Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE EFFECTIVENESS OF TEACHING ACTIVITY

Sotvoldiyeva Gulhayo Tursunboy qizi
First-Year Master's Student, Pedagogy
Asia International University
gulhayosotvoldiyeva02@gmail.com

Abstract

This article examines how artificial intelligence affects teaching effectiveness in three areas: lesson preparation, instructional support during learning, and students' independent performance. A comparative analysis of five international studies considers what each AI tool was designed to do, how it was used, and which outcomes were measured. In a school-based trial, teachers given access to ChatGPT and a practical guide spent less time preparing science lessons and materials. In mathematics tutoring, real-time AI support helped tutors ask more probing questions, and their students were more likely to master the topics covered. Research on AI tutoring also highlights the importance of assessing what students can do independently. In one mathematics experiment, unrestricted AI assistance improved performance during practice, but students scored lower than the control group when they later worked without the tool. An AI tutor that offered teacher-designed hints mitigated this effect. For pedagogical universities in Uzbekistan, the analysis identifies three priorities for preparing future teachers: reviewing AI-generated teaching materials, using AI to support questioning and feedback, and assessing what students can do without AI assistance.

Keywords: Artificial intelligence, teaching effectiveness, lesson planning, instructional support, AI tutoring, independent learning, teacher education.

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

SUN'IY INTELLEKTNING PEDAGOGIK FAOLIYAT SAMARADORLIGIGA TA'SIRI

Sotvoldiyeva Gulhayo Tursunboy qizi
Osiyo Xalqaro Universiteti
Pedagogika yo'nalishi 1-bosqich magistranti
gulhayosotvoldiyeva02@gmail.com

Annotatsiya

Maqolada sun’iy intellektning pedagogik faoliyat samaradorligiga ta’siri uch yo‘nalishda o‘rganiladi: darsga tayyorgarlik, o‘quv jarayonida pedagogik ko‘mak va ta’lim oluvchilarning mustaqil ish natijalari. Beshta xorijiy tadqiqotning qiyosiy tahlilida har bir sun’iy intellekt vositasi qanday vazifa uchun yaratilgani, qay tarzda qo‘llangani va qaysi natijalar o‘lchangani ko‘rib chiqiladi. Maktabda o‘tkazilgan tajribada ChatGPT va undan foydalanish bo‘yicha amaliy qo‘llanma taqdim etilgan o‘qituvchilar tabiiy fan darslari va o‘quv materiallarini tayyorlashga kamroq vaqt sarflagan. Matematika bo‘yicha qo‘shimcha mashg‘ulotlarda sun’iy intellektning tezkor ko‘magi repetitorlarga o‘quvchi fikrini chuqurroq ochib beruvchi savollarni ko‘proq berishga yordam bergan, ularning o‘quvchilari esa o‘rganilgan mavzularni egallash mezoniga ko‘proq erishgan. Sun’iy intellekt asosidagi repetitorlikka oid tadqiqotlar o‘quvchilarning mustaqil bajara oladigan ishlarini baholash ahamiyatini ham ko‘rsatadi. Matematika bo‘yicha bir tajribada cheklovsiz sun’iy intellekt yordami mashq natijalarini yaxshilagan, biroq vositasiz bajarilgan keyingi topshiriqda o‘quvchilar nazorat guruhidan pastroq natija ko‘rsatgan. O‘qituvchi tayyorlagan yo‘naltiruvchi ko‘rsatmalarni beruvchi sun’iy intellekt repetitori bu ta’sirni yumshatgan. Tahlil asosida O‘zbekiston pedagogika oliy ta’lim muassasalarida bo‘lajak o‘qituvchilarni tayyorlashning uchta ustuvor yo‘nalishi belgilanadi: sun’iy intellekt yaratgan didaktik materiallarni tekshirish, undan savol berish va qayta aloqa jarayonida foydalanish hamda o‘quvchilarning sun’iy intellekt yordamisiz bajara oladigan ishlarini baholash.

