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TRANSFORMING TEACHING: HOW GENERATIVE AI IS SHAPING CORE PEDAGOGICAL SKILLS

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ABSTRACT

The rapid proliferation of generative artificial intelligence (GenAI) in education has intensified interest into its potential impact on teachers' essential pedagogical competencies, particularly in lesson planning, classroom delivery, and assessment. Despite growing attention, empirical evidence in K–12 settings remains limited. This research explored female K–12 educators' perceptions of GenAI's influence on core teaching skills and identified barriers to its effective implementation within Saudi public schools. A quantitative descriptive survey design was employed using an online questionnaire administered to a convenience sample of 687 female K–12 teachers across Saudi Arabia. Data were analyzed using descriptive statistics, one-sample t-tests, and three-way analysis of variance to examine differences across teaching experience, academic qualifications, and subject areas. Findings revealed strong agreement regarding GenAI's usefulness in lesson planning (M = 3.50, SD = 1.13), indicating its perceived value in supporting instructional preparation, design, and alignment with student needs. Conversely, perceptions regarding GenAI's impact on lesson implementation (M = 3.05, SD = 1.07) and assessment practices (M = 2.98, SD = 0.92) were more moderate, suggesting more caution in classroom application. Furthermore, participants expressed significant concern about barriers to the successful integration of GenAI (M = 3.81, SD = 0.73), particularly related to insufficient digital infrastructure, limited professional development opportunities, and ethical considerations. No significant differences were observed across demographic variables. These results underscore the need for targeted professional development programs, enhanced technological infrastructure, and the establishment of ethical guidelines to facilitate the effective and pedagogically appropriate integration of GenAI in K–12 education. Although the study's scope is limited to self-reported perceptions from a single geographic context, its findings offer valuable empirical insights that can inform future teacher training initiatives, educational policy, and further research on integrating GenAI to strengthen core teaching competencies in K–12 settings.

KEYWORDS: Assessment and Evaluation, Generative AI, Instructional Practices, K–12 Teacher, Lesson Implementation, Lesson Planning.

1. INTRODUCTION

The rapid development of generative artificial intelligence (GenAI) is reshaping educational practices, particularly in lesson planning, instructional delivery, and assessment. Lesson planning is a foundational component of effective teaching, providing a structured roadmap that guides instruction, aligns learning objectives, and supports student development (Darling-Hammond et al., 2020; Liu & Zou, 2014; van den Berg & du Plessis, 2023). Within this context, GenAI can enhance the planning process by enabling teachers to efficiently design differentiated instructional materials; for instance, in a mathematics lesson, a teacher could use GenAI to generate multiple differentiated problem sets tailored to varying student skill levels, enhancing personalized learning while reducing preparation time (Fazilova, 2025; Kim et al., 2025).

From a competency-based perspective, GenAI should be considered not merely a technical innovation but a pedagogical resource that supports teachers' core teaching skills, including instructional planning, pedagogical decision-making, classroom interaction, and assessment literacy. Effective teaching requires integrating cognitive, social, emotional, and contextual dimensions of learning (Darling-Hammond et al., 2020). When pedagogically aligned, GenAI can strengthen technological–pedagogical competencies, support differentiated instruction, and enhance professional decision-making while preserving the central role of human judgment and ethical responsibility (Hava & Babayiğit, 2025; Shi, 2025; Tan et al., 2025).

During lesson implementation, GenAI can facilitate instructional and classroom management by automating routine tasks, such as monitoring student engagement, generating formative feedback, and organizing instructional resources. In a language lesson, an AI tool might deliver individualized reading comprehension prompts based on each student's performance, enabling teachers to focus on facilitating discussion and higher-order learning (Guo et al., 2024; Ng et al., 2023).

Assessment represents another area where GenAI can enhance teaching practice. AI-supported assessment provides immediate feedback, identifies misconceptions, and supports adaptive formative and summative evaluation strategies (Alazemi, 2024; Xia et al., 2024). In this context, AI systems may analyze student essays to highlight recurring errors and suggest improvement exercises, while teachers retain final evaluative authority (Kasneci et al., 2023; van den Berg & du Plessis, 2023).

Despite these pedagogical opportunities, integrating GenAI poses challenges. Overreliance on AI may undermine teachers' autonomy and expertise, emphasizing the need for technological, pedagogical, and ethical competence (Alam & Mohanty, 2022; Filiz et al., 2025). Moreover, research has largely focused on higher education or isolated AI applications, leaving in-service K–12 teachers underrepresented, particularly in non-Western contexts such as Saudi Arabia (Fazilova, 2025; Hsu et al., 2024; Kim et al., 2025).

To address these gaps, the current study investigates Saudi K–12 teachers' perceptions of GenAI across three essential teaching skills—lesson planning, implementation, and evaluation—while exploring challenges and differences based on experience, qualifications, and subject specialization. The study is guided by the following research questions:

1. How does GenAI influence teachers' lesson planning skills?
2. How does GenAI affect teachers' implementation of their lesson plans?
3. How does GenAI shape teachers' evaluation skills?
4. What obstacles limit teachers' use of GenAI to improve their teaching skills?
5. Are there significant differences in teachers' responses according to years of experience, qualifications, or subject specialization?

