristics of the sample are summarized in Table 1. Results indicate that 78.6% of the participating teachers are aged 40 years or younger. In terms of education, 60.7% have completed a Master's degree in their respective subject areas at the Faculty of Education, while 39.3% are currently pursuing Master's studies.

Regarding gender, 60.7% of participants identify as female and 38.4% as male. The majority (63.4%) have up to five years of teaching experience. With respect to teaching level, 55.4% are employed in lower secondary schools, and 44.6% teach at upper secondary schools.

Table 1. Demographic data of respondents

Attributes	Demographic Category	Frequency	(%)
Gender Categories	Men	43	38.4
	Women	68	60.7
	I prefer not to answer	1	0.9
Age group	Under 30	46	41.1
	31–40	42	37.5
	41–50	22	19.6
	Over 50	2	1.8
The role in education	Teacher	68	60.7
	Teacher/Student	44	39.3
Work experience	Less than 5 years	71	63.4
	6–10	19	17.0
	11–20	14	12.5
	More than 20 years	8	7.1
The level of teaching	Lower secondary education	62	55.4
	Upper secondary education	50	44.6

The data presented in Table 2 were obtained from questionnaire items designed to identify the interactive platforms used by teachers to enhance instructional practices and foster student engagement.

Table 2. Types of interactive platforms and frequency of use

Categories	Subcategories	%
LMS—which ones do you use most often in teaching?	Google Classroom	74.1
	Canvas	65.2
	Moodle	19.6
	Microsoft Teams for Education	18.8
Interactive platforms for remote communication	Google Meet	78.6
	Zoom	54.5
	Microsoft Teams	8.0
Which of the interactive educational platforms for quizzes, educational games, and quizzes do you use most often?	Kahoot!	92.9
	Quizizz	50.9
	Nearpod	43.8
	Quizlet	22.3
Which of the interactive platforms that enable learning through educational play do you use most often?	Classcraft	60.7
	Minecraft Education Edition	42.9
	Prodigy Math Game	9.8
	Gimkit	8.0
How often do you use the platforms?	Every day	13.4
	Twice a week	40.2
	Once a week	24.1
	Twice a month	11.6
	Once a month	10.7

As shown in Table 2, the most commonly used LMS are Google Classroom (74.1%) and Canvas (65.2%). Among interactive educational platforms designed for quizzes and educational games, the most frequently used are Kahoot! (92.9%), Quizizz (50.9%), and Nearpod (43.8%). Regarding platforms that support game-based learning, the most widely used are Classcraft (60.7%) and Minecraft Education Edition (42.9%).

With respect to usage frequency, the table indicates that 13.4% of respondents use these platforms daily, 40.2% report using them twice per week, 24.1% use them once per week, and 22.3% use them once or twice per month.

3 RESULTS

3.1 Quantitative findings

Given that the core constructs examined in this study (e.g., teaching practices and student engagement) are latent in nature and cannot be directly observed, an SEM approach was adopted. Following standard SEM procedures, the analysis proceeded in two stages: first, the measurement model was evaluated using CFA, and second, the structural model was tested to examine the hypothesized relationships among the latent constructs.

Confirmatory factor analysis. A CFA was conducted in lavaan using maximum likelihood (ML) estimation with full-information maximum likelihood (FIML) to handle missing data. The hypothesized four-factor measurement model specified platform elements (E1, E2), teaching practice (PM1, PM2), impact on teaching (M1–M5), and impact on student engagement (A1, A2). The model was estimated on N = 111 cases (see Table 3).

Overall, the CFA demonstrated good model fit to the data, $\chi^2(38) = 50.07$, $p = .091$, CFI = .984, TLI = .977, RMSEA = .053 (90% CI [.000, .091], p = .416), and SRMR = .033. Standardized factor loadings were all positive and statistically significant (*ps* < .001), ranging from .661 to .904, indicating that the indicators were adequate measures of their intended latent constructs. The proportion of variance explained in the observed indicators (R^2) ranged from .437 to .817, with the strongest explained variance for M1 ($R^2 = .817$) and the lowest for E2 ($R^2 = .437$).