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

Kalit so‘zlar. Sun’iy intellekt, pedagogik faoliyat samaradorligi, darsni rejalashtirish, pedagogik ko‘mak, sun’iy intellekt asosidagi repetitorlik, mustaqil o‘rganish, o‘qituvchilarni tayyorlash.

Аннотация

В статье рассматривается влияние искусственного интеллекта на эффективность педагогической деятельности по трём направлениям: подготовка к урокам, педагогическая поддержка в процессе обучения и результаты самостоятельной работы учащихся. При сравнительном анализе пяти зарубежных исследований учитывается, для каких задач создавался каждый инструмент искусственного интеллекта, как он применялся и какие результаты измерялись. В школьном эксперименте учителя, получившие доступ к ChatGPT и практическое руководство по его использованию, тратили меньше времени на подготовку уроков естественно-научного цикла и учебных материалов. На дополнительных занятиях по математике подсказки искусственного интеллекта в реальном времени помогали репетиторам чаще задавать вопросы, раскрывающие ход мысли учащихся, а их ученики чаще достигали критерия освоения изученных тем. Исследования цифровых репетиторов также показывают важность оценки того, что учащиеся способны выполнить самостоятельно. В одном эксперименте по математике помощь искусственного интеллекта без ограничений улучшила результаты выполнения упражнений, однако при последующей работе без этого инструмента учащиеся показали более низкие результаты, чем контрольная группа. Цифровой репетитор, предлагавший подготовленные учителем направляющие подсказки, смягчил этот эффект. Для подготовки будущих учителей в педагогических вузах Узбекистана выделены три приоритетных направления: проверка дидактических материалов, созданных искусственным интеллектом, его применение при постановке вопросов и предоставлении обратной связи, а также оценка того, что учащиеся способны выполнить без его помощи.

Ключевые слова: Искусственный интеллект, эффективность педагогической деятельности, планирование урока, педагогическая

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

поддержка, репетиторство на основе искусственного интеллекта, самостоятельное обучение, подготовка учителей.

INTRODUCTION

Artificial intelligence can support teachers before a lesson and during instruction [9; 12]. A teacher might use a generative tool to draft a worksheet, adapt an explanation, or develop questions that reveal how students reached an answer. Each use calls for a different measure of effectiveness. Time saved in preparing materials matters to teachers, while the quality of those materials and students' ability to apply what they learned address different aspects of teaching.

Roy and colleagues [1] examined how access to ChatGPT and a practical guide affected the time teachers spent preparing science lessons. Wang and colleagues [2] investigated how suggestions delivered during mathematics tutoring shaped tutors' questioning and students' topic mastery. Research on intelligent tutoring systems also connects the design of instructional support with learning outcomes [3; 4; 6; 7; 8]. Bastani and colleagues [5] add a further consideration by comparing performance during AI-assisted practice with performance after access to the tool was removed.

For pedagogical universities in Uzbekistan, these studies raise practical questions about what future teachers should learn to do with AI [10; 11]. For example, a student teacher who uses AI to draft a mathematics task must check its accuracy and decide what evidence will show that pupils understood the method. This article compares five international studies to examine teaching effectiveness across lesson preparation, instructional support, and independent learning.

METHODS

The article uses comparative analysis and thematic synthesis to examine teaching effectiveness across five international studies. The unit of analysis was the comparison reported in each study. For each comparison, the analysis identified the educational setting, the task supported by artificial intelligence, the person interacting with the tool, the comparison condition, and the outcome measured. The five studies were selected for their relevance to lesson preparation, instructional support, and student learning. They included school and university

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

experiments, a study of real-time support for mathematics tutors, and a meta-analysis of intelligent tutoring systems.

The first stage examined how AI was integrated into teaching and learning. In Roy and colleagues' study, teachers used ChatGPT and a practical guide to prepare science lessons and materials. In Wang and colleagues' study, mathematics tutors received suggestions during ongoing sessions. The analysis recorded these applications according to when assistance was provided and who acted on it. In the studies by Kestin and colleagues and Bastani and colleagues, learners interacted directly with AI tutors. The comparison therefore included the pedagogical design of the tools, particularly how they structured explanations, guided practice, and responded when learners encountered difficulty.