2. THEORETICAL FRAMEWORK

2.1. AI Technologies and Teaching Skills

The integration of technology in education has long been a central research focus, leading to the emergence of Artificial Intelligence in Education (AIED) as a key research domain (Moundridou et al., 2024). AIED seeks to leverage advanced GenAI tools to enhance teaching and learning by supporting instructional design, classroom delivery, and assessment practices (Lee & Zhai, 2024). Core teaching skills, including lesson planning, implementation, and evaluation, are foundational dimensions of effective instructional practice (van den Berg & du Plessis, 2023).

Competency-based frameworks highlight that the educational value of GenAI depends not only on access to tools but also on teachers' technological, pedagogical, and ethical competencies. The Teachers' GenAI Competencies (T-GAIC) framework (Shi, 2025) conceptualizes teachers' GenAI competencies in terms of technological proficiency, pedagogical alignment, and ethical confidence. Similarly, the Artificial Intelligence-Technological Pedagogical

Content Knowledge (AI-TPACK) framework extends TPACK to emphasize teachers' capacity to integrate AI tools in pedagogical decision-making, curriculum alignment, and responsible classroom use (Hava & Babayiğit, 2025). Together, these frameworks provide a theoretical lens for understanding how GenAI can support teachers' core skills while preserving professional judgment and instructional autonomy (Tan et al., 2025).

2.1.1. Lesson Planning and Instructional Design

GenAI supports lesson planning by reducing preparation time, generating instructional ideas, personalizing content, and assisting assessment design (Fazilova, 2025; Kim et al., 2025). In practice, teachers can use GenAI to draft lesson outlines and activity sequences, refining them to ensure alignment with learning objectives and curriculum standards, which enhances both efficiency and instructional quality (Patrik & Ilona, 2024).

Tools like ChatGPT can boost teachers' creativity when designing differentiated activities and aligning content with learner needs (Kim et al., 2025; Patrik & Ilona, 2024). However, effective use requires pedagogical expertise and ethical awareness. Without these competencies, AI may only support routine tasks, contributing minimally to higher-order decision-making or alignment with curricular standards (Hava & Babayiğit, 2025; Lee & Zhai, 2024; Shi, 2025).

2.1.2. Lesson Implementation and Classroom Interaction

During lesson implementation, GenAI supports classroom interaction through adaptive explanations, interactive simulations, and real-time learning analytics (Calleja & Camilleri, 2025; Kim et al., 2025; Sakamoto et al., 2024). For instance, in science lessons, GenAI can provide customized simulations based on students' prior knowledge, allowing teachers to focus on discussion and critical thinking facilitation (Calleja & Camilleri, 2025; Sakamoto et al., 2024).

Teachers can also use AI to automate routine tasks while retaining facilitation roles (Sakamoto et al., 2024; Wen & Jiang, 2025). Nevertheless, concerns about overreliance, reduced student agency, and erosion of teacher autonomy highlight the importance of ethical guidance and pedagogical alignment (Lee & Zhai, 2024; Shi, 2025). Competency-based approaches emphasize developing pedagogical and ethical confidence alongside technological proficiency (Hava & Babayiğit, 2025; Tan et al., 2025).

2.1.3. Lesson Evaluation and Assessment Practices

GenAI enhances both formative and summative assessment through automated feedback, performance analytics, and adaptive testing (Hsu et al., 2024). These AI-based functions can improve instructional effectiveness by providing timely insights and fostering self-regulated learning (Alazemi, 2024; Aldossary et al., 2024). For example, although teachers retain final grading authority, AI systems can be used to identify common errors in student work and suggest targeted exercises for improvement (Kasneci et al., 2023; van den Berg & du Plessis, 2023). However, critical ethical concerns include transparency, bias, academic integrity, and preservation of assessment literacy (Kasneci et al., 2023; van den Berg & du Plessis, 2023). Frameworks like T-GAIC and AI-TPACK stress the continued importance of teacher oversight in evaluating AI-generated outputs and ensuring alignment with curricular goals (Hava & Babayiğit, 2025; Shi, 2025).

2.2. Professional Development, Ethics, and Implementation Challenges

Despite its benefits, the integration of GenAI faces several barriers, including inadequate digital infrastructure, limited institutional guidance, insufficient professional development, and ethical uncertainty (Lee & Zhai, 2024; Moorhouse & Kohnke, 2024; Wen & Jiang, 2025). Teachers' adoption of GenAI is strongly influenced by their ethical awareness, professional confidence, and access to institutional support (Ogunleye et al., 2024; Shi, 2025; Tan et al., 2025).

Sustained professional development integrating technological, pedagogical, and ethical training is therefore key to ensure that GenAI functions as a pedagogical resource rather than a substitute for professional expertise (Wen & Jiang, 2025). Notably, much of the existing research has focused on Gen AI use in higher education contexts or its performance in isolated tasks, overlooking comprehensive investigations of in-service K–12 teachers' use (Hava & Babayiğit, 2025; Shi, 2025; Tan et al., 2025).