Latent factor covariances were uniformly large and statistically significant (*ps* < .001), suggesting strong associations among the constructs. Standardized latent correlations ranged from .672 to .847, with particularly strong correlations involving impact on student engagement (e.g., Platform elements—Impact on student engagement, $r = .847$).

Table 3. Standardized factor loadings from the CFA measurement model (N = 111)

Latent Factor	Indicator	Unstd. Loading	SE	z	p	Std. Loading (λ)	R^2
Platform elements	E1	0.711	0.099	7.18	< .001	0.693	0.480
	E2	0.597	0.087	6.86	< .001	0.661	0.437
Teaching practice	PM1	0.718	0.074	9.74	< .001	0.833	0.694
	PM2	0.729	0.071	10.29	< .001	0.870	0.757

(Continued)

Table 3. Standardized factor loadings from the CFA measurement model (N = 111) *(Continued)*

Latent Factor	Indicator	Unstd. Loading	SE	z	p	Std. Loading (λ)	R^2
Impact on teaching	M1	0.795	0.065	12.18	< .001	0.904	0.817
	M2	0.660	0.062	10.73	< .001	0.837	0.701
	M3	0.812	0.068	11.86	< .001	0.890	0.792
	M4	0.736	0.065	11.24	< .001	0.861	0.742
	M5	0.716	0.073	9.76	< .001	0.787	0.619
Impact on student engagement	A1	0.683	0.077	8.87	< .001	0.809	0.655
	A2	0.533	0.070	7.65	< .001	0.705	0.497

Note: Unstd. = unstandardized loading from lavaan output; Std. loading (λ) corresponds to Std.all; R^2 refers to the indicator variance explained by its latent factor.

Structural equation model. Following the establishment of an adequate measurement model, an SEM was estimated to test the hypothesized relationships among the latent constructs. The results presented in Figure 1 indicate that the elements of interactive learning platforms have a significant positive impact on all three main dimensions of the study.

