



Teachers' Digital Pedagogical Competence and Students' Learning Outcomes in Secondary Schools: An Empirical Study

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Abstract

The rapid integration of digital technologies into education has transformed teaching and learning, making teachers' digital pedagogical competence essential for improving instructional quality and students' learning outcomes. The present study aimed to examine the digital pedagogical competence of secondary school teachers and the level of students' learning outcomes in secondary schools. A descriptive survey method was employed, and the study was conducted on a sample of 200 secondary school teachers and 200 secondary school students selected through the stratified random sampling technique from Guntur District, Andhra Pradesh. Data were collected using two researcher-developed instruments: the Digital Pedagogical Competence Scale (71 items) and the Students' Learning Outcomes Scale (49 items). The reliability of the instruments was established using Cronbach's alpha and the test-retest method. Descriptive statistics, percentage analysis, t-test, ANOVA, and Pearson's correlation were employed for data analysis. The findings revealed that the majority of teachers demonstrated a moderate level of digital pedagogical competence across all six dimensions, namely Digital Literacy and Technical Skills, Instructional Design and Digital Content Creation, Digital Communication and Collaboration, Digital Assessment and Feedback, Ethical and Responsible Use of Technology, and Professional Development and Innovation. Similarly, most students

exhibited a moderate level of learning outcomes. The study highlights the need for continuous professional development, improved digital infrastructure, effective digital assessment practices, and supportive educational policies to strengthen teachers' digital pedagogical competence and enhance students' learning outcomes in secondary education.

Keywords: Digital Pedagogical Competence; Secondary School Teachers; Students' Learning Outcomes; Digital Technology Integration; Secondary Education.

I. Introduction

Digitalization has fundamentally transformed the teaching-learning process by integrating information and communication technologies (ICT) into educational practices. The widespread use of digital devices, learning management systems, cloud-based platforms, and online educational resources has made education more accessible, flexible, and learner-centred. Teachers can now deliver content through multimedia presentations, virtual classrooms, digital assessments, and interactive applications, while students can access learning materials anytime and anywhere. This shift has promoted self-directed learning, collaborative learning, and personalized instruction, enabling learners to develop the knowledge and skills required in the twenty-first century.



Artificial Intelligence (AI) has further accelerated this transformation by introducing intelligent systems that enhance both teaching and learning. AI-powered educational technologies, such as intelligent tutoring systems, adaptive learning platforms, virtual teaching assistants, automated grading systems, and educational chatbots, provide personalized learning experiences based on students' individual needs, learning pace, and performance. These technologies analyse learner data to identify strengths and weaknesses, recommend appropriate learning resources, and provide instant feedback, thereby improving student engagement and academic achievement. AI also supports teachers by reducing administrative workload, allowing them to devote more time to meaningful instructional activities.

The integration of digitalization and AI has significantly improved instructional effectiveness and educational decision-making. Teachers can use learning analytics to monitor students' progress, identify learning gaps, and implement timely interventions. AI-driven predictive analytics assists educators in identifying students who may be at risk of poor academic performance or dropping out, enabling proactive support. Furthermore, digital technologies facilitate collaborative learning through online discussion forums, virtual laboratories, video conferencing, and project-based learning environments, fostering critical thinking, creativity, communication, and problem-solving skills among students.

Despite these advantages, the successful implementation of digitalization and AI in education depends on several critical factors, including teachers' digital pedagogical competence, technological infrastructure, institutional support, and ethical use of AI. Challenges such as the digital divide, data privacy concerns, algorithmic bias, cybersecurity risks, and inadequate teacher training continue to hinder effective integration. Therefore, educational institutions and policymakers must invest in digital infrastructure, professional development programmes, and responsible AI governance to ensure that digital technologies and AI are used effectively, ethically, and equitably. Strengthening teachers' digital pedagogical competence remains essential for maximizing the educational benefits of digitalization and artificial intelligence in secondary education.

II. Conceptual Background

In the era of digitalization and artificial intelligence (AI), the role of teachers has evolved from being mere transmitters of knowledge to facilitators, mentors, and designers of technology-enhanced learning experiences. While digital tools and AI applications provide access to vast educational resources and personalized learning opportunities, their effectiveness largely depends on teachers' active involvement in planning, implementing, and evaluating technology-supported instruction. Teachers who possess strong digital pedagogical competence can effectively integrate digital technologies into classroom practices, select appropriate digital resources, and create engaging learning environments that promote students' cognitive, social, and emotional development. Teacher involvement extends beyond the use of digital devices to include instructional design, classroom interaction, continuous assessment, and learner support. By utilizing digital learning platforms, AI-powered assessment tools, and learning analytics, teachers can monitor students' progress, identify individual learning needs, and provide timely feedback and personalized interventions. Such practices enhance student engagement, motivation, participation, and self-regulated learning. Moreover, teachers play a critical role in developing students' digital literacy, critical thinking, creativity, collaboration, and responsible use of technology, which are essential competencies for success in the twenty-first century.