2.3. Practical Applications of GenAI in K–12 Classrooms

GenAI offers diverse practical applications across K–12 education. In lesson planning, teachers can leverage GenAI to generate differentiated activities, align instructional content with curriculum standards, and tailor materials to meet students' specific needs, ultimately enhancing both efficiency and instructional quality (Fazilova, 2025; Kim et al., 2025; Patrik & Ilona, 2024). For instance, an AI system may suggest various approaches for teaching a mathematical concept, enabling teachers to choose or modify strategies based on the cognitive abilities of their students.

During instructional delivery, GenAI enhances personalized learning through adaptive explanations, simulations, and real-time learning analytics (Calleja & Camilleri, 2025; Kim et al., 2025; Sakamoto et al., 2024). This allows teachers to monitor student engagement and address misconceptions, adjusting instructional strategies as needed. For example, an AI tool can scaffold reading comprehension exercises, adapting them individually to each student's proficiency level (Guo et al., 2024; Ng et al., 2023).

In terms of lesson evaluation, GenAI facilitates automated feedback, adaptive testing, and data-driven insights that inform instructional adjustments and targeted interventions (Alazemi, 2024; Aldossary et al., 2024; Hsu et al., 2024). For example, AI-powered systems can analyze student essays to identify common errors and suggest remedial exercises, providing valuable feedback that guides teachers' instructional adjustments (Kasneci et al., 2023; van den Berg & du Plessis, 2023).

Overall, the successful integration of GenAI in the classroom requires a balanced approach that combines technological proficiency, pedagogical alignment, and ethical awareness. As outlined in the T-GAIC and AI-TPACK frameworks (Hava & Babayiğit, 2025; Shi, 2025; Tan et al., 2025), these competencies ensure the creation of responsive, adaptive, and inclusive learning environments, where technology complements rather than replaces teacher expertise.

3. METHODS

This study employed a quantitative, cross-sectional survey design using a structured questionnaire. This approach is appropriate for examining teacher perceptions, competencies, and practices related to GenAI across large populations; it is particularly well-suited for identifying trends, group differences, and perceived impacts on core teaching skills, such as lesson planning, implementation, and assessment (Creswell & Creswell, 2017). Self-report questionnaires are widely used in educational technology research to capture teachers' beliefs, professional experiences, and instructional decision-making at scale, especially in studies examining technology integration, professional competencies, and ethical considerations in teaching (Hava & Babayiğit, 2025; Tan et al., 2025).

3.1. Population and Sample

This study was conducted in public general education schools in Riyadh, Saudi Arabia, encompassing primary, intermediate, and secondary levels. The target population comprised all female K–12 general education teachers working during the first semester of 2025.

Table 1. Distribution of Sample according to Experience, Qualifications, and Major.

Variable		Frequency	Percent
Years of Teaching Experience			
1	< 5	110	16.0
2	5–9	308	44.8
3	10+	269	39.2
Total		687	100
Qualifications (Highest Degree Attained)			
1	Diploma	464	67.5
2	Bachelor's Degree	66	9.6
3	Master's Degree	126	18.3
4	Doctorate (PhD)	31	4.5
Total		687	100
University Major			
1	Social and National Studies (e.g., Social Sciences, National Identity)	96	14.0
2	Islamic Studies	115	16.7
3	Mathematical and Numerical Studies (e.g., Mathematics, Statistics)	105	15.3
4	Scientific Studies (e.g., Science, Biology, Chemistry, Physics)	100	14.6
5	Languages (e.g., English, French, Chinese)	91	13.2
6	Arabic Language	147	21.4
7	Computer Science	33	4.8
Total		687	100

A non-probability convenience sampling technique was employed, as participation depended on teachers' voluntary response to an online questionnaire distributed through official school communication channels. This approach is appropriate given the large, geographically dispersed population and the exploratory nature of the study.

The sample consisted exclusively of female teachers due to the sex-segregated structure of the Saudi education system, in which female teachers predominantly teach in girls' schools. This sampling decision ensured contextual consistency and accurately reflects the demographic characteristics of the target population within the selected educational setting.

Teachers were invited via email to participate in the study and were provided with an electronic informed consent form prior to completing the questionnaire. The use of an online survey facilitated flexible participation and encouraged more candid and objective responses (Robson, 2002). A total of 687 complete and valid questionnaires were received and included in the final analysis.

This sample size exceeds the minimum recommended for survey-based educational research and provides sufficient statistical power to conduct subgroup comparisons based on years of teaching experience, academic qualifications, and subject specialization (Cohen, 1992). Table I shows the distribution of the sample.

3.2. Instrument

Data were collected using a structured questionnaire based on established theoretical frameworks and recent empirical studies on GenAI in education and teacher professional competencies.

The instrument was designed to measure teachers' perceptions of GenAI in relation to core teaching skills, operationalized as lesson planning and preparation, lesson implementation, and lesson evaluation, as well as the obstacles that limit teachers' professional development and effective use of GenAI.

