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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

AI-Enhanced Lesson Study: Transforming Teacher Professional Development

Yapay Zeka Destekli Ders Araştırması: Öğretmenlerin Mesleki Gelişiminin Dönüşümü

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Abstract

This study examines the integration of Artificial Intelligence (AI) into the Lesson Study (LS) model as an innovative approach to teacher professional development. LS, a collaborative learning model, allows teachers to systematically plan, implement, observe, and refine their teaching practices. Advances in AI offer new opportunities by providing data-driven insights, personalized feedback, and adaptive learning strategies. Through a systematic literature review, this study explores how AI-supported LS enhances teacher education and student learning. Key themes include AI's role in real-time feedback, data-driven lesson planning, and improved teacher collaboration. Challenges such as digital literacy, ethical concerns, and the need for structured implementation are also discussed. Findings indicate that AI-supported LS optimizes decision-making, fosters reflective teaching, and personalizes student learning. However, effective implementation requires training, institutional support, and integration into existing structures. AI-enhanced LS holds promise for professional development while preserving the model's collaborative essence.

Keywords: AI, AI in education, collaborative learning, LS, teacher professional development.

Öz

Bu çalışma, Yapay Zeka'nın (YZ) ders araştırması (LS) modeline öğretmen mesleki gelişimine yönelik yenilikçi bir yaklaşım olarak entegrasyonunu incelemektedir. İşbirlikçi bir öğrenme modeli olan ders araştırması, öğretmenlerin öğretim uygulamalarını sistematik olarak planlamalarına, uygulamalarına, gözlemlemelerine ve iyileştirmelerine olanak tanır. Yapay zekadaki gelişmeler, veri odaklı içgörüler, kişiselleştirilmiş geri bildirim ve uyarlanabilir öğrenme stratejileri sağlayarak yeni fırsatlar sunar. Sistematik bir literatür incelemesi yoluyla, bu çalışma YZ destekli ders araştırmasının öğretmen

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eğitimini ve öğrenci öğrenimini nasıl geliştirdiğini araştırmaktadır. Temel temalar arasında YZ'nin gerçek zamanlı geri bildirimdeki rolü, veri odaklı ders planlaması ve geliştirilmiş öğretmen işbirliği yer almaktadır. Dijital okuryazarlık, etik kaygılar ve yapılandırılmış uygulamaya duyulan ihtiyaç gibi zorluklar da tartışılmaktadır. Bulgular, YZ destekli ders araştırmasının karar almayı optimize ettiğini, yansıtıcı öğretimi teşvik ettiğini ve öğrenci öğrenimini kişiselleştirdiğini göstermektedir. Ancak, etkili uygulama eğitim, kurumsal destek ve mevcut yapılara entegrasyon gerektirir. YZ destekli ders araştırması, modelin işbirlikçi özünü korurken mesleki gelişim için umut vaat etmektedir.

Anahtar Kelimeler: yapay zeka, eğitimde YZ, işbirlikli öğrenme, ders araştırması, öğretmenlerin mesleki gelişimi.

INTRODUCTION

Learning is a process in which the individual has a role to better understand his/her environment and at the same time develops ways of learning in order to change the world in which he/she lives. In the learning process, the individual is exposed to many options and choices. Therefore, the learning process is a reflection of one's relationship with other individuals and a roadmap that shapes one's own life. The learning process focuses on the questions "how does one learn best" and "how do other individuals realize their own learning using one or more perspectives". Globally, our education systems focus on enabling children to develop their own individual learning styles and strategies, while at the same time systematizing learning processes for society. Learning is an individualized process through which individuals make sense of their environment and mission (Ramphele, 2015).

Learning is also built on the boundaries of educational systems. The education system limits learning to learning tools such as reading, writing and math. If teaching is considered as a system, it provides information about what teaching does as a whole rather than evaluating each feature of teaching in isolation. What is important is how all the features act together as a whole. Individual features of teaching are highly relevant to how individuals surround each other. The value of the features of teaching depends on their interconnectedness and fit within the lesson (Stigler & Hiebert, 1999). According to Stigler and Hiebert (1999), teaching is a cultural activity, like a family dinner. Teaching takes place with informal participation over a long period of time. In this context, a successful person is one who has a clear knowledge of right and wrong, is self-confident, adaptable, self-aware, able to think freely and critically, and able to communicate effectively. This approach to learning enables individuals to find their vocation and role in their own lives. Therefore, education systems should offer elements that are connected to the world in a global dimension. The nature of the tasks and systems of educational institutions from pre-school to higher education need to change to develop a more creative and open environment. Schools and other learning institutions are the center of society.

Therefore, the learning process should take shape from the community and influence the environment as part of an open learning laboratory (Ramphele, 2015). This is also the nature of teacher education. Within this approach, teachers are the creators and providers of lifelong learning. Each teacher sees teaching as a profession for the existence of the world. Accordingly,

society must create the environment that enables the teaching profession to be realized while at the same time providing the environment for pre-service and in-service training (Ramphele, 2015).

Preparing teachers to learn from their teaching throughout their careers requires the development of systematic practices and skills, deliberate inquiry/research and critical reflection. While many teacher educators focus on the development of these skills, they emphasize that pre-service teachers should focus on journals and activities related to their teaching practices and systematic research in the classroom and school (Gore & Zeichner, 1991; Price, 2001). In this way, pre-service teachers will be in constant questioning about what/why they learn and what they can do when they encounter practice, and how they can overcome the limitations they encounter depending on their experiences in practice.