Students' learning outcomes encompass not only academic achievement but also the acquisition of knowledge, skills, attitudes, problem-solving abilities, and lifelong learning competencies. Effective teacher involvement in digitally enriched classrooms contributes significantly to these outcomes by promoting meaningful learning experiences, encouraging active participation, and supporting differentiated instruction. AI-enabled educational technologies further strengthen this process by providing adaptive learning pathways, real-time feedback, and data-driven insights that assist teachers in making informed instructional decisions. Consequently, students benefit from more personalized, interactive, and inclusive learning experiences that improve both academic performance and higher-order thinking skills.

However, achieving positive learning outcomes through digitalization and AI requires teachers to continuously update their technological, pedagogical, and content knowledge. Professional development programmes, institutional support, adequate digital infrastructure, and favourable educational policies are essential for enhancing teachers' digital pedagogical competence. Without competent teacher involvement, the potential benefits of digital technologies and AI cannot be fully realized. Therefore, teachers remain the central agents



in transforming digital innovations into meaningful educational practices that foster improved student learning outcomes in secondary education.

III. Digital Pedagogical Competence

Digital Pedagogical Competence (DPC) refers to teachers' ability to effectively integrate digital technologies into instructional practices to facilitate meaningful teaching and improve students' learning outcomes. It extends beyond the technical proficiency required to operate digital tools and encompasses the pedagogical knowledge needed to select, design, implement, and evaluate technology-enhanced learning experiences. DPC enables teachers to create engaging, interactive, inclusive, and learner-centred learning environments across face-to-face, blended, and online educational settings (Tretinjak & Andelic, 2016).

Digital pedagogical competence is built upon the integration of technological knowledge, pedagogical knowledge, and content knowledge. Teachers with high levels of DPC can effectively align digital technologies with curriculum objectives, instructional strategies, and learners' diverse needs. They are capable of selecting appropriate digital resources, designing technology-supported learning activities, facilitating collaborative and inquiry-based learning, and employing digital assessment tools to monitor student progress. Such competence also enables teachers to personalize instruction, accommodate different learning styles, and promote students' critical thinking, creativity, communication, collaboration, and problem-solving skills.

A digitally pedagogically competent teacher strategically incorporates various digital technologies, including multimedia resources, educational applications, virtual simulations, learning management systems, artificial intelligence (AI)-supported platforms, online assessment tools, and collaborative learning environments to enrich the teaching-learning process. Rather than using technology as an isolated instructional aid, competent teachers integrate digital tools purposefully to achieve clearly defined learning objectives and enhance students' engagement, participation, and academic performance. They continuously adapt instructional strategies based on students' learning needs, technological contexts, and emerging educational innovations to ensure effective and meaningful learning experiences (Prachi, 2020).

An equally important dimension of digital pedagogical competence is the promotion of students' digital literacy and responsible technology use. Teachers guide learners in critically evaluating online information, practicing ethical and responsible digital behaviour, protecting privacy and cybersecurity, and demonstrating responsible digital citizenship. These competencies are increasingly essential as students interact with digital information, online learning environments, and AI-powered educational technologies in both academic and everyday contexts (Vinay Kumar, 2026).

Given the rapid evolution of digital technologies and artificial intelligence, digital pedagogical competence is not a static skill but a continuous professional learning process. Teachers must regularly update their technological knowledge and pedagogical practices through professional development programmes, online courses, webinars, workshops, and professional learning communities. Continuous capacity building enables educators to remain responsive to emerging educational technologies and innovative teaching practices, thereby enhancing instructional effectiveness and improving students' learning outcomes in the digital age (Sarva et al., 2023).

Improving Digital Pedagogical Competence (DPC) among teachers is essential for promoting effective teaching and meaningful student learning in an increasingly digital educational environment. As digital technologies and artificial intelligence continue to reshape educational practices, teachers must develop both technological proficiency and the pedagogical expertise required to integrate these tools effectively into classroom instruction. Continuous professional development through workshops, webinars, certification programmes, and technology-focused training enables teachers to remain current with emerging educational technologies and innovative instructional strategies (Lim & Hassan, 2018). Equally important is the integration of digital technologies into everyday teaching practices through learning management systems, virtual classrooms, multimedia resources, educational applications, AI-supported platforms, and online collaborative tools, which provide teachers with practical experience and enhance their confidence in technology-enhanced instruction (Alwan, 2025). Strengthening digital literacy—including information management, digital communication, cybersecurity, ethical technology use, and digital citizenship—further equips teachers to make informed decisions regarding the selection and effective use of digital resources in teaching and assessment.



The development of digital pedagogical competence also requires collaborative learning opportunities, institutional support, and a commitment to continuous professional growth. Participation in professional learning communities, peer mentoring, and online educator networks encourages the sharing of best practices, innovative instructional approaches, and practical solutions to technology-related challenges. Educational institutions play a crucial role by providing reliable digital infrastructure, access to technological resources, technical support, and a supportive environment that encourages experimentation with innovative teaching methods. Teachers should also develop pedagogical strategies that effectively integrate technology into collaborative, inquiry-based, problem-based, blended, and flipped learning models while employing digital assessment tools such as online quizzes, e-portfolios, learning analytics, and digital rubrics to monitor student progress and provide timely feedback. Regular reflection on technology-integrated teaching practices, combined with constructive feedback from students and colleagues, enables teachers to refine their instructional approaches and continuously improve their effectiveness. Since digital technologies evolve rapidly, digital pedagogical competence should be viewed as a lifelong professional learning process that requires adaptability, continuous skill enhancement, and a willingness to embrace innovation. By strengthening these competencies, teachers can create engaging, inclusive, and learner-centred educational environments that enhance students' academic achievement and prepare them for success in the digital society.