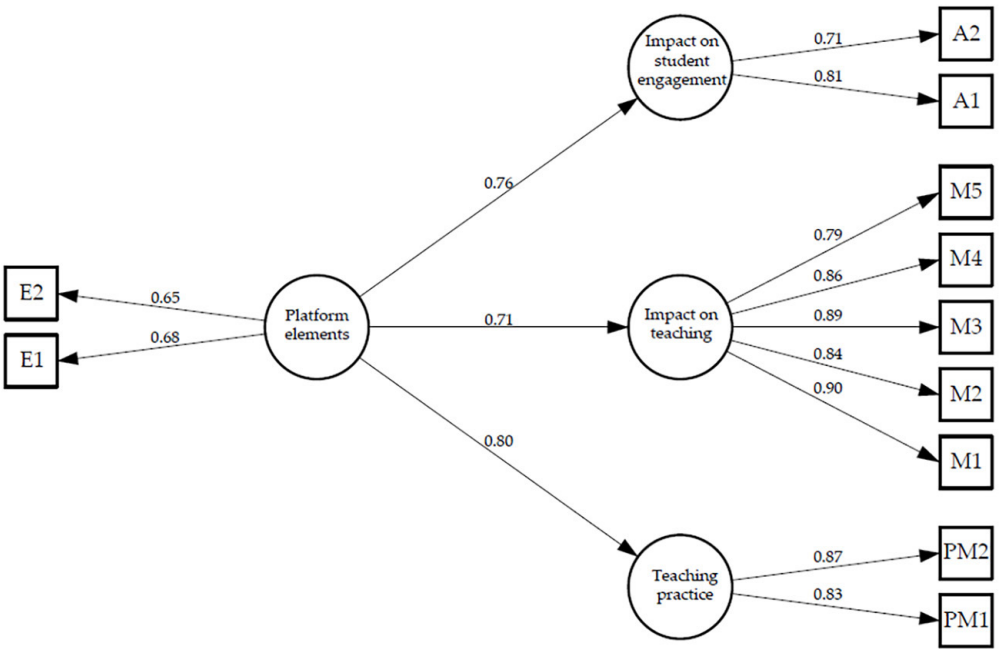

Fig. 1. SEM

The SEM (see Figure 1) was estimated using FIML for missing data (N = 111). The model demonstrated a good fit to the data, $\chi^2(39) = 50.22$, p = .108, CFI = .986, TLI = .980, RMSEA = .051 (90% CI [.000, .088], pclose = .457), and SRMR = .033. Standardized results indicated that Platform elements were a strong positive predictor of Teaching practice (β = .802, p < .001) and also significantly predicted Impact on teaching (β = .708, p = .014) and Impact on student engagement (β = .757, p = .006). In contrast, the hypothesized paths from Teaching practice to Impact on teaching (β = .104, p = .668) and from Impact on teaching to Impact on student engagement

($\beta = .141$, $p = .546$) were not statistically significant when included alongside Platform elements, suggesting that their direct effects were not supported in the presence of Platform elements.

The model explained substantial variance in the endogenous latent variables, with R^2 values of .642 for Teaching practice, $R^2 = .630$ for Impact on teaching, and $R^2 = .761$ for Impact on student engagement. Overall, these findings confirm that the integration of interactive learning platform elements plays a central role in enhancing teaching practices, teaching quality, and student engagement, while the incremental contributions of Teaching practice and Impact on teaching to downstream constructs were negligible within this model specification.

3.2 Qualitative findings from the teacher focus group

To complement the quantitative findings and gain deeper insights into how interactive platforms and their core components influence the instructional process, a focus group interview was conducted with ten selected teachers who reported using these platforms daily in their teaching practices. The aim of this phase was to explore teachers' perceptions, experiences, and reflections regarding how interactive platforms affect teaching practices, instructional styles, student engagement, and learning outcomes. It also sought to identify the challenges teachers encounter when using these technologies and the strategies they adopt to address them.

Based on the analysis of responses to the question, "How has the use of interactive platforms influenced your teaching style?", the main reported effects were grouped into six major categories: (1) improvement in teaching quality, (2) increased student engagement, (3) adaptation to student needs, (4) professional development of teachers, (5) influence on teaching style, and (6) manageable challenges.

According to the findings summarized in Table 4, participants reported a marked enhancement in teaching quality. They noted that lesson planning had become more efficient and that their instructional approach had evolved from traditional to modern, student-centered methods. Interactive platforms such as Kahoot! were especially recognized for boosting engagement and making lessons more appealing. Teachers also emphasized improved responsiveness to individual student needs, particularly through personalized content and targeted support for students with learning difficulties.

Another key theme was the professional development of teachers, who reported acquiring new technological competencies and feeling more motivated to experiment with creative teaching strategies. Despite initial challenges such as time management and lesson design, most participants perceived the transition as manageable and beneficial, ultimately enhancing their pedagogical effectiveness.

Table 4. Teachers' responses to the question: How has the use of interactive platforms influenced your teaching style?

Main Category	Sub-Category	Impact Description
1. Improving the quality of teaching	More effective and structured learning	Platforms facilitate lesson preparation, organization, and management.
	Facilitating the teacher's work	Learning becomes more practical, more accessible, and more visual.
	Transition from traditional to modern methods	Many teachers mention the shift towards digital, student-centered teaching.

(Continued)

Table 4. Teachers' responses to the question: How has the use of interactive platforms influenced your teaching style? *(Continued)*

Main Category	Sub-Category	Impact Description
2. Increasing student engagement	Greater interactivity and involvement	Lessons are more attractive, and students are more focused and motivated.
	Increased interest and participation	The use of quizzes, games, and platforms like Kahoot has enlivened the learning process.
3. Adaptation to student needs	Personalized and flexible learning	Platforms offer opportunities to adapt to the learner's individual pace and style.
	Support for students with difficulties	Additional help, clear instructions, and diverse materials are provided.
4. Teacher professional development	Creativity and innovation in teaching	Teachers feel more creative and use more visual tools, videos, etc.
	New digital and pedagogical skills	The platforms promote the development of teachers' technological and didactic skills.
5. Influence on teaching style	More dynamic and collaborative learning	Teachers emphasize the shift to a more active style, where students take a central role.
	Focus on the student as the center of learning	The use of platforms has made teaching more oriented towards student needs.
6. Easily Manageable Challenges	Time load and lesson planning	Some report initial difficulties but overcome them with practice and dedication.
	Neutral Impact or no change	A very small number of responses are average or unclear about concrete impact.