The entire teacher education program is seen as the starting point for pre-service teachers to learn and to understand their role in their own lifelong learning. Teacher education is crucial for the qualification of teachers. Increasing teacher quality is highly related to the currency and openness to improvement of teacher education programs. For this reason, teacher education programs should always focus on moving forward by seeking answers to what qualities are desired in teachers (Bayrak-Özmutlu, 2018).

Teacher education programs are very important for teachers to prepare future generations. Teacher education programs enable prospective teachers to gain skills in content, managing classroom activities, communicating effectively, incorporating technology into teaching, and reflecting on practice for continuous improvement (Allen, Hancock, Starker-Glass &Lewis, 2017).

Little (1987) defines professional development as all activities in schools that are organized and staffed to prepare teachers to improve their current or future performance. This perspective envisions teachers' informal and formal learning communities working as a powerful mechanism for teacher growth and development. These new conceptualizations of professional development develop professional development in both its individual and organizational dimensions. According to Cobb (1994), "learning is the process of active individual construction and its feeding into broader social practices". Similarly, Borko (2004) notes that many descriptions of the content of teacher learning explicitly state that it challenges and measures teacher education. For teachers, learning occurs in many practice settings such as classrooms, school communities and professional development courses or workshops. Learning can also take place when talking with a colleague or when seeking solutions for groups of students with problem behaviors after school. To understand teacher learning in this context, both the individual teacher-learner relationship and the social systems in which they participate need to be considered together.

This kind of professional development is directly related to the work of teaching, guiding, managing and reflecting on teaching. Most powerful teacher learning experiences occur in the teacher's own classroom through the analysis of the teacher's own experiences. Another dimension of teacher professional development is teachers' individual activities. Individual activities may include teacher's educational online practices or action research (Desimone, 2009). However, under

the umbrella of professional development, teachers are expected to be involved in development processes by selecting new textbooks or helping with school development plans. Teachers can create opportunities for learning for themselves by teaching lessons, conducting assessments, reviewing the curriculum, or reading professional journals. All these examples draw attention to the ongoing nature of professional development, which should be part of teachers' daily lives.

Studies over the last 30 years have put forward a framework that includes critical features of professional development (Fernandez, Cannon & Choksi, 2003; Desimone, 2009, Avalos, 2011; Sales, Traver & Garcia, 2011). Professional development should be shaped towards increasing teachers' knowledge and skills, thus improving their practices and increasing student achievement. In this context, professional development focuses on content-oriented, active learning, coherence, duration and collaborative participation.

Understanding how teachers work with each other and how they share their practices in the learning process is particularly important for learning and communities of practice to coach each other in the learning process. In this context, quantitative and ethnographic studies suggest that teachers help each other to reveal their identities, teaching purposes and meaning-making (Hofman & Dijkstra, 2010; Niesz, 2010). Different studies on LS, which is one of the peer learning experiences of teachers through mutual collaboration and feedback, examine the impact, effectiveness and collaboration of teaching improvement (Fernandez et al., 2003; Punchner & Taylor, 2006; Lee, 2008; Cheng & Yee, 2012; Bayar, 2014).

Lesson study is a professional learning model in which teachers collaboratively plan, implement, monitor and evaluate their lessons. This model allows teachers to continuously review and improve their teaching practices. Vygotsky's Social Learning Theory and Shulman's Pedagogical Content Knowledge (PCK) theories argue that LS contributes to teachers' professional development.

Vygotsky (1978) emphasizes that learning is a social process and that teachers sharing their experiences by interacting with other teachers will enrich the learning process. LS allows teachers to increase their professional knowledge by discussing their experiences collectively. Shulman (1986) states that pedagogical content knowledge is an important factor in how teachers relate to course materials and how the course should be presented. LS allows teachers to reflect on lesson content and teaching strategies and to gain practical experience.

The integration of artificial intelligence into the LS process should not be viewed as being limited solely to social learning theories; rather, it should also be conceptualized within the framework of Connectivism theory (Siemens, 2005), which emphasizes the reconstruction of knowledge through digital networks and algorithms. This transformation is grounded in the human–AI collaboration model (Luckin, 2018), where teachers' pedagogical expertise is synthesized with the analytical power of AI. Such collaboration enables teachers to move beyond the role of mere technology users and to function as strategic facilitators who make data-driven decisions. However, rather than a classical LS approach, the increasing importance of technology and AI integrated professional development models and individuals becoming able to manage their own professional development processes are considered to be very important. In recent years, AI has found various application

areas in the education sector, providing new learning environments and tools, especially in the field of teacher education (Holmes et al., 2019). AI has the potential to make students' learning process more effective, efficient and personalized in education (Meylani, 2024). However, the issue of how AI will be integrated into educational practices is still a matter of debate. Examples of the content of the discussion topics include which of the teacher roles AI applications will replace in the classroom, the contribution it offers to diversify learning styles according to different learning styles or speeds in learning due to individual differences, or the extent to which some applications offer flexible working hours and provide the opportunity to make lessons when students feel motivated in this direction (İşler & Kılıç, 2021). The use of AI in teacher education is seen to contribute to improving the quality of education by supporting the professional development of both prospective and in-service teachers (Zawacki-Richter, Marin & Bond, 2019).

AI is a powerful technology that can support teachers in their classroom practices and teaching processes. The role of AI in education has great potential in areas such as optimizing teachers' decision-making processes, student performance monitoring and assessment processes. Constructivist learning theory and personalized learning support how AI can be used in education.