These domains align with widely accepted models of teacher professional competence, which emphasize planning, enactment, and assessment as fundamental dimensions of effective teaching, and incorporate GenAI-specific competencies that support pedagogical decision-making and instructional design (Darling-Hammond et al., 2020; Hava & Babayiğit, 2025; Shi, 2025; Tan et al., 2025).

The questionnaire consisted of two sections: The first collected demographic information, including years of teaching experience, highest academic qualification, and subject specialization.

The second comprised 36 items distributed equally across four domains regarding GenAI use: (i) lesson planning and preparation, (ii) lesson implementation, (iii) lesson evaluation, and (iv) obstacles to professional development and use of GenAI.

Responses were recorded using a five-point Likert scale ranging from 1 ("very low") to 5 ("very high"). Mean scores were interpreted as follows: 1.00–1.80 (very low), 1.81–2.60 (low), 2.61–3.40 (moderate), 3.41–4.20 (high), and 4.21–5.00 (very high).

To establish face and content validity, the questionnaire was reviewed by a panel of five university faculty members specializing in educational technology, curriculum and instruction, and teacher education.

The reviewers evaluated item relevance, clarity, comprehensiveness, and alignment with the study objectives and core teaching skills. Based on their feedback, revisions were made to improve wording clarity, reduce redundancy, and ensure conceptual consistency.

A pilot study was subsequently conducted with 60 teachers from the same population who were not included in the main sample. Pilot data were coded and analyzed using SPSS (Version 26) to examine the instrument's psychometric properties.

3.3. Instrument Validity and Reliability

3.3.1. Construct Validity

Construct validity was examined using item–total correlation analysis, which assesses the degree to which each item aligns with the construct measured by its corresponding domain.

Pearson correlation coefficients were calculated for each item and its respective domain total score using pilot study data. This procedure is commonly employed in educational research to assess internal structure consistency prior to large-scale administration (Miller & Linn, 2013).

As shown in Table II, all item domain correlation coefficients were positive and statistically significant at the 0.01 level, indicating that each item contributed meaningfully to its intended construct.

Correlation coefficients ranged from 0.508 to 0.693 for Axis 1 (lesson planning and preparation), 0.502 to 0.707 for Axis 2 (lesson implementation), 0.524 to 0.726 for Axis 3 (lesson evaluation), and 0.527 to 0.716 for Axis 4 (professional development obstacles).

These values exceed the commonly accepted threshold of 0.30, indicating adequate item discrimination and satisfactory representation of the underlying constructs (Miller & Linn, 2013). Overall, the results provide evidence of acceptable internal consistency and preliminary construct validity for the instrument.

Table 2: Instrument Internal Consistency.

Item	Correlation with Domain	Item	Correlation with Domain	Item	Correlation with Domain	Item	Correlation with Domain
Axis 1		Axis 2		Axis 3		Axis 4	
1	0.508**	1	0.572**	1	0.714**	1	0.675**
2	0.613**	2	0.691**	2	0.636**	2	0.716**
3	0.693**	3	0.600**	3	0.524**	3	0.570**
4	0.578**	4	0.644**	4	0.726**	4	0.528**
5	0.612**	5	0.704**	5	0.584**	5	0.527**
6	0.574**	6	0.560**	6	0.537**	6	0.673**
7	0.575**	7	0.626**	7	0.593**	7	0.662**
8	0.676**	8	0.707**	8	0.608**	8	0.538**
9	0.602**	9	0.502**	9	0.712**	9	0.569**
**Significant at the 0.01 level.							

3.3.2. Reliability Analysis

The internal consistency reliability of the questionnaire was assessed using Cronbach's alpha coefficients based on pilot study data. As presented in Table III, Cronbach's alpha values ranged from 0.817 to 0.866 across the four domains, with an overall reliability coefficient of 0.858 for the full instrument. These values exceed the recommended threshold of 0.70, indicating a high level of internal consistency and reliability for measuring teachers' perceptions of GenAI and its impact on core teaching skills (Cheung et al., 2024).

Table 3: Instrument Reliability Coefficients Using Cronbach's Alpha.

Questionnaire Axes	Items	Cronbach's Alpha
Axis 1: Role of GenAI in Lesson Planning and Preparation	9	0.866
Axis 2: Role of GenAI in Lesson Implementation	9	0.817
Axis 3: Role of GenAI in Lesson Evaluation	9	0.854
Axis 4: Obstacles to Teachers' Professional Development	9	0.830
Total	36	0.858
Note: GenAI: generative artificial intelligence.		

3.4. Ethical Considerations

This study adhered to established ethical principles for educational research and received formal ethical approval from a public university in Saudi Arabia.

Participation was voluntary, and all teachers were informed of the study's purpose before completing the online questionnaire. Informed consent was obtained electronically, and participants were free to withdraw at any time without penalty. No personally identifiable information was collected, and all responses were anonymous and used solely for research purposes.

Data were securely stored and accessed only by the researcher. As the study focused on teachers' professional perceptions, it posed minimal risk and complied with institutional and national guidelines for confidentiality, data protection, and responsible reporting.