IV. Students' Learning Outcomes

Students' learning outcomes refer to the measurable knowledge, skills, attitudes, and competencies that learners are expected to acquire as a result of participating in educational activities. They provide evidence of the extent to which instructional objectives have been achieved and reflect students' cognitive, behavioural, and affective development. In contemporary education, particularly in technology-enhanced learning environments, learning outcomes extend beyond academic achievement to include critical thinking, communication, collaboration, self-regulation, and lifelong learning competencies. The integration of digital technologies and innovative pedagogical practices has broadened the scope of learning outcomes, enabling students to develop essential twenty-first-century skills. The present study conceptualizes students' learning outcomes through five interrelated dimensions.

a. Academic Understanding and Knowledge Gain

Academic understanding and knowledge gain refer to the extent to which students acquire, comprehend, retain, and apply subject-specific concepts and information. This dimension emphasizes meaningful learning rather than rote memorization, enabling students to analyse, interpret, synthesize, and evaluate knowledge in different contexts. Technology-enhanced instructional strategies, multimedia resources, virtual simulations, and AI-supported learning platforms facilitate deeper conceptual understanding by presenting content in interactive and personalized ways. Effective teaching practices that integrate digital technologies enable students to strengthen their academic performance while developing higher-order cognitive abilities.

b. Skill Development

Skill development encompasses the acquisition of practical, cognitive, technological, and problem-solving abilities that enable students to perform academic and real-life tasks effectively. In addition to subject-specific competencies, students develop digital literacy, information management, critical thinking, creativity, decision-making, and technological skills through digitally enriched learning environments. Teachers who effectively integrate digital pedagogical approaches provide opportunities for inquiry-based learning, project work, collaborative problem-solving, and authentic learning experiences, thereby preparing students for future educational and professional challenges.

c. Engagement and Motivation

Engagement and motivation refer to students' active participation, interest, enthusiasm, and commitment toward learning activities. Engaged learners demonstrate sustained attention, curiosity, persistence, and willingness to participate in classroom discussions and collaborative tasks. Digital technologies, interactive multimedia, gamified learning environments, adaptive learning systems, and immediate feedback mechanisms enhance students' intrinsic and extrinsic motivation by making learning more relevant, personalized, and enjoyable. High levels of engagement contribute to improved academic achievement, deeper learning, and greater satisfaction with the educational experience.



d. Collaboration and Communication

Collaboration and communication represent students' ability to work effectively with peers, teachers, and learning communities while expressing ideas clearly through multiple forms of communication. Digital learning environments provide numerous opportunities for collaborative learning through online discussion forums, shared documents, virtual classrooms, collaborative projects, and video conferencing platforms. These experiences help students develop teamwork, interpersonal communication, leadership, negotiation, and conflict-resolution skills. Effective collaboration also promotes knowledge sharing, collective problem-solving, and the exchange of diverse perspectives, thereby enriching the overall learning process.

e. Reflection and Self-Directed Learning

Reflection and self-directed learning refer to students' ability to evaluate their own learning processes, identify strengths and areas for improvement, set learning goals, and independently regulate their academic progress. Self-directed learners take responsibility for planning, monitoring, and assessing their learning while utilizing appropriate digital resources to achieve educational objectives. Reflective practices, such as digital portfolios, online journals, formative assessments, and AI-supported personalized feedback, encourage students to think critically about their learning experiences and continuously improve their performance. This dimension fosters lifelong learning habits, adaptability, metacognitive awareness, and independent learning skills, all of which are essential for success in the rapidly evolving digital world.

V. Need and Significance of the study

The integration of digital technologies into education has transformed the way students learn and teachers facilitate instruction. However, the effectiveness of technology-enhanced learning largely depends on teachers' digital pedagogical competence, which enables them to design, implement, and evaluate meaningful learning experiences. Teachers who effectively integrate digital technologies can enhance students' academic understanding by presenting complex concepts through multimedia resources, virtual simulations, interactive content, and AI-supported learning platforms. Such technology-supported instructional practices promote deeper conceptual understanding, improve knowledge retention, and encourage the application of learning to real-life situations. Nevertheless, the successful achievement of these outcomes remains challenging due to inadequate teacher training, limited pedagogical support, insufficient technological infrastructure, and unequal access to digital resources (Yadav, 2020; Ntuli & Nyarambi, 2018). These barriers often prevent teachers from utilizing technology in ways that maximize students' academic learning and cognitive development.