Piaget (1976) and Bruner (1996) emphasize that students actively construct knowledge and participate in their own learning processes. AI can customize course content according to students' individual needs, thus supporting constructivist learning environments. The personalized learning model advocates providing education according to each student's different learning speed, interests and abilities. By providing student-specific feedback, AI can help maximize the potential of each student.

In this context, the LS model stands out as an effective professional development strategy that enables teachers to learn continuously by planning, implementing and evaluating together. However, the effectiveness of these processes depends on the active participation of teachers, their time and their commitment to the teaching content. AI is a tool that can make significant contributions to this process. An AI-supported LS model can enable teachers to make more systematic and data-driven decisions in lesson planning, implementation, evaluation and improvement.

The aim of this study is to theoretically discuss the effects of LS and AI integration on teachers' professional development and students' learning processes in education. This study aims to explore the potential of these two models in order to understand innovative approaches that support the use of technology in education and teachers' professional development. To this end, this systematic review research seeks to answer the following questions on LS and AI (integration with teacher education).

- How do AI and the LS model relate to teacher education?
- What are the advantages and limitations of AI and the LS model in terms of teachers' professional development?
- How does the AI-supported LS model differ from traditional LS models?

METHOD

Research Model

In this study, systematic review, one of the qualitative research methods, was used. Web of Science database was used for systematic review. In the study, the studies in the relevant literature were examined in order to determine the relationship between AI and LS. In this context, a review design was chosen for this study since it was aimed to examine the AI-supported LS model in terms of professional development in teacher education. The data collection process was carried out by using the keywords "LS", "AI in teacher education", "AI in education", "Professional development with AI" and "LS and technology integration".

Inclusion and Exclusion Criteria

In the research, full-text, open-access studies on the integration of AI and LS in the international index in the last five years (2019-2024) were included in the research. Non-academic sources such as blog posts, theses, dissertations, news articles, and studies that examined only one component (AI only or LS only) were excluded. Within the scope of the study, a systematic literature review was conducted using the Web of Science, Scopus, Google Scholar, IEEE Xplore, and ERIC databases. The review covered studies published between January 2018 and December 2024. During the search process, the following keyword combinations were employed:

- ("Artificial Intelligence" OR "AI") AND ("Lesson Study")
- ("Generative Artifical Intelligence" OR "Machine Learning") AND ("Teacher Professional Development")
- ("Yapay Zeka") AND ("Ders Araştırması")

Inclusion Criteria:

- Studies that directly focus on the integration of AI and LS.
- Research using teachers' professional development, TPACK skills, or classroom practices as primary data sources.
- Full-text articles published in peer-reviewed journals.
- Studies published in either English or Turkish.

Exclusion Criteria:

- Studies addressing only the technical or algorithmic aspects of AI without an educational context.
- General technology integration studies that do not employ the LS methodology.
- Conference papers published solely as abstracts and book reviews.

Data Collection Process

The screened studies were filtered according to the PRISMA flow diagram and the following steps were followed.

- 250 articles were included in the initial screening.
- After title and abstract evaluation, 150 articles were eliminated.
- The full text was analyzed and 50 articles were selected. Following the full-text screening, 50 articles were selected. These studies actively employed AI tools in at least one stage of the LS cycle (planning, implementation, or observation) and reported findings supported by empirical evidence. The selected studies were reviewed based on predefined criteria, including their contribution to teacher collaboration, their role in decision-making processes, and ethical considerations.
- For the final analysis, 20 articles were included. The descriptive characteristics of the studies reviewed (author, year, research focus, and key findings) are summarized in Table 1. To ensure transparency and enhance the reliability of the study, the full bibliographic details of all 20 included studies are provided in Appendix A. (See Appendix A for full list of studies)

Table 1.
The Selected Examples of Included Studies

Author(s) and Year	Research Focus	Mode of AI Integration	Key Findings / Contributions
Zhang (2023)	MOOC-based and AI-supported flipped instruction	AI-assisted assessment tools for EFL writing skills	The use of technology was found to enhance teacher collaboration and support student development.
Wang, Wang & Chen (2024)	Effects of visual analytics on peer feedback	Presentation of peer feedback through visual analytics tools	AI-supported visual analytics contributed to the development of teachers' Technological Pedagogical Content Knowledge (TPACK).
Aydın-Yıldız (2024)	Lesson planning skills of pre-service English teachers	Use of ChatGPT in the lesson planning process	AI tools were found to facilitate the development of 21st-century skills and support instructional material design.
Lammert et al. (2024)	Analysis of AI-generated lesson plans	Examination of AI-generated plans using Universal Design for Learning and Transition frameworks	While AI's potential for rapid content generation was highlighted, the need for teacher oversight to ensure pedagogical alignment was emphasized.
Baytak (2024)	Content analysis of lesson plans created using generative AI tools	Comparison of lesson plans generated by ChatGPT and Google Gemini	AI-supported tools were found to be effective in testing diverse instructional strategies and enabling data-driven lesson planning.
Collet & Penaflorida (2020)	Transformative learning experiences of international teaching assistants	AI-supported assessment systems for analyzing writing skills	Real-time data analysis and feedback systems were found to provide objectivity in identifying students' areas for improvement.

Note: Table 1 presents selected examples of the included studies. The full list of all 20 studies is provided in Appendix A.