4. RESULTS AND DISCUSSION

4.1. Research Question 1: GenAI and Lesson Planning and Preparation

As shown in Table IV, teachers reported a high level of agreement regarding the role of GenAI in lesson planning and preparation (M = 3.50, SD = 1.13), with results significantly exceeding the hypothesized mean. This indicates that teachers generally perceive GenAI as a supportive tool for planning instructional activities and aligning lessons with student needs.

The highest-rated items reflected teachers' confidence in integrating technology into lesson planning and their perception that GenAI encourages the use of modern, flexible pedagogical strategies. These findings align with those of Darling-

Hammond et al. (2020), who emphasized that effective planning involves selecting instructional strategies that address cognitive, social, and emotional dimensions of learning. Similarly, Zhao et al. (2025) and Southworth et al. (2023) highlighted the potential of GenAI to enhance efficiency and personalization in instructional design.

Table 4: Results for GenAI's Role in Lesson Planning and Preparation.

Item		One-Sample Statistics				Item Rank	Response Level
		M	*SD*	*t*	Sig.		
1	I feel comfortable planning lessons that incorporate students' use of technology.	3.66	1.28	13.56	0.000	1	Large
2	I feel adequately prepared to manage GenAI-supported learning in the classroom.	3.52	1.31	10.38	0.000	5	Large
3	My school has a clear vision about how teachers use technology in education.	3.37	1.28	7.69	0.000	7	Medium
4	GenAI helps me achieve the lesson objectives effectively.	3.52	1.26	10.88	0.000	5	Large
5	GenAI encourages me to use modern teaching strategies that suit the lesson content.	3.64	1.22	13.81	0.000	2	Large
6	GenAI contributes to improving my interaction with machines through the smart tools and interfaces used.	3.57	1.26	11.87	0.000	3	Large
7	GenAI helps me design homework that meets the diverse needs of students.	3.46	1.29	9.29	0.000	6	Large
8	GenAI contributes to planning the development of higher-order thinking skills among students.	3.54	1.22	11.62	0.000	4	Large
9	GenAI helps me accurately formulate the lesson objectives (cognitive, psychomotor, affective).	3.23	1.34	4.48	0.000	8	Medium
	Total	3.50	1.13	11.65	0.000		Large
	Note: GenAI: generative artificial intelligence.						

In contrast, comparatively lower mean scores for items related to formulating multidimensional lesson objectives and institutional clarity regarding technology use suggest that while teachers value GenAI for efficiency and creativity, they remain cautious about relying on it for higher-level pedagogical judgment. This pattern reflects concerns noted by Shi (2025), who argued that AI tools can support, but not replace, teachers' professional expertise in aligning objectives with curriculum standards and learner outcomes. It further underscores the importance of integrating AI tools with teachers' technological–pedagogical competencies (Hava & Babayiğit, 2025; Tan et al., 2025).

Overall, these findings suggest that GenAI is perceived as a complementary planning tool that enhances teachers' core planning skills when used alongside pedagogical knowledge and institutional guidance.

4.2. Research Question 2: GenAI and Lesson Implementation

Results presented in Table V indicate a moderate level of agreement regarding GenAI's role in lesson implementation (M = 3.05, SD = 1.07), with no statistically significant difference from the hypothesized mean.

Teachers reported the strongest agreement for items related to GenAI's contribution to student engagement and teaching effectiveness, while lower agreement was observed for classroom management and human-like interaction.

These findings suggest that teachers primarily view GenAI as a tool to support instructional delivery and engagement rather than to manage classroom dynamics or replace interpersonal interaction.

This aligns with the findings of prior research indicating that while GenAI can support instructional activities and automate routine tasks, effective classroom management and relational teaching remain fundamentally human responsibilities (Darling-Hammond et al., 2020; Wen & Jiang, 2025). The relatively low ratings for classroom management echo concerns raised by Kim et al. (2025) and Calleja and Camilleri (2025), who emphasized that overreliance on AI during instruction may undermine teachers' situational awareness and pedagogical responsiveness.

Table 5: Results for GenAI's Role in Lesson Implementation.

Item		One-Sample Statistics				Item Rank	Response Level
		M	*SD*	*t*	Sig.		
1	GenAI helps me create a learning environment that supports learning.	3.19	1.38	3.59	0.000	4	Medium
2	GenAI provides me with a learning environment that fosters creativity.	3.23	1.39	4.41	0.000	3	Medium
3	GenAI enables me to deliver lessons flexibly according to students' needs.	3.05	1.41	1.00	0.318	7	Medium
4	GenAI enhances my ability to manage the classroom effectively.	2.35	1.32	-12.96	0.000	9	Low
5	GenAI enhances my ability to deliver innovative learning activities.	3.12	1.39	2.23	0.026	6	Medium
6	GenAI supports the development of my professional teaching skills.	3.17	1.38	3.31	0.001	5	Medium
7	GenAI improves the quality of teaching and makes me more effective.	3.26	1.38	5.04	0.000	2	Medium
8	GenAI helps me create engaging learning experiences for students.	3.57	1.33	11.31	0.000	1	Large
9	GenAI enables human-like interactions in the educational process.	2.54	1.39	-8.77	0.000	8	Low
Total		3.05	1.07	1.34	0.182		Medium
Note: GenAI: generative artificial intelligence.							