Beyond academic achievement, digital pedagogical competence plays a significant role in fostering students' skill development. Technology-integrated instruction provides opportunities for learners to develop digital literacy, critical thinking, creativity, problem-solving, communication, and information management skills that are essential for success in the twenty-first century. Teachers who employ inquiry-based learning, project-based activities, virtual laboratories, and digital collaboration tools enable students to acquire practical competencies while actively constructing knowledge. However, differences in teachers' confidence, technological expertise, and willingness to adopt innovative instructional practices can limit the development of these essential skills. Resistance to change, concerns regarding cybersecurity, classroom management, and varying levels of students' digital readiness further complicate effective technology integration (Johnson et al., 2016).

Teachers' digital pedagogical competence also has a direct influence on students' engagement, motivation, collaboration, and communication. Interactive digital resources, gamified learning environments, educational applications, online discussion forums, and collaborative platforms create dynamic and learner-centred classrooms where students actively participate in learning activities. Such environments encourage teamwork, knowledge sharing, peer interaction, and meaningful communication while increasing learners' motivation and sustained engagement. Personalized learning environments supported by artificial intelligence and adaptive technologies further enhance students' interest by accommodating diverse learning needs and providing immediate feedback. At the same time, teachers benefit from digital assessment tools and learning analytics that enable continuous monitoring of student progress and evidence-based instructional decision-making, ultimately contributing to improved learning outcomes (Lim et al., 2023).

Another important contribution of digital pedagogical competence is its ability to promote reflection and self-directed learning among students. Through digital portfolios, online journals, self-assessment tools, adaptive



learning platforms, and AI-generated feedback, students become more responsible for planning, monitoring, and evaluating their own learning. These practices foster metacognitive awareness, independent learning habits, and lifelong learning competencies that are increasingly important in a rapidly evolving digital society. Achieving these outcomes, however, requires sustained professional development, institutional support, collaborative learning communities, and continuous innovation in teaching practices. Therefore, strengthening teachers' digital pedagogical competence is essential for improving students' academic understanding and knowledge gain, skill development, engagement and motivation, collaboration and communication, and reflection and self-directed learning. In this context, the present study is undertaken to empirically examine teachers' digital pedagogical competence and its impact on students' learning outcomes in secondary schools, thereby generating evidence-based insights to support educational improvement and technology-enhanced teaching practices.

VI. Review of related literature

The review of related literature indicates that digital pedagogical competence is a crucial determinant of effective teaching and improved students' learning outcomes in contemporary education. Studies consistently demonstrate that teachers who possess strong digital pedagogical competence are better able to integrate technology into instructional practices, resulting in enhanced student engagement, academic achievement, and the development of twenty-first-century skills. Vinay Kumar Cherukuri (2026) reported that teachers with higher levels of digital pedagogical competence exhibited greater teacher effectiveness and were more successful in promoting student engagement and meaningful learning. Similarly, Kiryakova and Kozhuharova (2024) found that teachers actively employed digital technologies for content delivery, collaborative learning, assessment, and timely feedback, thereby creating interactive and learner-centred classroom environments. Guillén-Gámez et al. (2020) observed that teachers' pedagogical digital competence varied significantly according to age and gender, whereas educational stage showed no significant influence. Likewise, Orakova et al. (2024) reported that digital literacy significantly predicted teachers' pedagogical and technological competencies, with notable variations across gender and professional experience. Tzafilkou et al. (2023) also identified significant differences in teachers' digital competence across demographic and professional characteristics, highlighting the need for continuous professional development.

The literature further suggests that teachers' digital pedagogical competence has a direct and positive influence on students' learning outcomes. Trust and Whalen (2020) emphasized that teachers' ability to integrate digital technologies effectively enhances students' engagement, collaboration, communication, and self-directed learning, particularly in technology-rich learning environments. Hattie (2009) identified teacher quality and instructional effectiveness as among the strongest predictors of students' academic achievement, indicating that competent technology integration can further strengthen these outcomes. The meta-analysis by Tamim et al. (2011) concluded that technology integration has a positive effect on students' academic performance when supported by appropriate pedagogical practices. Furthermore, Fraillon et al. (2019) reported that effective digital teaching practices contribute significantly to students' digital literacy, problem-solving abilities, and higher-order thinking skills. Collectively, these studies demonstrate that digitally competent teachers positively influence multiple dimensions of students' learning outcomes, including academic understanding and knowledge gain, skill development, engagement and motivation, collaboration and communication, and reflection and self-directed learning. Despite this growing body of international evidence, empirical research examining the relationship between teachers' digital pedagogical competence and students' learning outcomes in the Indian secondary school context remains limited. In particular, studies investigating variations in teachers' digital pedagogical competence with respect to demographic variables such as gender and locality, along with its impact on students' multidimensional learning outcomes, are scarce. Therefore, the present study seeks to address this research gap by empirically examining teachers' digital pedagogical competence and its influence on students' learning outcomes in secondary schools.