Data Analysis

The thematic analysis method was used in the data analysis phase. The findings obtained from the relevant literature are grouped into themes and general inferences are made through these themes. Coding verification analysis was performed by independent coders. The 20 core articles identified through the screening process were analyzed using thematic analysis. The analysis followed four main stages:

- Familiarization: The full texts of the articles were read in detail, and notes were taken regarding the use of AI tools and the stages of the LS process.
- Coding: Initial codes were generated from the texts, including concepts such as "real-time data," "collaborative reflection," and "ethical concerns."
- Theme Development: The codes were grouped into three overarching themes: (1) the role of AI in the LS process, (2) advantages for professional development, and (3) implementation challenges.
- Reporting: The findings were synthesized and reported in relation to the specific objectives of the study.

The studies obtained in this context would be analyzed according to the following stages.

- Literature review: In the first stage, a review of the existing literature on LS and AI integration was conducted. The literature review included academic articles, books and reports examining the current applications of both models in education, their impact on teachers' professional development and how they contribute to students' learning processes. In this stage, studies focusing specifically on teachers' professional development, research examining the interaction of AI and LS, and literature on the use of technology in education were compiled.
- Examining the theoretical framework and model: In the light of the findings of the literature review, the contributions of the LS model to teachers' professional development were theoretically analyzed. In particular, how AI adapts to teachers' personal development, lesson planning, instructional material production and students' individual learning needs. In this review, the analysis focused not merely on summarizing existing studies, but on examining how Artificial Intelligence was integrated into different stages of the Lesson Study cycle and for what pedagogical purposes**.** Specifically, the selected studies were analytically examined in terms of: (a) the stage of the Lesson Study process in which AI was employed (planning, implementation, or observation), (b) the type of AI tools used (e.g., generative AI, visual analytics, automated feedback systems), (c) the pedagogical functions attributed to AI (such as supporting teacher collaboration, enhancing reflective practice, or enabling data-driven decision-making), and (d) the challenges and ethical concerns reported in relation to AI integration. Through this analytical framework, the review moved beyond descriptive reporting and enabled a comparative synthesis of how AI reshapes instructional decision-making, professional learning processes, and collaborative practices within the LS model.

- Examining the integration of AI and LS: In this phase, a theoretical analysis of how AI and LS work together was conducted. In particular, how AI can be integrated into LS processes and the effects of teachers' interactions with AI technologies on teaching methods and student achievement were analyzed.
- Theoretical discussion: Contributions and limitations of LS and AI integration: By combining the findings, an in-depth discussion on the contributions and potential limitations of LS and AI integration to teachers' professional development is provided.

Accordingly, the analysis addressed not only what AI tools were used in Lesson Study, but also how and why they were employed to reshape instructional decision-making and professional learning processes.

Validity and Reliability

To enhance the trustworthiness of the study, multiple strategies addressing validity and reliability were implemented. Transparency was ensured by presenting the full list of included studies in Appendix A, enabling readers to trace the data sources and evaluate the selection process. A systematic and criteria-based screening procedure was followed to maintain consistency in study inclusion. The analysis was conducted through an iterative thematic approach, where coding and categorization were continuously refined to ensure internal coherence. The alignment between research objectives, themes, and findings contributed to the construct validity of the study. Furthermore, the use of multiple studies as data sources enabled methodological triangulation, strengthening the credibility and depth of the analysis. Care was also taken to maintain consistency across data interpretation and reporting. These procedures collectively enhance the transparency, reliability, and replicability of the research.

RESULTS

The findings are organized in line with the research questions and thematic structure identified in the methodology section, namely: (1) the role of AI in the LS process, (2) advantages for teacher professional development, and (3) implementation challenges.

The Role of AI in the Lesson Study Process for Teacher Professional Development

LS is a collaborative, continuous improvement-oriented model for teachers' professional development. Originating in Japan, this model involves teachers planning, implementing, observing and re-evaluating lessons. AI supported education models are increasingly being used to enhance teachers' professional development. AI is seen to be effective in areas such as analyzing student feedback, creating individualized learning pathways, and helping teachers produce lesson content. The combination of LS and AI allows teachers to develop pedagogical approaches supported by digital tools.

The reviewed studies indicate that AI is integrated into the LS cycle (planning, implementation, and observation) in various ways. Generative AI tools such as ChatGPT and Gemini were found

to guide teachers during the lesson planning phase by supporting the development of diverse instructional strategies and instructional materials (Aydın-Yıldız, 2024; Baytak, 2024). In addition, visual analytics tools were reported to assume the role of an "objective observer" by mapping teacher–student interactions during classroom instruction (Wang et al., 2024).

This integration is supported by various theoretical and practical studies on the use of technology in education (Wang et al., 2024). Studies on LS and AI integration (Wang et al., 2024) are of great importance in terms of their impact on teacher education and student achievement. The combination of these two important concepts in education is increasingly gaining attention to support teachers' professional development, improve lesson planning and contribute to students' learning. While the existing literature emphasizes LS as a model that supports teachers' professional development, the role of AI in education is often discussed in terms of supporting individualized learning experiences, strengthening teachers' lesson planning and improving instructional materials (Herlanti et al., 2024). In particular, studies in Germany and Ecuador focus on how LS restructures teachers' professional knowledge and skills, while research in China reveals how the integration of AI into LS processes improves teachers' technological pedagogical content knowledge (TPACK) (Zhang, 2023; Lee & Jeon, 2024; Wang et al., 2024). The findings of these studies provide a critical perspective for the adoption and implementation of innovative approaches in education.