Collectively, these findings reinforce the view that GenAI contributes to instructional enhancement, but its impact on core teaching skills during implementation depends on teachers' pedagogical judgment and training.

4.3. Research Question 3: GenAI and Lesson Evaluation

As shown in Table VI, teachers expressed a moderate level of agreement regarding the role of GenAI in lesson evaluation (M = 2.98, SD = 0.92), with no significant difference from the hypothesized mean. Teachers reported high comfort with using GenAI for data collection and interpretation but lower confidence in its use for instant feedback and student self-assessment. This pattern suggests that teachers value GenAI primarily as a data-driven support tool rather than as an autonomous assessment agent.

Table 6: Results for GenAI's Role in Lesson Evaluation.

Item		One-Sample Statistics				Item Rank	Response Level
		M	*SD*	*t*	Sig.		
1	GenAI provides me with a system for continuous assessment of student performance.	3.09	1.39	1.76	0.080	4	Medium
2	GenAI helps me accurately analyze student performance.	2.95	1.42	-0.86	0.391	7	Medium
3	GenAI helps me in diagnostic assessment of student performance.	3.03	1.41	0.49	0.626	5	Medium
4	GenAI helps me provide instant feedback.	2.50	1.39	-9.39	0.000	8	Low
5	GenAI contributes to systematic monitoring of lesson evaluation.	3.15	1.33	2.87	0.004	2	Medium
6	GenAI helps create effective tools for evaluating student feedback	3.11	1.33	2.24	0.025	3	Medium
7	GenAI helps students practice self-assessment.	2.28	1.32	-14.31	0.000	9	Low
8	GenAI helps me define objective criteria for correcting tests and performance tasks.	2.98	1.36	-0.37	0.715	6	Medium
9	I feel comfortable using GenAI to collect and interpret data to understand student progress.	3.68	1.24	14.49	0.000	1	Large
Total		2.98	0.92	-0.70	0.484		Medium
Note: GenAI: generative artificial intelligence.							

These findings align with those of Aldossary et al. (2024) and Xia et al. (2024), who found that AIassisted assessment is perceived as effective for monitoring progress but raises concerns related to accuracy, fairness, and ethical responsibility when used for feedback or judgment. The cautious stance toward AI-generated feedback and self-assessment also reflects ethical and pedagogical concerns highlighted by Kasneci et al. (2023) and Shi (2025), particularly regarding transparency, bias mitigation, and the preservation of teachers' assessment literacy. These concerns are further supported by recent research emphasizing the need for professional development and careful integration of GenAI into teaching practices (Hava & Babayiğit, 2025; Tan et al., 2025).

Overall, the results suggest that GenAI can enhance evaluative efficiency, but its effective use in assessment requires clear guidelines, pedagogical alignment, and targeted teacher training.

4.4. Research Question 4: Obstacles Limiting Teachers' Professional Development

Table 7 shows a high level of agreement regarding barriers to teachers' effective use of GenAI for professional development-related goals (M = 3.81, SD = 0.73). The most prominent barriers identified were weak technological infrastructure, insufficient evidence-based guidance, and limited training opportunities.

Table 7: Results for Obstacles Limiting Teachers' Professional Development.

Item		One-Sample Statistics				Item Rank	Response Level
		M	*SD*	*t*	Sig.		
1	Weak infrastructure of wireless communications, computers, and software.	4.23	0.92	35.03	0.000	1	Very Large
2	Some teachers are not convinced of the importance of using GenAI in teaching.	3.92	1.16	20.80	0.000	6	Large
3	Teachers' fear of unethical use of GenAI (such as cheating or breach of academic integrity).	3.98	1.03	24.79	0.000	5	Large
4	Lack of adequate training programs to enable teachers to use GenAI.	4.08	0.98	28.92	0.000	4	Large
5	Lack of evidence-based guidance for GenAI applications.	4.14	0.93	32.24	0.000	2	Large
6	Some teachers believe that GenAI training requires more effort than traditional methods.	4.11	0.97	30.04	0.000	3	Large
7	Female teachers' job burnout limits their interest in GenAI courses.	3.12	1.43	2.27	0.024	9	Medium
8	Lack of incentives for teachers who use GenAI.	3.44	1.28	9.07	0.000	7	Large
9	Limited awareness among teachers of the balanced pros and cons of GenAI.	3.24	1.27	4.92	0.000	8	Medium
Total		3.81	0.73	29.01	0.000		Medium
Note: GenAI: generative artificial intelligence; M = Mean; SD = Standard Deviation; t = t-value; Sig. = Significance level.							

These findings reinforce prior research emphasizing that effective AI integration depends on systemic support rather than individual motivation alone (Kasneci et al., 2023; Moorhouse & Kohnke, 2024). Ethical concerns, including academic integrity and misuse, were also rated highly, reinforcing the need for structured professional development that addresses both technical competence and ethical awareness (Ogunleye et al., 2024; Tan et al., 2024).

The results highlight that barriers to GenAI adoption are largely institutional and structural, underscoring the importance of policy frameworks and sustained professional learning opportunities aligned with teachers' core teaching skills.