VII. Objectives

1. To find out the Digital Pedagogical Competence of Secondary School Teachers with respect to the following dimensions: a. Digital Literacy and Technical Skills, b. Instructional Design and Digital Content Creation, c. Digital Communication and Collaboration, d. Digital Assessment and Feedback e. Ethical and Responsible Use of Technology, f. Professional Development and Innovation



2. To find out the level of Students' Learning Outcomes in Secondary Schools and to classify them.

VIII. Methodology

The present study was conducted on a sample of 200 secondary school teachers and 200 secondary school students selected from Guntur District, Andhra Pradesh, using the stratified random sampling technique. A descriptive survey method was adopted to collect quantitative data on teachers' digital pedagogical competence and students' learning outcomes. Data were collected using two researcher-developed instruments: the Digital Pedagogical Competence Scale (DPCS) consisting of 71 items, and the Students' Learning Outcomes Scale (SLOS) comprising 49 items. The Digital Pedagogical Competence Scale measured teachers' competence in integrating digital technologies into pedagogical practices, whereas the Students' Learning Outcomes Scale assessed five dimensions of learning outcomes, namely academic understanding and knowledge gain, skill development, engagement and motivation, collaboration and communication, and reflection and self-directed learning.

The reliability of both instruments was established using Cronbach's alpha and the test-retest method. The Digital Pedagogical Competence Scale yielded a Cronbach's alpha coefficient of 0.89, indicating high internal consistency, while the test-retest reliability coefficient was 0.79, demonstrating satisfactory temporal stability. Similarly, the Students' Learning Outcomes Scale exhibited a Cronbach's alpha coefficient of 0.91, reflecting excellent internal consistency, and a test-retest reliability coefficient of 0.86, indicating high stability over time. These reliability coefficients confirm that both instruments are psychometrically sound and reliable for assessing teachers' digital pedagogical competence and students' learning outcomes in secondary schools.

IX. Data Analysis

The collected data were analysed using appropriate descriptive and inferential statistical techniques. Descriptive statistics, including the Mean (M) and Standard Deviation (SD), were computed to determine the levels of teachers' digital pedagogical competence and students' learning outcomes. An empirical classification based on the Mean $\pm$ 1 Standard Deviation criterion was employed to categorize the respondents. Scores below (M – 1SD) were classified as indicating a low level, scores between (M – 1SD) and (M + 1SD) were classified as indicating a moderate level, and scores above (M + 1SD) were classified as indicating a high level of digital pedagogical competence and students' learning outcomes. This classification was applied to the overall scores as well as to the respective dimensions of both constructs to facilitate meaningful interpretation of the findings.

Objective 1: To find out the Digital Pedagogical Competence of Secondary School Teachers with respect to the following dimensions:

- Digital Literacy and Technical Skills,
- Instructional Design and Digital Content Creation
- Digital Communication and Collaboration,
- Digital Assessment and Feedback
- Ethical and Responsible Use of Technology,
- Professional Development and Innovation

Table 1. Classification of secondary school teachers based on Digital Literacy and Technical Skills

Sl.No.	Score Range	Category	Sample	%
1	69.37 and above ($\geq M + 1SD$)	High level	33	16.5
2	62.57 to 69.37 (between M – 1SD and M + 1SD)	Moderate level	167	83.5
3	62.57 and Below ($\leq M - 1SD$)	Low level	0	0
			200	100

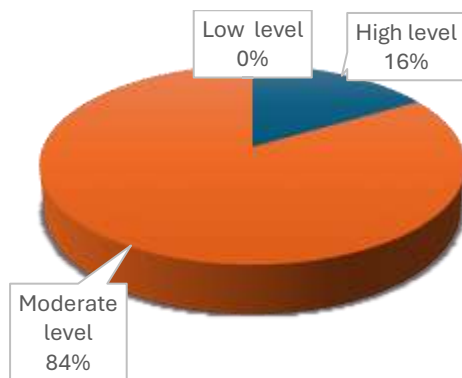


Figure 1. Classification of secondary school teachers based on Digital Literacy and Technical Skills Interpretation

Table 1 presents the classification of secondary school teachers according to their level of Digital Literacy and Technical Skills, one of the dimensions of Digital Pedagogical Competence. The results indicate that the majority of the teachers ($n = 167$, 83.5%) possessed a moderate level of digital literacy and technical skills, whereas 33 teachers (16.5%) demonstrated a high level of competence. Notably, none of the teachers (0.0%) fell into the low-level category.

Table 2. Classification of secondary school teachers based on Instructional Design and Digital Content Creation

Sl.No.	Score Range	Category	Sample	%
1	53.2 and above ($\geq M + 1SD$)	High level	25	12.5
2	49.08 to 53.2 (between $M - 1SD$ and $M + 1SD$)	Moderate level	175	87.5
3	49.08 and Below ($\leq M - 1SD$)	Low level	0	0
			200	100

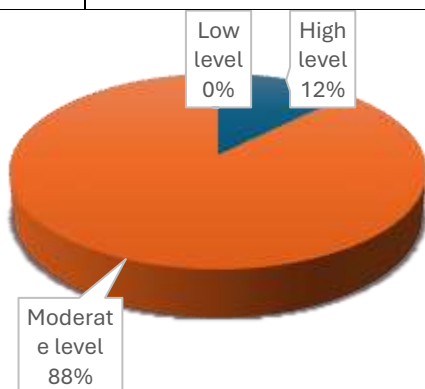


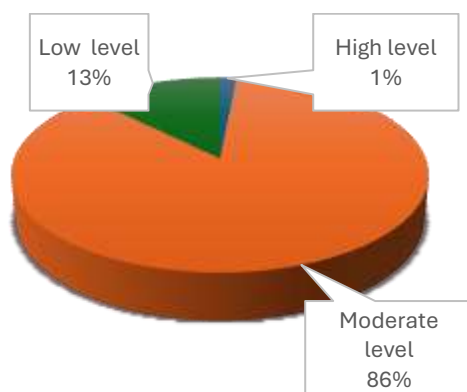
Figure 2. Classification of secondary school teachers based on Instructional Design and Digital Content Creation