Advantages of AI-Supported Lesson Study for Teacher Professional Development

The LS model has a structure that encourages teachers to plan lessons together, observe lessons in practice and engage in continuous improvement processes. The theoretical framework of this model is shaped by an understanding of collaborative learning, the development of teachers' reflective thinking skills and the improvement of teaching practices. Various studies support that LS is an effective method for teachers to improve their pedagogical knowledge and skills (Zhang, 2023; Efendi et al., 2024; Lammert et al., 2024; Nuruddaroini et al., 2024). The integration of AI into the LS model is valuable for understanding how teachers use digital tools in lesson planning, how they optimize the teaching process by analyzing student data, and how they deliver individualized learning experiences. Studies in China show that MOOC-based and AI-supported models used in LS processes contribute to teachers' professional development (Zhang, 2023). Moreover, these models are reported to increase students' engagement and lead to significant improvements in learning outcomes.

The integration of AI technologies into LS processes allows teachers to analyze student data and individualize course content. These can be stated as follows.

– AI can provide teachers with instant data analysis during the lesson observation process. This can be used to evaluate student interactions.

– AI-supported lesson planning tools can help teachers to test different strategies in the LS process and analyze how students react (Baytak, 2024).

– E-learning tools and AI can help teachers to provide students with individualized learning paths. For example, AI-based recommendation systems can provide appropriate content for each student (Arevalo et al., 2024; Govender & Juggernath, 2024).

– The integration of AI into teachers' assessment processes can allow teachers to evaluate student performance more objectively.

– AI-supported assessment systems can provide feedback by instantly analyzing student writing and help teachers better identify students' areas of improvement (Collet & Penaflorida, 2020).

– AI-based analysis tools in lesson observations can help teachers evaluate classroom interactions and make teaching processes more effective.

– MOOC and AI-based feedback systems can support teachers' lesson planning processes and enable them to create materials that are more suitable for students' individual learning needs (Zhang, 2023; Aydın-Yıldız, 2024; Govender & Juggernath, 2024).

In studies in Germany, it was reported that during the implementation of LS, teachers were initially skeptical about AI-based tools, but in the process they realized that these technologies facilitated their teaching processes (Vock et al., 2024). It is emphasized that it is critical to provide adequate guidance and support for teachers to use these tools more effectively.

Implementation Challenges and Limitations of AI-Supported Lesson Study in Teacher Professional Development

Research on LS and AI integration shows how new approaches that support teachers' professional development can be integrated into the education system. However, this integration has some limitations (Rodriguez-Robles et al., 2024; Vock et al., 2024):

– Advantages:

- The use of AI enhances teachers' reflective thinking skills and TPACK levels. In particular, real-time data analysis enables teachers to develop deeper insights into their own instructional performance (Zhang, 2023; Wang et al., 2024).
- Accelerates professional development: Teachers can assess student performance faster with the analysis tools offered by AI.
- Promotes student-centered learning: AI-based education platforms can create customized learning pathways according to students' individual needs.
- Increases teacher collaboration: AI-based feedback mechanisms during LS can facilitate teachers to learn from each other.

– Limitations and Challenges:

- A lack of digital literacy, concerns regarding data privacy, and limited trust in the pedagogical validity of AI-generated content were identified as key challenges (Lammert et al., 2024).

- Ethical and pedagogical limits of AI in education: Teachers should not become over-dependent on AI and lose their critical thinking skills.
- Tailoring AI to the educational context: Since most existing AI tools are trained with generic datasets, they need to be adapted to local education systems.
- Technology literacy of teachers: Teachers may need to be provided with technology training so that they can use AI and e-learning tools effectively.

Comparison of Traditional and AI-Supported Lesson Study for Teacher Professional Development

The analyses indicate that the integration of AI has led to a digital transformation of the traditional LS model, with the differences between the two approaches becoming evident across four main dimensions:

- Data Depth and Evidence-Based Practice: In the traditional LS model, lesson observation largely relies on teachers' handwritten notes and subjective interpretations. In contrast, the AI-supported model presents concrete evidence through learning analytics dashboards that visualize student participation, speaking time, and patterns of classroom interaction.
- Speed and Quality of Feedback: While feedback in the traditional LS cycle is typically postponed until post-lesson evaluation meetings, AI-based systems (e.g., ChatGPT-supported feedback tools or real-time assessment applications) enable teachers to intervene during lesson planning and implementation by providing real-time feedback.
- Personalization and Diversity: The traditional model generally focuses on lesson plans designed for the class as a whole, whereas the AI-supported model analyzes student performance data to offer adaptive recommendations for learners with varying learning speeds within the same lesson.
- Collaboration and Accessibility: Traditional LS often requires face-to-face meetings due to geographical constraints and time limitations. In contrast, MOOC – and AI-based platforms expand the scope of collaboration by allowing teachers to share data asynchronously across different locations and to analyze each other's instructional decisions through digital traces.

A Proposed Model for AI-Supported Lesson Study in Teacher Professional Development

Based on the findings of the reviewed studies, a conceptual model is proposed to illustrate how AI can be systematically integrated into the Lesson Study process to support teacher professional development.

Table 2.