Regarding the impact on teaching practices, in response to the question "Which teaching practices do you believe are most effectively supported through interactive platforms?" as shown in Table 5, teachers' responses indicate that interactive platforms do not support only one aspect of instruction. Rather, they facilitate a broad range of pedagogical practices spanning personalization and collaboration, formative assessment, game-based learning, and the development of critical thinking skills.

Table 5. Teachers' responses to the question: Which teaching practices do you think are best supported through interactive platforms?

Main Category	Sub-Category	Description of Supported Practices
Personalized learning	Learning pace and individual needs	The platforms allow for the adaptation of content according to the level and style of the students.
	Group work	Students work together on assignments and projects through platforms.
	Discussions and interaction	Online conversations, mutual feedback, and direct engagement are enabled.
Project-based learning	Practical projects	Interactive platforms help in the management and presentation of learning projects.
Formative assessment	Tests and quizzes	Digital quizzes and tests like Kahoot, and Quizizz, provide immediate feedback.
Learning through play (gamification)	Engagement through play	Educational games promote student motivation and participation.

(Continued)

Table 5. Teachers' responses to the question: Which teaching practices do you think are best supported through interactive platforms? *(Continued)*

Main Category	Sub-Category	Description of Supported Practices
Active learning	Active participation of students	Students are directly involved in the learning process.
Technology-integrated learning	Use of digital tools	Platforms like Canva, Google Drive, and Prezi help visualize and concretize topics.
Developing critical thinking	Analysis and reflection	Students develop critical thinking through discussions and open-ended questions.
Developing digital skills	Use of ICT tools	Internships include acquiring technological skills necessary for the 21st century.
All practices	Comprehensive approach	Many responses mention that the platforms support all practices in an integrated manner.

Teachers perceive the use of interactive platforms as a powerful tool that supports a broad spectrum of essential pedagogical practices across several key areas:

- *Personalized and differentiated learning*—Interactive platforms enable instruction tailored to students' individual pace and needs, allowing them to engage with content flexibly. This helps teachers design more effective and learner-centered experiences.
- *Collaboration and communication*—By providing opportunities for group work and online discussions, interactive platforms foster interaction, collaboration, and social learning. Students actively participate through mutual feedback and idea exchange, thereby enriching the overall learning experience.
- *Project-based learning and practical activities*—Interactive platforms facilitate the management, sharing, and presentation of projects, supporting hands-on approaches grounded in problem-solving and creativity.
- *Formative assessment*—The use of digital quizzes and tests such as those offered through Kahoot or Quizizz provides immediate feedback, which is essential for tracking student progress and delivering real-time insights to teachers.
- *Gamification and student motivation*—Educational games integrated into platforms significantly enhance motivation and engagement, transforming the learning process into a more enjoyable and stimulating experience.
- *Active and inclusive learning*—Platforms promote active student participation by positioning learners at the center of the educational process, moving them beyond the passive role of information recipients and encouraging inclusive engagement.
- *Integration of technology in teaching*—Teachers reported that applications such as Canva, Google Drive, and Prezi help visualize content more effectively, making instruction clearer and more engaging.
- *Development of critical thinking and reflection*—Through open-ended questions and discussions, platforms encourage analysis, reflection, and critical thinking, fostering essential competencies for deep and independent learning.
- *21st-century digital skills*—Platforms support the acquisition of technological skills necessary for future readiness, including both functional and creative uses of ICT tools.
- *Inclusive approach*—Some teachers stated that all aspects of their teaching practices had been positively influenced by interactive platforms, underscoring their broad potential and flexibility in supporting contemporary instruction.