Interpretation

Table 2 presents the classification of secondary school teachers based on the Instructional Design and Digital Content Creation dimension of Digital Pedagogical Competence. The findings reveal that the majority of the teachers ($n = 175$, 87.5%) demonstrated a moderate level of competence in instructional design and digital content creation. A smaller proportion of teachers ($n = 25$, 12.5%) exhibited a high level of competence, while none of the teachers (0.0%) were classified as having a low level of competence.

**Table 3. Classification of secondary school teachers based on Digital Communication and Collaboration**

Sl.N o.	Score Range	Category	Sample	%
1	52.27 and above ($\geq M + 1SD$)	High level	3	1.5
2	47.17 to 52.27 (between $M - 1SD$ and $M + 1SD$)	Moderate level	172	86.0
3	47.17 and Below ($\leq M - 1SD$)	Low level	25	12.5
			200	100

**Figure 3. Classification of secondary school teachers based on Digital Communication and Collaboration**

Interpretation

Table 3 presents the classification of secondary school teachers based on the Digital Communication and Collaboration dimension of Digital Pedagogical Competence. The findings indicate that a substantial majority of the teachers ($n = 172$, 86.0%) demonstrated a moderate level of digital communication and collaboration competence. A relatively small proportion of teachers ($n = 25$, 12.5%) fell into the low-level category, whereas only 3 teachers (1.5%) exhibited a high level of competence.

Table 4. Classification of secondary school teachers based on Digital Assessment and Feedback

Sl.N o.	Score Range	Category	Sample	%
1	48.82 and above ($\geq M + 1SD$)	High level	0	0
2	41.82 to 48.82 (between $M - 1SD$ and $M + 1SD$)	Moderate level	158	79.0
3	41.82 and Below ($\leq M - 1SD$)	Low level	42	21.0
			200	100

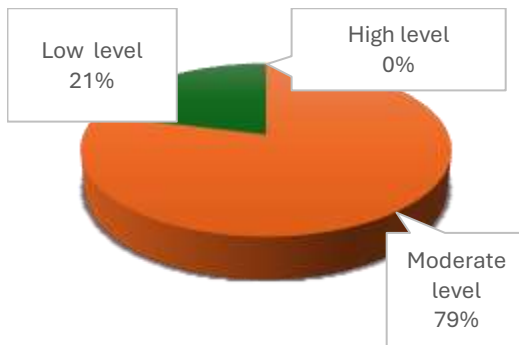


Figure 4. Classification of secondary school teachers based on Digital Assessment and Feedback

Interpretation

Table 4 presents the classification of secondary school teachers based on the Digital Assessment and Feedback dimension of Digital Pedagogical Competence. The findings reveal that the majority of the teachers ($n = 158$, 79.0%) demonstrated a moderate level of competence in digital assessment and feedback. In contrast, 42 teachers (21.0%) were classified as having a low level of competence, while none of the teachers (0.0%) exhibited a high level of competence in this dimension.

The results indicate that although most secondary school teachers possess a moderate ability to use digital technologies for assessing student learning and providing feedback, a considerable proportion still demonstrates limited competence in this area. The absence of teachers in the high-competence category suggests that advanced practices, such as the effective use of online assessment platforms, digital rubrics, automated feedback systems, learning analytics, and technology-supported formative assessment, are not yet widely adopted. Furthermore, the presence of 21.0% of teachers in the low-competence category highlights the need for targeted professional development programmes that emphasize the design and implementation of digital assessment strategies and timely, data-driven feedback. Strengthening teachers' competence in digital assessment and feedback will support more effective monitoring of students' progress, facilitate personalized learning, and contribute to improved academic achievement and overall learning outcomes.

Table 5. Classification of secondary school teachers based on Ethical and Responsible Use of Technology

Sl.No.	Score Range	Category	Sample	%
1	51.23 and above ($\geq M + 1SD$)	High level	0	0
2	42.89 to 51.23 (between $M - 1SD$ and $M + 1SD$)	Moderate level	146	73.0
3	42.89 and Below ($\leq M - 1SD$)	Low level	54	27.0
			200	100

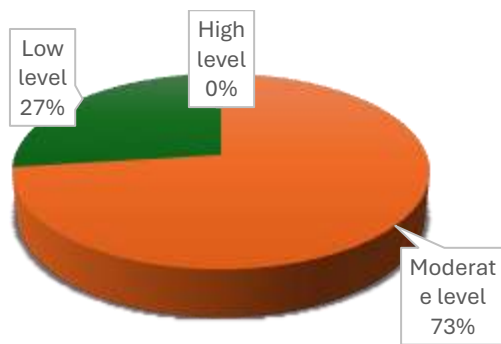


Figure 5. Classification of secondary school teachers based on Ethical and Responsible Use of Technology

Interpretation

Table 5 presents the classification of secondary school teachers based on the Ethical and Responsible Use of Technology dimension of Digital Pedagogical Competence. The findings indicate that the majority of the teachers ($n = 146$, 73.0%) demonstrated a moderate level of competence in the ethical and responsible use of technology. However, 54 teachers (27.0%) were classified as having a low level of competence, while none of the teachers (0.0%) attained a high level of competence in this dimension.