The second stage examined the outcomes and how they were measured. Lesson preparation time was treated as an indicator of teacher workload. The frequency of probing questions was examined as an indicator of instructional practice, and topic mastery was considered a learning outcome within the tutoring setting. For outcomes measured through tests, the analysis specified when the assessment occurred and whether students could use AI while completing it. This distinction was particularly relevant to Bastani and colleagues' experiment, which measured mathematics performance during supported practice and after access to the tool ended. The assessment conditions helped clarify what each result represented.

The third stage compared the findings within these categories. The time difference reported by Roy and colleagues, the percentage-point difference in topic mastery reported by Wang and colleagues, and the standardized effect summarized by Kulik and Fletcher were interpreted on their original scales. For the review of intelligent tutoring systems, particular attention was paid to the type of test used and the way the system was implemented. Across the five sources, the analysis considered whether each outcome described a change in teacher workload, a change in instructional interaction, or a difference in learner performance under specified conditions.

The final stage considered how the evidence could inform teacher preparation in Uzbekistan. The analysis focused on tasks that student teachers encounter in methods courses and school placements, including drafting instructional materials, planning follow-up questions, and assessing independent work. A

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

lesson planning example was used to connect preparation time with the accuracy and suitability of materials. A tutoring example illustrated how a teacher might adapt an AI-generated question to a pupil's reasoning. An assessment example examined how a comparable task completed independently could help a teacher judge whether the pupil could apply the method introduced during guided practice.

RESULTS

The five studies documented changes in lesson preparation, instructional interaction, and learner performance. Roy and colleagues reported that science teachers given ChatGPT and a practical guide spent 31 percent less time preparing lessons and resources than teachers in the comparison group during weeks six through ten. The trial included 259 teachers across 68 schools in England. The difference concerned time spent preparing lessons and materials during that period. The comparison captured the combined use of ChatGPT and the guide, which gave teachers practical advice on incorporating the tool into their planning. Wang and colleagues found that students whose mathematics tutors received real-time suggestions from Tutor CoPilot were four percentage points more likely to master the topics covered. Analysis of tutoring messages showed that tutors using the tool asked more probing questions and offered generic praise less frequently. The gain in topic mastery was larger among students assigned to tutors with lower initial ratings. These results identify changes at two levels of the same tutoring intervention. The message analysis tracked changes in how tutors responded to students, while the mastery measure captured whether students met the learning criterion for the topic.

Kulik and Fletcher synthesized 50 controlled evaluations of intelligent tutoring systems and reported a median effect of 0.66 standard deviations on test performance. The magnitude of the effect varied with the type of test used. Evaluations using locally developed measures often yielded larger effects than those using standardized tests, highlighting the importance of alignment between instruction and assessment. At the university level, Kestin and colleagues found that students working with an AI tutor designed for an introductory physics course achieved higher immediate learning gains in less time than students assigned to

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

an active learning class. That comparison concerned the instructional materials and topics used in the experiment.

Bastani and colleagues found that access to generative AI improved students' performance during high school mathematics practice. When students later completed an assessment without access to AI, those who had practiced with an unrestricted version performed worse than the control group. The negative effect was mitigated in the group that used a tutor designed to provide guidance through teacher-developed hints. This comparison showed that performance on similar mathematics tasks could follow different patterns depending on whether students were practicing with support or applying the method on their own. The design of the assistance also mattered within the same subject and setting.

When applied to teacher preparation in Uzbekistan, the synthesis yielded three observable criteria for examining AI use during teaching practice. A planning task can record the time needed to produce a ready-to-use resource, including the time spent checking examples and revising instructions. An observation of classroom interaction can document whether a teacher's follow-up question prompts a pupil to explain a step or reconsider an error. An independent assessment can use a comparable problem to examine whether the pupil applies the method after guided practice. Used together, these criteria connect the teacher's preparation, the support provided during instruction, and the evidence pupils produce when completing a task on their own.