Teachers were also asked to indicate which specific elements of interactive platforms contributed directly to the improvement of their students' academic achievement.

Table 6. Teachers' responses to the question: Which specific elements of digital platforms have specifically contributed to the improvement of your students' learning?

Main Category	Sub-Category	Description of the Impact on Learning
Evaluation and feedback	Interactive quizzes and tests	Provides immediate feedback and increases motivation through points and challenges.
	Automatic assessment and analysis	It helps track progress and adapt methods for each student.
Visual and multimedia content	Videos, animations, photos	They increase understanding, engagement, and interest in learning.
Individual adaptation	Pace and personal approach	It allows them to learn at their own pace and return to content when they need to.
Cooperation and interaction	Shared documents and forums	Facilitates real-time collaboration and group discussions.
Practical learning and simulations	Simulations and applications	Helps develop practical skills through digital experiences.
Access to resources	Numerous online resources	It helps with research, argument building, and diverse approaches to content.
Organization and management	Calendars, notifications, structures	It helps organize tasks and increases accountability.
Motivation and involvement	Game elements and interactivity	Motivates through positive competition and active involvement.

Regarding the specific elements of interactive platforms that have contributed to the improvement of students' academic achievement, as shown in Table 6, teachers reported that the components of interactive platforms categorized by functionality and impact enhance students' learning experiences in several key ways:

- *Assessment and feedback*—Interactive quizzes and tests provide immediate feedback, making the evaluation process more dynamic and motivating for students. Through scoring, challenges, and friendly competition, student engagement and motivation to learn are significantly increased. Automated assessment and the ability to track task completion allow teachers to monitor progress and adapt their instructional approaches to individual needs, thereby improving the overall efficiency of the learning process.
- *Visual and multimedia content*—Multimedia elements such as videos, animations, and images make learning clearer and more engaging, particularly for students who learn more effectively through visual or audiovisual input.
- *Individualized learning*—Self-paced learning and the option to revisit content as needed help students internalize knowledge more effectively and reduce frustration that may arise from gaps in understanding during real-time instruction.
- *Collaboration and interaction*—Features such as forums, online discussions, and shared documents strengthen students' social and collaborative skills, preparing them for teamwork and idea exchange.

- *Practical learning and simulations*—Simulation tools and digital applications provide real world like experiences that support the development of practical skills particularly in technical or scientific subjects where theoretical concepts may be more abstract.
- *Access to diverse resources*—Students gain access to a wide range of online materials that support research, argument construction, and the exploration of multiple perspectives on a given topic.
- *Learning organization and management*—Tools such as calendars, notifications, and structured layouts within platforms help students manage their time and tasks more effectively, fostering greater responsibility and independence in the learning process.
- *Motivation and engagement*—Game like features and interactive elements create an enjoyable and stimulating learning environment, where positive competition and direct participation play a vital role in sustaining student engagement.

Recognizing that the integration of educational technology into instructional processes inherently involves certain challenges, focus group participants also described the difficulties they encountered when using interactive platforms, as well as the strategies they employed to overcome them. The data presented in Table 7 provide a clear overview of the main obstacles teachers face when implementing interactive platforms, together with the practical solutions they adopt to address these challenges.

An analysis of these data highlights a combination of structural, technological, pedagogical, and social challenges that directly affect the effectiveness of integrating interactive platforms into the teaching and learning process.

Table 7. Teachers' responses to the question: What are the main challenges in using them, and how do you overcome them?

Main Category	Sub-Category	Description of the Challenge/Solution
Technological infrastructure	Lack of equipment	Schools and students do not have computers, tablets, or basic tools to use the platform.
	Old or low-performance equipment	Existing equipment is unsuitable for optimal operation of the platforms.
	Solution	Use of personal equipment, group work, and combination with traditional methods.
Internet access	Weak or missing connection	Unstable or absent internet in some school areas or families.
	Inequality in access	Students do not all have the same level of access, creating inequality in learning.
	Solution	Internet distribution from the phone, use of platforms that work offline, and alternative materials.
Technological skills	Lack of training for teachers	Teachers are not well trained in the effective use of platforms.
	Difficulty in use by students	Some students have technical difficulties using the platforms.
	Solution	Short trainings, support from colleagues, and use of simple tools.