Table 6. Classification of secondary school teachers based on Professional Development and Innovation

Sl.No.	Score Range	Category	Sample	%
1	460.43 and above ($\geq M + 1SD$)	High level	18	9.0
2	38.59 to 46.43 (between $M - 1SD$ and $M + 1SD$)	Moderate level	130	65.0
3	38.59 and Below ($\leq M - 1SD$)	Low level	52	26.0
			200	100

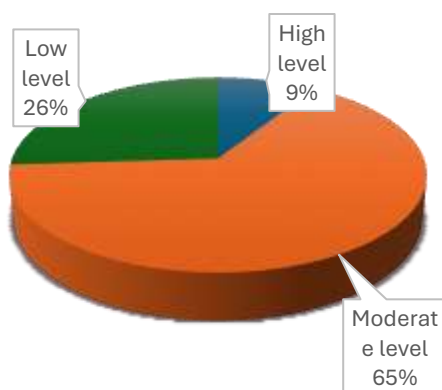


Figure 6. Classification of secondary school teachers based on Professional Development and Innovation

Interpretation

Table 6 presents the classification of secondary school teachers based on the Professional Development and Innovation dimension of Digital Pedagogical Competence. The findings indicate that the majority of the teachers ($n = 130$, 65.0%) demonstrated a moderate level of competence in professional development and



innovation. A smaller proportion of teachers ($n = 18$, 9.0%) exhibited a high level of competence, whereas 52 teachers (26.0%) were classified as having a low level of competence.

X. Findings

1. The majority of secondary school teachers (83.5%) exhibited a moderate level of Digital Literacy and Technical Skills, while 16.5% demonstrated a high level of competence.
2. Most secondary school teachers (87.5%) possessed a moderate level of Instructional Design and Digital Content Creation, with 12.5% exhibiting a high level.
3. A majority of teachers (86.0%) demonstrated a moderate level of Digital Communication and Collaboration, whereas 12.5% exhibited a low level and only 1.5% a high level.
4. Most teachers (79.0%) showed a moderate level of Digital Assessment and Feedback, while 21.0% demonstrated a low level of competence.
5. The majority of teachers (73.0%) possessed a moderate level of Ethical and Responsible Use of Technology, whereas 27.0% exhibited a low level of competence.
6. Most teachers (65.0%) demonstrated a moderate level of Professional Development and Innovation, while 26.0% exhibited a low level and 9.0% a high level of competence.

Objective 2: To find out the level of Students' Learning Outcomes in Secondary Schools and to classify them.

Table 7. Classification of secondary school Students' Learning Outcomes

Sl.No.	Score Range	Category	Sample	%
1	188.18 and above ($\geq M + 1SD$)	High level	32	16.0
2	157.7 to 188.18 (between $M - 1SD$ and $M + 1SD$)	Moderate level	137	68.5
3	157.7 and Below ($\leq M - 1SD$)	Low level	31	15.5
			200	100

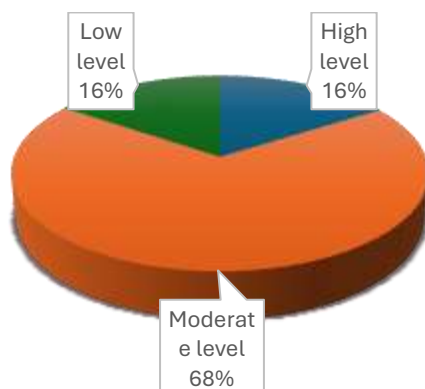


Figure 7. Classification of secondary school Students' Learning Outcomes

Interpretation

Table 7 presents the classification of secondary school students based on their overall Students' Learning Outcomes. The findings reveal that the majority of the students ($n = 137$, 68.5%) demonstrated a moderate level of learning outcomes. In contrast, 32 students (16.0%) were classified as having a high level of learning outcomes, while 31 students (15.5%) fell into the low-level category.

Finding:

The majority of secondary school students (68.5%) exhibited a moderate level of learning outcomes, while 16.0% demonstrated a high level and 15.5% exhibited a low level of learning outcomes.



XI. Discussion of Findings

1. Digital Literacy and Technical Skills

The study found that the majority of secondary school teachers (83.5%) demonstrated a moderate level of digital literacy and technical skills, while 16.5% exhibited a high level of competence. This finding suggests that most teachers possess the fundamental technological skills required to use digital devices, educational software, and online learning platforms in classroom instruction. However, the relatively small proportion of highly competent teachers indicates that advanced digital skills are not yet widespread. This finding is consistent with the studies of Guillén-Gámez et al. (2020) and Orakova et al. (2024), who reported that teachers generally exhibit moderate levels of digital competence and require continuous professional development to strengthen their technological capabilities.