DISCUSSION

The studies suggest that AI can improve teaching effectiveness when its use addresses a specific instructional task. Roy and colleagues found that teachers using ChatGPT alongside a guide spent less time preparing lessons and resources. For a student teacher, the practical question is how much time it takes to produce a resource that is ready for use. A worksheet may take seconds to generate, while checking its examples, adjusting its wording, and aligning it with the lesson objective require additional time [15; 16; 17]. Counting those steps gives a more informative measure of workload than timing the initial generation alone.

Wang and colleagues illustrate how AI can support instructional decisions during a tutoring session. A suggested question gives the tutor a prompt to consider, and

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

the pupil's answer helps determine whether the prompt fits the situation. For example, a pupil who applies the wrong operation may need to explain what each quantity represents before attempting another calculation. A question that elicits this explanation can reveal where the reasoning went astray and help the tutor select a useful follow-up. The frequency of probing questions is informative in this context because it captures one observable change in how tutors responded to pupils.

The findings on direct AI tutoring also depend on the design of the activity and the assessment [14]. The immediate gains reported by Kestin and colleagues concern a physics tutor designed around specific instructional materials. Kulik and Fletcher likewise found that estimates of effectiveness varied with the type of test. Together, these studies direct attention to the relationship between what students practice and what they are later asked to demonstrate. A closely aligned test can show whether students learned the targeted content. A task that presents the same principle in a different context can provide evidence about transfer.

Bastani and colleagues show how success during supported practice can diverge from later independent performance. The design of the assistance matters because a tool that provides a complete solution allows the learner to proceed without making every decision required by the problem [18; 19]. A tool that offers a targeted hint can leave the next step to the learner. For teaching practice, this distinction supports pairing guided work with a comparable independent task. Asking pupils to explain why they chose a method can further help teachers identify which parts of the solution pupils can reconstruct on their own.

In pedagogical universities in Uzbekistan, these findings can inform assignments in subject methods courses and school placements [13; 20]. A student teacher could prepare a short lesson with AI assistance, record the time spent editing the materials, and explain why particular suggestions were retained. During the lesson, the student teacher could use pupils' responses to decide when to ask a probing question or offer a hint. A subsequent independent task could reveal whether pupils can apply the method taught. Reviewing these stages with a mentor would connect decisions about AI use to observable aspects of teaching. The mentor can discuss whether the revised resource matched the lesson

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

objective, whether the prompt elicited reasoning, and what pupils' independent work revealed about their understanding.

CONCLUSION

Artificial intelligence can improve teaching effectiveness by reducing preparation time and supporting instructional decisions. Across the five studies reviewed, the clearest workload benefit concerned time spent preparing science lessons and materials. In mathematics tutoring, real-time suggestions helped tutors ask more probing questions, and pupils were more likely to achieve topic mastery. These findings illustrate how AI can support different parts of teaching, from drafting classroom resources to responding to a pupil's reasoning during instruction.

The evidence on learner performance highlights the importance of how assistance is designed and when learning is assessed. A purpose-built physics tutor supported immediate learning gains, while the mathematics experiment showed that stronger performance during assisted practice could coexist with weaker performance on a subsequent independent assessment. Teacher-designed hints helped mitigate this pattern. Teaching effectiveness should therefore be assessed through the quality of instructional support and the work pupils can complete independently.

For pedagogical universities in Uzbekistan, these findings point to three practices for preparing future teachers. Student teachers can review AI-generated materials for accuracy and alignment with lesson objectives, adapt suggested questions to pupils' responses, and use comparable tasks to assess independent learning. In school placements, mentors can ask student teachers to explain what they changed in a generated resource, how their questions supported reasoning, and what pupils' independent work revealed about their understanding of the method they taught.