(Continued)

Table 7. Teachers' responses to the question: What are the main challenges in using them, and how do you overcome them? *(Continued)*

Main Category	Sub-Category	Description of the Challenge/Solution
Student participation	Lack of commitment	Students become distracted in online environments or do not actively participate.
	Social isolation	Virtual learning affects social interaction between students.
	Solution	Interactive activities, group work, and collaboration with parents.
Technical and organizational problems	Paid or complex platforms	Some platforms are limited or require a subscription.
	Time commitment for planning	Preparing digital learning takes considerable time.
	Solution	Free platform selection, pre-practical planning, and peer support.
Institutional support	Lack of investment in ICT	Lack of ICT cabinets and limited equipment in schools.
	Solution	Donor search, cooperation with directorates, and awareness raising of institutions.

The main challenges faced by teachers in using interactive platforms include inadequate equipment and weak technological infrastructure, unstable internet connectivity, limited digital competence among both students and teachers, as well as reduced engagement and social isolation in online learning environments. Additionally, technical and organizational difficulties such as subscription-based platforms and the time-consuming nature of lesson preparation further complicate the situation. The lack of institutional support further intensifies these challenges.

To overcome these barriers, teachers reported using personal devices, opting for free and user-friendly platforms, organizing collaborative group work with students, seeking collegial support, involving parents in providing equipment when needed, and fostering cooperation with school administrators and donors to improve teaching and learning conditions.

4 DISCUSSION

This study examined how interactive learning platforms influence teaching practices and student engagement in secondary education, while also exploring the challenges teachers encounter when integrating these technologies into instructional practice. By combining structural equation modeling with qualitative focus group data, the findings offer a coherent and complementary interpretation of the pedagogical role of interactive platforms within a context of ongoing digital transformation in education.

Overall, both quantitative and qualitative findings indicate that interactive learning platforms play a central role in shaping teachers' instructional practices and perceptions of student engagement. Platform-related features such as interactivity, feedback mechanisms, and multimedia resources emerged as key drivers of pedagogical change. These results are consistent with sociocultural and

constructivist perspectives, which emphasize interaction, participation, and shared meaning-making as essential conditions for effective learning environments.

4.1 Impact of interactive platforms on teaching practices

The structural equation model revealed a strong and statistically significant relationship between platform elements and teaching practices, supporting H1, which posits that higher use of interactive learning platforms is positively associated with the improvement of teaching practices. This confirms RQ1, showing that teachers perceive interactive platforms as directly contributing to more effective and structured instructional approaches. In this sense, interactive platforms function as enabling infrastructures that support lesson organization, instructional clarity, and the adoption of learner-centered teaching strategies.

Qualitative findings further reinforced this interpretation. Teachers described a clear shift from predominantly traditional, teacher-centered methods toward more interactive, visually supported, and student-oriented instructional practices. Participants emphasized that interactive platforms facilitated lesson preparation and classroom management while allowing greater flexibility in instructional design. These findings, derived from focus group responses and summarized in Table 4, confirm that teachers perceive a positive pedagogical impact, consistent with prior research highlighting the role of digital platforms in promoting reflective teaching practices [34–37].

4.2 Impact on teaching quality

Results from the structural model indicate that perceived teaching quality was significantly influenced both directly by platform elements and indirectly through improved teaching practices. This supports H1 again, demonstrating that interactive platforms enhance teaching quality via improved instructional practices (RQ1).

Focus group responses corroborated these findings. Teachers reported increased creativity, enhanced digital competence, and a greater willingness to experiment with innovative instructional strategies. Several participants specifically referred to tools such as Pear Deck as supporting more interactive, student-centered classroom practices. These results align with prior studies documenting the contribution of interactive digital tools to improving teaching quality and fostering innovation in instruction [34–37, 39].