2. Instructional Design and Digital Content Creation

The findings revealed that 87.5% of teachers demonstrated a moderate level of competence in instructional design and digital content creation, whereas 12.5% exhibited a high level. This indicates that teachers are capable of integrating digital resources into lesson planning and instructional activities but require additional support to develop innovative and interactive digital learning materials. The findings are in agreement with Kiryakova and Kozuharova (2024), who emphasized that teachers increasingly use digital technologies for instructional planning and content delivery but continue to require training in designing high-quality digital learning experiences.

3. Digital Communication and Collaboration

The study revealed that 86.0% of teachers demonstrated a moderate level of digital communication and collaboration, while only 1.5% achieved a high level and 12.5% exhibited a low level. These findings indicate that although teachers are generally familiar with digital communication tools, relatively few effectively utilize collaborative digital platforms to facilitate interactive learning. This finding supports the observations of Tzafilkou et al. (2023), who reported variations in teachers' digital communication competencies and highlighted the importance of strengthening collaborative digital practices through professional development.

4. Digital Assessment and Feedback

The findings indicated that 79.0% of teachers possessed a moderate level of competence in digital assessment and feedback, whereas 21.0% demonstrated a low level and none achieved a high level. This suggests that digital assessment remains one of the comparatively weaker dimensions of teachers' digital pedagogical competence. Many teachers may still rely on conventional assessment methods rather than technology-supported assessment tools. This finding is consistent with Lim and Hassan (2018), who emphasized that teachers require specialized training to effectively use digital assessment tools, online feedback systems, and learning analytics for improving student learning.

5. Ethical and Responsible Use of Technology

The results showed that 73.0% of teachers demonstrated a moderate level of competence in the ethical and responsible use of technology, while 27.0% exhibited a low level and none attained a high level. This finding suggests that although teachers possess a basic understanding of ethical technology use, there remains a considerable need to strengthen competencies related to digital citizenship, cybersecurity, data privacy, copyright, and responsible use of artificial intelligence. The findings are consistent with recent research emphasizing that ethical digital competence has become an essential component of effective digital pedagogy in modern education.

6. Professional Development and Innovation

The study found that 65.0% of teachers exhibited a moderate level of competence in professional development and innovation, while 26.0% demonstrated a low level and only 9.0% achieved a high level. These findings indicate that teachers participate in professional learning activities to some extent but may not consistently engage in advanced digital training or innovative instructional practices. This finding supports the work of Lim et al. (2023), who emphasized that continuous professional development and participation in professional learning communities are essential for strengthening teachers' digital pedagogical competence and promoting innovative teaching practices.



7. Students' Learning Outcomes

The findings revealed that the majority of secondary school students (68.5%) demonstrated a moderate level of learning outcomes, while 16.0% exhibited a high level and 15.5% demonstrated a low level. This suggests that most students possess satisfactory levels of academic understanding, skill development, engagement, collaboration, and self-directed learning; however, there remains scope for further improvement. The findings are consistent with Tamim et al. (2011), who concluded that effective integration of digital technologies can positively influence students' academic achievement and learning outcomes when supported by appropriate pedagogical practices. Similarly, Trust and Whalen (2020) emphasized that teachers' effective use of digital pedagogical strategies enhances student engagement, collaboration, and self-directed learning in technology-enhanced educational environments.

XII. Educational Implications

1. Educational institutions should organize regular professional development programmes to strengthen teachers' digital pedagogical competence.
2. Teacher education curricula should integrate digital pedagogy and AI-based instructional practices as core components.
3. Schools should promote the use of digital assessment and feedback tools to enhance students' learning outcomes.
4. Teachers should be trained in ethical technology use, digital citizenship, cybersecurity, and responsible AI practices.
5. Governments and school managements should provide adequate digital infrastructure and technical support for effective technology integration.
6. Teachers should adopt learner-centred digital pedagogies that foster students' academic understanding, skills, engagement, collaboration, and self-directed learning.
7. Schools should encourage continuous professional learning through workshops, mentoring, and professional learning communities.
8. Educational policymakers should formulate policies that support teachers' digital competence and sustainable technology integration in secondary education.

XIII. Conclusion

The present study concludes that secondary school teachers generally possess a moderate level of digital pedagogical competence across the dimensions of digital literacy and technical skills, instructional design and digital content creation, digital communication and collaboration, digital assessment and feedback, ethical and responsible use of technology, and professional development and innovation. Similarly, secondary school students demonstrated a moderate level of learning outcomes, indicating satisfactory achievement in academic understanding, skill development, engagement and motivation, collaboration and communication, and reflection and self-directed learning. The findings highlight that while teachers have developed foundational digital competencies, there is considerable scope for strengthening advanced digital pedagogical practices, particularly in digital assessment, ethical technology use, and continuous professional development. Therefore, sustained professional training, improved digital infrastructure, supportive educational policies, and the effective integration of technology into classroom practices are essential to enhance teachers' digital pedagogical competence and promote improved students' learning outcomes in secondary education.

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