Sample Of AI Supported LS Process

Planning / Preparation phase	
Goal and content setting	A group of teachers comes together to develop a specific course content or pedagogical strategy. With AI supported data analysis tools, students' past performance data are examined and critical points of the course are determined.
AI-powered content development	Teachers prepare lesson plans using ChatGPT, Copilot, or similar AI-powered tools. Students' learning needs are determined using learning analytics platforms (e.g. Google Classroom, Edmodo AI, Knewton).
Implementation Phase	
AI Based Student Tracking	During class, teachers use AI-powered classroom analysis tools (e.g. ClassDojo AI, GoGuardian) to observe student interactions. With AI-supported individualized learning suggestions, students are guided according to their level.
AI-Powered Feedback	Students are provided with personalized feedback through instant AI-powered assessment tools (e.g. Quizizz AI, Kahoot AI).
Observation and Reflection Phase	
AI Supported Data Analysis	Teachers evaluate students' performance in the course using AI-based analysis tools (e.g. Learning Analytics Dashboard). AI helps teachers determine which teaching methods are more effective by evaluating their classroom interactions. The LS team holds an evaluation meeting and shares its observations.
Collaboration Between Teachers	AI can provide suggestions to support discussions between teachers (e.g., AI-based automatic feedback systems).
Revised Planning Phase	
AI-Assisted Revision	Teachers update the lesson plan by analyzing previous lesson data. New teaching strategies are developed with AI-supported suggestions and adaptations are made according to student needs.
Iterating the Application	The revised lesson is applied again and the process continues within the LS cycle.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

The results of this study reveal that integrating AI into LS enhances teacher collaboration, provides real-time feedback, and supports data-driven decision-making processes. At the same time, challenges related to teachers' levels of digital literacy, ethical considerations, and the adaptation of AI tools to educational contexts remain significant. Based on the research findings, relevant studies on teachers' in-service and pre-service training indicate that AI and LS are highly related and can be considered as a new generation professional development model. In his study examining the effect of AI-supported LS models, Zhang (2023) reveals that technology increases collaboration between teachers. However, it is also emphasized that the integration of digital technologies may be difficult due to the traditional structure of LS. The collaborative nature of LS, in particular, can be initially challenging for teachers unaccustomed to the use of digital tools. The results of the study are consistent with Zhang (2023), who argues that the AI-supported LS model extends teacher collaboration to a global scale through digital platforms. However, resistance rooted in traditional

practices and the process of adapting to digital tools are regarded as major barriers to the effective integration of this model.

When the benefits in terms of teacher education are examined based on the studies examined in the research, it is seen that AI can provide feedback to teachers by analyzing student performance and in-class interactions. LS and AI integration provides professional development opportunities for teacher education. AI-powered analytics help teachers optimize lesson planning and get real-time feedback. For example, it can be said that data on in-class student participation, student achievement, and course pace help teachers constantly improve course content and teaching methods. However, AI can provide students with personalized learning experiences, providing content that suits the needs of each student. In this process, teachers state that they can customize student learning processes by using AI more effectively with the data they obtain in LS groups. Data analysis tools provided by AI can help teachers better understand students' learning processes and make teaching processes individualized. Moving LS to digital environments can allow teachers to collaborate remotely and enable broader participation by eliminating geographical barriers. AI-supported lesson observation and analysis systems can offer new opportunities for teachers to improve their teaching skills. While traditional LS models typically rely on subjective observations, the studies examined in this research—particularly Wang et al. (2024) and Collet and Penaflorida (2020) highlight the importance of AI as an "objective data provider." AI-supported visual analytics and real-time feedback systems enable teachers to evaluate their in-class performance based on concrete evidence. This, in turn, enhances teachers' reflective thinking skills and accelerates their professional development.

On the other hand, besides the advantages, there are also difficulties and limitations of using LS and AI tools. In order to implement LS, teachers need to get used to the collaborative work culture. As noted by Lammert et al. (2024) and Baytak (2024), the pedagogical validity and ethical boundaries of AI-generated lesson plans remain subject to ongoing debate. The risk that teachers may become overly dependent on AI tools and consequently lose their critical thinking skills represents one of the weakest points of the model. This finding is consistent with the emphasis in the educational technology literature on the need to preserve "pedagogical control." The transition from traditional individual teaching to a collaborative model may take time for some teachers. There is a lack of training for teachers in the use of AI-based tools. The process of adapting to technology may create an additional burden for teachers' professional development. Since the planning and implementation of the LS process is time-consuming, it needs to be aligned with existing course schedules. It is thought that this situation may lead to the need to allocate additional time for teachers.

In addition to Vygotsky's social learning theory, this integration can be conceptualized within the framework of Connectivism theory (Siemens, 2005), which views knowledge as being distributed across networks. Furthermore, the technological transformation of the LS process should be explained through the human–AI collaboration model (Luckin, 2018), which integrates teachers' pedagogical expertise with the analytical power of AI.

Overall, AI-supported LS represents an innovative model that optimizes data-driven decision-making, enables real-time feedback in teacher education, and supports the personalization of student learning. While preserving the collaborative essence of the traditional model, the analytical depth provided by AI directly enhances teachers' Technological Pedagogical Content Knowledge (TPACK) levels. However, the success of this model depends on institutional support, clear ethical guidance, and the improvement of teachers' digital literacy levels.

In this regard, the Ministry of National Education and universities should design and implement practice-oriented training programs that integrate AI tools into the LS cycle for both pre-service and in-service teachers. Clear guidelines addressing data privacy, algorithmic bias, and ethical standards for the use of AI in education should also be established. Future research should focus on longitudinal studies examining the long-term effects of AI-supported LS on student achievement, as well as qualitative investigations that explore ethical dimensions in greater depth. In addition, cross-cultural comparative studies examining AI-supported LS practices across countries with diverse educational systems—such as China, Germany, and Türkiye—are strongly recommended. To support sustainable implementation, practical training initiatives aimed at enhancing teachers' digital literacy should be systematically provided.