4.3 Impact on student engagement

Student engagement was found to be significantly influenced by both the interactive elements of learning platforms and by improvements in teaching quality. This confirms H2, which hypothesized a positive relationship between the use of interactive platforms and student engagement. In terms of RQ2, teachers reported that interactive tools such as digital quizzes, educational games, online discussions, and immediate feedback mechanisms increased student attention, motivation, and participation. These elements were perceived as particularly effective in sustaining engagement in learning environments characterized by competing distractions.

Qualitative evidence further supports this interpretation, showing that engagement is not driven solely by technology but by the pedagogical integration of interactive platforms. The findings are consistent with previous research emphasizing the importance of interactivity, feedback, and gamification in enhancing student engagement in digital learning contexts [26, 35, 37–39].

4.4 Challenges and coping strategies

Despite the evident benefits, teachers reported ongoing challenges, confirming H3, which anticipated that technical difficulties and lack of digital competence are major barriers to effective platform integration. Respondents highlighted inadequate equipment, unstable internet connectivity, limited digital skills, and insufficient institutional support as critical obstacles (RQ3). These challenges reflect not only technical issues but also structural and social barriers that affect equity and the quality of learning experiences.

Nevertheless, teachers demonstrated adaptability through strategies such as using free platforms, sharing resources, seeking collegial assistance, involving parents, and collaborating with school leaders and donors. Such strategies reflect high professional resilience while underscoring the urgent need for sustainable institutional support to ensure equitable and effective integration of interactive platforms in education.

These findings, derived from focus group interviews, are consistent with the results reported in [40], which emphasize that the improvement of participants' digital skills represents the most positive aspect of online education. Similarly, respondents in this study, alongside structural and social barriers affecting the quality of learning experiences, highlighted that the lack of digital competence constitutes one of the main challenges in the effective use of interactive platforms.

5 CONCLUSIONS

This study examined the role of interactive learning platforms in shaping teaching practices and student engagement in secondary education, using an explanatory sequential mixed-methods design. By integrating structural equation modeling with qualitative focus group insights, the findings provide a coherent account of how teachers perceive interactive platforms as meaningful pedagogical tools within digitally evolving educational environments.

Overall, the results indicate that interactive learning platforms are perceived by teachers as important enablers of pedagogical innovation. The quantitative findings demonstrate strong associations between platform-related elements and teaching practices, while the qualitative data further illustrate how features such as interactivity, multimedia content, and feedback mechanisms support more structured, flexible, and learner-centered instructional approaches. In this sense, interactive platforms function not merely as supplementary technologies but as integral components of contemporary teaching practice.

Student engagement emerged as a central outcome linked to the effective integration of interactive platforms. Teachers consistently reported that interactive features such as quizzes, gamified activities, collaborative tools, and real-time feedback enhanced students' attention, motivation, and active participation in the learning process. These findings underscore the importance of pedagogical design and

instructional strategies in maximizing the potential of digital platforms to foster meaningful engagement.

At the same time, the study highlights several persistent challenges associated with the use of interactive platforms, including limitations in technological infrastructure, varying levels of digital competence, and insufficient institutional support. Teachers' adaptive strategies, such as peer collaboration, the use of free and accessible tools, and flexible instructional planning, reflect a high degree of professional resilience. However, these findings also point to the need for more systematic and sustained institutional investment to support equitable and effective digital integration in secondary education.

In conclusion, this study contributes to the growing body of research on digital transformation in education by providing empirical evidence from teachers' perspectives on the pedagogical role of interactive learning platforms. While the findings are context-specific, they offer valuable insights for educators, school leaders, and policymakers seeking to support innovative, inclusive, and sustainable teaching practices. Future research should build on these results by employing larger and more diverse samples, incorporating longitudinal designs, and integrating the perspectives of students and parents to better understand the longer-term implications of interactive platform use in secondary education.

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