4.5. Research Question 5: Differences by Demographic Variables

Across all four domains and the total questionnaire score (Tables 8-12), the three-way analysis of variance results revealed no significant differences based on teaching experience, academic qualifications, or subject specialization. This uniformity suggests a shared perception of GenAI's role among teachers, regardless of background characteristics.

This consistency aligns with Mousa (2025), who reported similar patterns across school contexts, and suggests that teachers' perceptions of GenAI are shaped more by systemic factors, such as access, training, and institutional support, than by individual demographic characteristics. The absence of subgroup differences reinforces the need for broad, inclusive professional development initiatives rather than targeted interventions for specific teacher groups.

Table 8: Three-Way Analysis of Variance Results for the First Axis by Experience, Qualifications, and Major.

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Intercept	2065.78	1	2065.78	1644.03	0.000
Teaching Experience	2.82	2	1.41	1.12	0.326
Qualifications	7.89	3	2.63	2.09	0.100
Major	7.03	6	1.17	0.93	0.471
Teaching Experience × Qualifications	14.03	6	2.34	1.86	0.085
Teaching Experience × Major	22.64	12	1.89	1.50	0.119
Qualifications × Major	28.39	17	1.67	1.33	0.168
Teaching Experience × Qualifications × Major	31.74	28	1.13	0.90	0.613
Error	769.00	612	1.26		
Total	9297.89	687			
Note: SS (Type III) = Type III Sum of Squares; df = Degrees of freedom; MS = Mean Square; F = F-value; Sig. = Significance level.					

Table 9: Three-Way Analysis of Variance Results for the Second Axis by Experience, Qualifications, and Major.

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Intercept	1595.81	1	1595.81	1452.68	0.000
Teaching Experience	0.15	2	0.08	0.07	0.933
Qualifications	7.33	3	2.45	2.23	0.084
Major	6.95	6	1.16	1.05	0.389
Teaching Experience × Qualifications	9.65	6	1.61	1.46	0.188
Teaching Experience × Major	19.41	12	1.62	1.47	0.130
Qualifications × Major	23.26	17	1.37	1.25	0.223
Teaching Experience × Qualifications × Major	34.21	28	1.22	1.11	0.317
Error	672.30	612	1.10		
Total	7187.74	687			

Table 10: Three-Way Analysis of Variance Results for the Third Axis by Experience, Qualifications, and Major.

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Intercept	1591.19	1	1591.19	1906.36	0.000
Teaching Experience	1.21	2	0.61	0.73	0.484
Learn	3.11	3	1.04	1.24	0.294
Major	9.50	6	1.58	1.90	0.079
Teaching Experience × Learn	5.80	6	0.97	1.16	0.327
Teaching Experience × Major	11.96	12	1.00	1.19	0.283
Qualifications × Major	16.39	17	0.96	1.16	0.297
Teaching Experience × Learn × Major	24.83	28	0.89	1.06	0.380
Error	510.82	612	0.84		
Total	6663.00	687			

Table 11: Three-Way Analysis of Variance Results for the Fourth Axis by Experience, Qualifications, and Major.

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Intercept	2619.11	1	2619.11	5110.21	0.000
Teaching Experience	1.59	2	0.79	1.55	0.213
Learn	2.86	3	0.95	1.86	0.135
Major	2.61	6	0.44	0.85	0.532
Teaching Experience × Learn	3.37	6	0.56	1.10	0.363
Teaching Experience × Major	4.64	12	0.39	0.75	0.698
Qualifications × Major	8.45	17	0.50	0.97	0.491
Teaching Experience × Learn × Major	12.95	28	0.46	0.90	0.612

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Error	313.67	612	0.51		
Total	10316.96	687			

Table 12: Three-Way Analysis of Variance Results for the Entire Questionnaire by Experience, Qualifications, and Major.

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Intercept	31140.00	1	31140.00	3295.15	0.000
Teaching Experience	7.86	2	3.93	0.42	0.660
Learn	71.26	3	23.76	2.51	0.058
Major	60.57	6	10.10	1.07	0.380
Teaching Experience × Learn	117.02	6	19.50	2.06	0.056
Teaching Experience × Major	166.40	12	13.87	1.47	0.132
Qualifications × Major	208.71	17	12.28	1.30	0.186
Teaching Experience × Learn × Major	258.17	28	9.22	0.98	0.502
Error	5783.55	612	9.45		
Total	128859.22	687			

4.6. Theoretical Implications

This study contributes to the growing literature on GenAI in education by explicitly linking GenAI use to core teaching skills—lesson planning, implementation, and evaluation—rather than treating AI adoption as a purely technological phenomenon. Consistent with competency-based models of teaching (Darling-Hammond et al., 2020), the findings suggest that teachers perceive GenAI as most effective when it supports instructional planning and pedagogical decision-making, particularly in aligning lesson objectives, designing differentiated activities, and addressing diverse learner needs. This is congruent with the whole-child approach, where technology serves as an enabler of cognitive, instructional, and adaptive teaching practices rather than a replacement for teacher expertise.