As a result, while LS and AI integration offers important opportunities for teachers' professional training both before and during service, it can be said that in order to implement the process successfully, teachers' digital skills should be increased, adequate technical support should be provided and collaborative working models should be encouraged. Based on the research results, it can be recommended for future research to evaluate the ethical dimensions of AI-based tools and their effects on teacher-student relations. It may also be recommended to examine in detail issues such as data privacy, algorithmic biases and how they affect teachers' pedagogical control. It may be suggested to investigate the changes in teachers' perceptions towards AI-supported LS models and to examine their long-term effects through longitudinal studies.

Data Availability Statement: The data generated or analyzed during this study are available from the authors upon request.

Use of AI for Language and Grammar Checking: The author(s) declare that a paraphrasing tool (e.g., QuillBot) was used in accordance with ethical guidelines, with an approximate contribution of 10% to the language editing process

Ethical Statement: Since this study is a systematic review, ethics committee approval is not required.

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Appendix A.

Full List of Included Studies

This appendix presents the full list of studies included in the review to ensure transparency and enhance the reliability of the research process.

No	Author(s)	Year	Research Focus	Type of AI Integration	Key Findings
1	Hu et al.	2022	AI-supported English learning using multimedia and deep learning approaches	AI-supported multimedia learning	AI-enhanced teaching improves student motivation, engagement, and language skills
2	Wang et al.	2023	Visual analytics of peer feedback in Lesson Study for TPACK development	AI-supported analytics dashboard	AI-supported analytics improves teachers' reflection and TPACK development
3	Zhang	2023	AI-powered flipped learning within Lesson Study for EFL writing	AI-powered MOOC and flipped model	AI integration improves teachers' TPACK and student learning outcomes
4	Araya	2023	AI and Lesson Study integration through learning analytics	AI, ML, and LLM-based analytics	AI enables data-driven Lesson Study processes and classroom analysis
5	Railean et al.	2023	AI-supported pedagogical models in teacher education	AI-based instructional systems	AI transforms instructional design and learning environments
6	Aydın Yıldız	2024	ChatGPT use in pre-service teacher education	Generative AI (ChatGPT)	Enhances 21st-century skills and lesson planning competencies
7	Baytak	2024	AI-generated lesson plans in education	Generative AI (ChatGPT, Gemini)	AI produces human-like lesson plans but lacks deep pedagogical integration
8	Chen et al.	2024	AI anxiety and self-efficacy in higher education	AI-supported learning environments	AI self-efficacy positively influences motivated learning
9	Efendi et al.	2024	AI-supported learning in mathematics education	AI learning systems	AI enhances engagement and learning outcomes
10	Govender & Juggernath	2024	ICT and Lesson Study in teacher professional development	Technology-integrated LS (ICT)	LS enhances teachers' collaboration and ICT integration skills
11	Herlanti et al.	2024	Online Lesson Study and environmental literacy	Online LS with digital tools	LS improves teacher professionalism and student outcomes
12	Lammert et al.	2024	Evaluation of AI-generated lesson plans	Generative AI (ChatGPT)	AI-generated plans are usable but pedagogically limited
13	Lee & Jeon	2024	Chatbot-supported lesson planning for teacher education	AI chatbot integration	Improves TPACK development in pre-service teachers
14	Nuruddaroini et al.	2024	AI in teacher competencies and education systems	AI in education	AI supports personalization but teachers remain central

No	Author(s)	Year	Research Focus	Type of AI Integration	Key Findings
15	Rodriguez-Robles et al.	2024	Lesson Study in initial teacher education (Europe)	LS models (non-AI)	LS strengthens university-school collaboration and pedagogical knowledge
16	Vock et al.	2024	Challenges in implementing Lesson Study	LS implementation	Identifies structural and motivational barriers in LS
17	Wang et al.	2024	AI-supported peer feedback and teacher learning	AI analytics	Improves professional development through feedback analysis
18	Arevalo et al.	2024	Virtual Lesson Study and teacher knowledge development	Digital/virtual LS	LS enhances teachers' practical knowledge in virtual settings
19	Huang et al.	2024	Generative AI-informed pedagogies in Lesson Study	Generative AI (LLMs)	AI supports creativity, personalization, and pedagogical innovation
20	Collet & Penaflorida	2020	Lesson Study for international graduate teaching assistants	Lesson Study (non-AI)	LS supports transformative learning and pedagogical adaptation

Yapay Zeka Destekli Ders Araştırması: Öğretmenlerin Mesleki Gelişiminin Dönüşümü

Duygu İLERİTÜRK*

Giriş

Öğretmenlerin mesleki gelişimi, eğitim sistemlerinin niteliğini belirleyen temel unsurlardan biridir. Değişen eğitim ihtiyaçları, dijital dönüşüm ve teknolojik gelişmeler öğretmenlerin sürekli öğrenmelerini ve öğretim uygulamalarını geliştirmelerini gerekli kılmaktadır. Bu bağlamda Ders Araştırması, öğretmenlerin iş birliği içinde ders planladıkları, uyguladıkları, gözlemledikleri ve yeniden düzenledikleri etkili bir mesleki gelişim modeli olarak öne çıkmaktadır. Son yıllarda yapay zekâ (YZ) teknolojilerindeki gelişmeler ise öğretmenlere veri temelli karar verme, kişiselleştirilmiş geri bildirim sağlama ve öğretim süreçlerini daha etkili biçimde yönetme fırsatları sunmaktadır. Bu çalışma, yapay zekâ ile ders araştırması modelinin bütünleşmesini inceleyerek söz konusu entegrasyonun öğretmenlerin mesleki gelişimine ve öğrenci öğrenmesine sağlayabileceği katkıları ortaya koymayı amaçlamaktadır. Bu kapsamda çalışma; yapay zekâ ile ders araştırması arasındaki ilişkiyi, bu entegrasyonun avantaj ve sınırlılıklarını ve yapay zekâ destekli ders araştırmasının geleneksel ders araştırması modellerinden hangi yönleriyle farklılaştığını incelemektedir.