REFERENCES

1. Roy, P., Poet, H., Staunton, R., Aston, K., & Thomas, D. (2024). ChatGPT in lesson preparation: A teacher choices trial [Evaluation report]. Education Endowment Foundation.

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

2. Wang, R. E., Ribeiro, A. T., Robinson, C. D., Loeb, S., & Demszky, D. (2025). Tutor CoPilot: A human-AI approach for scaling real-time expertise (EdWorkingPaper No. 24-1054). Annenberg Institute at Brown University.
3. Kulik, J. A., & Fletcher, J. D. (2016). Effectiveness of intelligent tutoring systems: A meta-analytic review. Review of Educational Research, 86(1), 42–78.
4. Kestin, G., Miller, K., Klales, A., Milbourne, T., & Ponti, G. (2025). AI tutoring outperforms in-class active learning: An RCT introducing a novel research-based design in an authentic educational setting. Scientific Reports, 15(1), Article 17458.
5. Bastani, H., Bastani, O., Sungu, A., Ge, H., Kabakcı, Ö., & Mariman, R. (2025). Generative AI without guardrails can harm learning: Evidence from high school mathematics. Proceedings of the National Academy of Sciences, 122(26), Article e2422633122.
6. Ma, W., Adesope, O. O., Nesbit, J. C., & Liu, Q. (2014). Intelligent tutoring systems and learning outcomes: A meta-analysis. Journal of Educational Psychology, 106(4), 901–918.
7. VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. Educational Psychologist, 46(4), 197–221.
8. Steenbergen-Hu, S., & Cooper, H. (2013). A meta-analysis of the effectiveness of intelligent tutoring systems on K–12 students' mathematical learning. Journal of Educational Psychology, 105(4), 970–987.
9. Celik, I., Dindar, M., Muukkonen, H., & Järvelä, S. (2022). The promises and challenges of artificial intelligence for teachers: A systematic review of research. TechTrends, 66(4), 616–630.
10. Celik, I. (2023). Towards Intelligent-TPACK: An empirical study on teachers' professional knowledge to ethically integrate artificial intelligence (AI)-based tools into education. Computers in Human Behavior, 138, Article 107468.
11. Nazaretsky, T., Ariely, M., Cukurova, M., & Alexandron, G. (2022). Teachers' trust in AI-powered educational technology and a professional development program to improve it. British Journal of Educational Technology, 53(4), 914–931.

Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 2, Issue 11, November, 2026
Website: usajournals.org
This work is Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

12. Molenaar, I. (2022). Towards hybrid human-AI learning technologies. European Journal of Education, 57(4), 632–645.
13. Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? International Journal of Educational Technology in Higher Education, 16, Article 39.
14. Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. International Journal of Artificial Intelligence in Education, 26(2), 582–599.
15. Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature. Education Sciences, 13(4), Article 410.
16. Tlili, A., Shehata, B., Adarkwah, M. A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. Smart Learning Environments, 10, Article 15.
17. Kohnke, L., Moorhouse, B. L., & Zou, D. (2023). ChatGPT for language teaching and learning. RELC Journal, 54(2), 537–550.
18. Yilmaz, R., & Karaoglan Yilmaz, F. G. (2023). The effect of generative artificial intelligence (AI)-based tool use on students' computational thinking skills, programming self-efficacy and motivation. Computers and Education: Artificial Intelligence, 4, Article 100147.
19. Fan, Y., Tang, L., Le, H., Shen, K., Tan, S., Zhao, Y., Shen, Y., Li, X., & Gašević, D. (2025). Beware of metacognitive laziness: Effects of generative artificial intelligence on learning motivation, processes, and performance. British Journal of Educational Technology, 56(2), 489–530.
20. Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Buckingham Shum, S., Santos, O. C., Rodrigo, M. T., Cukurova, M., Bittencourt, I. I., & Koedinger, K. R. (2022). Ethics of AI in education: Towards a community-wide framework. International Journal of Artificial Intelligence in Education, 32(3), 504–526.