The stronger agreement observed in lesson planning than in lesson implementation and evaluation reinforces the argument advanced by Shi’s (2025) T-GAIC framework, which posits that teachers’ technological proficiency often develops faster than their pedagogical compatibility and ethical confidence. This aligns with empirical findings showing that while teachers are comfortable using GenAI for preparatory and organizational tasks, they remain more cautious about its role in real-time classroom interaction, assessment feedback, and student self-regulation (Hava & Babayiğit, 2025; Tan et al., 2025). Overall, this pattern supports prior research indicating that effective AI integration depends not only on access to tools but also on teachers’ pedagogical judgment, professional autonomy, and ethical awareness (Kasneci et al., 2023).

The absence of significant differences across experience, qualifications, and subject specialization suggests that perceptions of GenAI are becoming profession-wide rather than demographically segmented, indicating a systemic shift in how teachers conceptualize AI-supported teaching. This finding extends prior work (Haroud & Saqri, 2025; Mousa, 2025) by demonstrating that perceived benefits and challenges of GenAI cut across traditional teacher subgroups, highlighting the need for institution-wide rather than targeted interventions.

4.7. Practical Implications

From a practical perspective, the findings suggest that GenAI is currently perceived as a planning enhancement tool rather than a mechanism for classroom management or assessment authority. Educational leaders and policymakers should therefore prioritize professional development programs that move beyond technical training and focus on pedagogical integration, ethical use, and instructional decision-making. Training aligned with frameworks such as T-GAIC (Shi, 2025) and informed by research on AI-related teacher competencies and digital proficiency (Hava & Babayiğit, 2025; Tan et al., 2025) can help teachers critically evaluate when and how GenAI adds pedagogical value, particularly in assessment design, formative feedback, and student self-assessment.

The high level of agreement regarding obstacles, especially weak infrastructure, limited training, and ethical concerns, underscores the need for systemic support structures. Investment in digital infrastructure, clear institutional policies, and evidence-based guidance is essential to prevent overreliance on AI and safeguard academic integrity, data privacy, and teacher autonomy (Filiz et al., 2025; Ogunleye et al., 2024). Moreover, the relatively lower confidence in using GenAI for classroom management and evaluation suggests that teachers require structured opportunities to experiment with AI tools in authentic instructional contexts, supported by mentoring and reflective practice.

At the policy level, the results highlight the importance of embedding GenAI within national teacher professional standards and curriculum frameworks. Rather than positioning GenAI as an optional innovation, educational systems should frame it as a pedagogical support tool that complements teachers' core competencies while reinforcing the central role of human judgment in teaching and learning.

5. CONCLUSION

GenAI is increasingly influencing core teaching practices in K–12 education, particularly lesson planning, implementation, and assessment. This study examined Saudi female K–12 teachers' perceptions of GenAI across these domains and identified the main obstacles limiting its effective use. The findings revealed a high level of agreement on the role of GenAI in lesson planning, indicating that teachers perceive these tools as valuable for structuring lessons, aligning objectives, and addressing diverse learner needs. In contrast, moderate perceptions were reported for lesson implementation and evaluation, suggesting greater caution in applying GenAI during live classroom instruction and student assessment. Teachers also reported significant institutional and technical barriers, most notably weak digital infrastructure, insufficient training, and limited evidence-based guidance.

Notably, no significant differences were found in teachers' perceptions based on years of experience, academic qualifications, or subject specialization, indicating a shared perspective across demographic groups. This finding suggests that effective GenAI integration depends less on individual background characteristics and more on system-level factors, such as access to infrastructure, clear policies, and targeted professional development.

The results support competency-based frameworks that view GenAI as a supportive tool for enhancing, rather than replacing, core teaching skills, particularly in planning and data-informed decision-making. Practically, the findings underscore the need for pedagogically grounded professional development that moves beyond technical training to address classroom implementation, assessment literacy, and ethical use. Educational policymakers and school leaders should prioritize infrastructure development, establish clear guidelines for responsible AI use, and integrate AI literacy into ongoing teacher development programs.

This study has several limitations that should be considered when interpreting the findings. First, the data are based on self-reported perceptions, which may be subject to response bias and may not fully reflect actual classroom practices. Second, the sample is limited to female K–12 teachers within a single geographic context (Saudi Arabia), which may restrict the generalizability of the results to other educational settings or populations. Third, the cross-sectional design captures perceptions at a single point in time and does not account for how teachers' use of GenAI may evolve with increased experience, training, or policy changes. Despite these limitations, the study provides valuable empirical insights that can inform future teacher training initiatives, educational policy, and further research on integrating GenAI to strengthen core teaching competencies in K–12 settings.

Future research should examine how structured professional development influences teachers' use of GenAI in classroom implementation and assessment, particularly regarding feedback, classroom management, and student self-regulation. Longitudinal and mixed-methods studies are also needed to explore how teachers' competencies, ethical awareness, and professional identities evolve as GenAI becomes more embedded in educational practice. Such research would provide deeper insight into how GenAI can be integrated responsibly to strengthen teaching quality and support sustainable educational innovation.

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