Yöntem

Araştırmada nitel araştırma yöntemlerinden sistematik derleme deseni kullanılmıştır. Çalışma kapsamında Web of Science ve Scopus veri tabanlarında yer alan çalışmalar incelenmiştir. Araştırmaya 2018-2024 yılları arasında yayımlanan, hakemli dergilerde yer alan ve yapay zekâ ile ders araştırmasının entegrasyonunu doğrudan ele alan çalışmalar dâhil edilmiştir. PRISMA süreci doğrultusunda gerçekleştirilen tarama sonucunda ilk aşamada 250 çalışmaya ulaşılmış, başlık ve

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özet incelemelerinin ardından 150 çalışma elenmiştir. Tam metin incelemesi sonucunda 50 çalışma değerlendirmeye alınmış ve belirlenen ölçütleri karşılayan 20 çalışma nihai analiz kapsamına dâhil edilmiştir. Veriler tematik analiz yöntemiyle çözümlenmiş ve bulgular üç temel tema altında toplanmıştır: (1) yapay zekânın ders araştırması sürecindeki rolü, (2) öğretmenlerin mesleki gelişimine sağladığı katkılar ve (3) uygulama sürecinde karşılaşılan güçlükler.

Bulgular

Araştırma sonuçları, yapay zekânın ders araştırmasının planlama, uygulama, gözlem ve değerlendirme aşamalarında farklı şekillerde kullanıldığını göstermektedir. Özellikle ChatGPT ve Gemini gibi üretken yapay zekâ araçlarının ders planlama sürecinde öğretmenlere alternatif öğretim stratejileri geliştirme, materyal hazırlama ve öğrenci ihtiyaçlarını analiz etme konusunda destek sağladığı belirlenmiştir. Ayrıca yapay zekâ tabanlı öğrenme analitiği araçları sayesinde öğretmenlerin öğrenci katılımı, öğrenme performansı ve sınıf içi etkileşimler hakkında ayrıntılı verilere ulaşabildikleri görülmüştür. İncelenen çalışmalar, yapay zekâ destekli ders araştırmasının öğretmenlerin yansıtıcı düşünme becerilerini geliştirdiğini, Teknolojik Pedagojik Alan Bilgisi (TPAB/TPACK) düzeylerini artırdığını ve veri temelli karar verme süreçlerini güçlendirdiğini ortaya koymaktadır. Bunun yanında yapay zekâ destekli sistemlerin öğrencilerin bireysel öğrenme ihtiyaçlarını belirleyerek kişiselleştirilmiş öğrenme fırsatları sunduğu belirlenmiştir. Dijital platformlar aracılığıyla öğretmenler arasında iş birliğinin güçlendiği ve coğrafi sınırlılıkların önemli ölçüde azaldığı da tespit edilmiştir. Bununla birlikte, yapay zekâ entegrasyonunun bazı sınırlılıkları bulunmaktadır. Öğretmenlerin dijital okuryazarlık düzeylerinin yetersiz olması, veri gizliliği ve etik sorunlar ile yapay zekâ tarafından üretilen içeriklerin pedagojik uygunluğuna ilişkin kaygılar önemli engeller olarak öne çıkmaktadır. Ayrıca bazı öğretmenlerin yeni teknolojilere karşı direnç gösterdiği ve yapay zekâ araçlarının kullanımının ek zaman ve çaba gerektirdiği belirlenmiştir.

Tartışma, Sonuç ve Öneriler

Araştırma bulguları, yapay zekâ destekli ders araştırmasının öğretmenlerin mesleki gelişimini destekleyen yenilikçi bir model olduğunu göstermektedir. Geleneksel ders araştırması modelinin iş birlikli yapısını koruyan bu yaklaşım, yapay zekânın sunduğu veri analizi, öğrenme analitiği ve anlık geri bildirim olanakları sayesinde öğretmenlerin öğretim süreçlerini daha etkili biçimde değerlendirmelerine olanak sağlamaktadır. Böylece öğretmenler daha bilinçli kararlar verebilmekte, öğretim uygulamalarını geliştirebilmekte ve öğrencilerin öğrenme gereksinimlerine daha uygun öğrenme ortamları oluşturabilmektedir. Ancak bu modelin etkili biçimde uygulanabilmesi için öğretmenlerin dijital yeterliklerinin geliştirilmesi, yapay zekâ kullanımına ilişkin etik ilkelerin belirlenmesi ve kurumsal destek mekanizmalarının oluşturulması gerekmektedir. Milli Eğitim Bakanlığı ve yükseköğretim kurumlarının hizmet öncesi ve hizmet içi öğretmen eğitimlerinde yapay zekâ destekli ders araştırması uygulamalarına yer vermesi önerilmektedir. Sonuç olarak yapay zekâ destekli ders araştırması, öğretmenlerin mesleki öğrenmelerini güçlendiren, iş birliğini artıran ve veri temelli öğretim uygulamalarını destekleyen güçlü bir mesleki gelişim modeli olarak değerlendirilebilir.