

<https://doi.org/10.3126/jme.v6i1.95924>

Transforming Mathematics Teaching through GenAI: Classroom Experiences from Probability Lessons

Sthir Babu Subedi, Ph.D. Scholar, Tribhuvan University,

sthirbabusubedi@gbs.edu.np

Shristi Shrestha, Ph.D. Scholar, Iowa State University

shristi@iastate.edu

Subekshya Ghimire, Ph.D. Scholar, Ohio University

sg451723@ohio.edu

Article Info:

Received: July 27, 2025 | Revised: September 11, 2025 | Accepted: February 26, 2026

Abstract: *This study explores the use of Generative Artificial Intelligence (GenAI) tools, such as ChatGPT and Gemini, to teach probability to Grade 12 students in Nepal. Utilizing the Teaching Experience Methodology (TEM), this study was conducted across three classroom sections, each comprising 38 to 42 students. Data were collected through interviews, classroom observations, reflective notes, and student assessment scores to examine students' engagement, conceptual understanding, learning experiences, and the teacher's concerns regarding the integration of GenAI in the classroom. The findings indicated an increase in student engagement, characterized by active participation, peer discussions, and immediate feedback. Students demonstrated improved conceptual understanding by identifying errors in questions generated by AI and engaging in reflective problem-solving. Results also showed positive changes in metacognitive skills, and variations in learning experiences have been noticed. The study suggests that GenAI can support more interactive and student-centered mathematics instruction by adapting to students' needs, providing AI based teachers' trainings and careful verification of AI-generated contents.*

Keywords: *Artificial Intelligence, Generative AI, Mathematics Education, Probability Lesson, Teaching Experience Methodology, Students' Engagement*

Introduction

Artificial Intelligence (AI) is increasingly emerging as a powerful digital innovation in various sectors. In education, AI has contributed to the development of new teaching and learning approaches that are being applied across diverse educational contexts (Pedro et al., 2019). AI is primarily utilized to enhance students' learning experiences, and strengthen the efficiency and quality of instructional practices (Hwang et al., 2020). Its integration has introduced innovative pedagogical approaches, significantly transforming conventional learning systems globally, including Nepal, where the adoption of digital technologies in education is gradually expanding (Dhakal, 2025). A branch of artificial intelligence (AI) is Generative AI, also known as generative modelling, focused on creating models capable of generating new data that is similar to a given dataset (Chavan, et al., 2024). Generative Artificial (GenAI) as “a technology that (i) leverages deep learning models to (ii) generate human-like content (e.g., images, words) in response to (iii) complex and varied prompts (e.g., languages, instructions, questions).” Its application includes multiple input and output formats such as text-to-image, text-to-text, image-to-video, and text-to-video generation (Lim and colleagues, 2023). GenAI's capabilities extend from creating extremely personalized learning for students to systematizing routine tasks such as grading and developing instructional materials for teachers (Menon & Shilpa, 2023; Yilmaz & Yilmaz, 2023).

In mathematics education, GenAI tools provide innovative possibilities for personalized instruction, timely feedback, adaptive task design, and creative lesson preparation. It is increasingly

recognized as a useful resource for developing instructional materials (Ellis & Slade, 2023), supporting the mathematical problem-solving process (Guler et al., 2024), shaping teaching practice, and planning how these tools can improve students' conceptual understanding, engagement, and learning autonomy (Walkington, 2025; Xing et al., 2025). On the other hand, integrating ChatGPT and other large language models (LLMs) into mathematics learning poses many challenges (Gao et al., 2023). One key concern is the need for rigorous cross-checking to validate the accuracy and reliability of AI-generated mathematical content (Wardat et al., 2023). In addition, issues related to data privacy and the responsible use of AI must be carefully considered and addressed (Rane, 2023).

Students' active participation, teachers' self-confidence, and a supportive self-learning environment play a significant role in the learning process, and these aspects can be further strengthened through the use of GenAI (Silwal et al., 2025; Ghimire et al., 2024). GenAI assists teachers in preparing lesson plans efficiently by providing information in an accessible manner (Adhikari et al., 2026). Similarly, it can contribute to teachers' continuous professional development and assist in designing instructional strategies to address diverse learning needs. However, limited technical skill, data privacy concerns, and over-reliance on AI are the key challenges that may undermine critical thinking and weaken teacher-student relationships (Shrestha et al., 2025).

Existing studies reveal limited research on the integration of GenAI in teaching and learning contexts in Nepal. Most of the prior studies (Budhathoki et al., 2024; Shrestha et al., 2025; Neupane et al., 2025) have focused on higher education and English language learning. Research exploring the use of AI tools in K-12 education, especially in mathematics teaching, remains scarce. Therefore, this paper aims to explore and share the experiences of a mathematics teacher (first author) and students in implementing AI-augmented lessons on probability topics. The study highlights the processes of lesson planning, classroom implementation, teacher-researcher reflection, and students' feedback and learning experiences while integrating GenAI in the classroom.

Methodology

This study adopted Teaching Experimental Methodology (TEM) to explore the integration of AI-supported instructional practices in mathematics teaching. Teaching experiments are considered a dynamic research approach designed to investigate and explain students' mathematical thinking through a sequence of instructional episodes. Grounded in constructivist epistemology, TEM considers mathematical knowledge as actively constructed by learners through adaptation, interaction and reflection (Steffe & Thompson, 2000). This method allows the researcher to assess the viability of students' conceptual frameworks as they develop over time because instruction is not predetermined but rather changes in response to students' emerging mathematical ideas (Confrey, 2000). From this viewpoint, teaching experimentation serves as both a pedagogical and epistemological inquiry. Rather than considering teaching as a delivery mechanism, TEM regards it as an iterative process of developing hypothesis, and refining instructional actions based on students' mathematical reasoning (Czarnocha & Prabhu, 2006). Therefore, TEM was adopted for this study, as the aim of the research is to examine the evolving nature of students' mathematical reasoning in probability within an AI-supported instructional environment. It allowed the researcher to function as both teacher and investigator while systematically analyzing students' learning in a real classroom setting.

Research Context and Participants

The study was conducted in a secondary-level school in Nepal involving three Grade 12 mathematics sections: 12B, 12C, and 12D. Each section consisted of approximately 38 to 42 students. One of the researchers (first author) served as the classroom teacher for all three sections, enabling the consistent application of instructional strategies and ongoing reflection across all classrooms.

Instructional Procedure

A Consistent instructional plan was implemented across all three sections. Teaching was conducted four days per week according to the school's regular timetable. The probability unit was completed within 6 instructional periods of 40 minutes each. The topic "Probability" was systematically implemented across all sections. Instructional planning was carried out in alignment with the curriculum-prescribed instructional hours, and the teaching process was executed continuously in accordance with the actual class periods allocated by the school. The instructional intervention integrated mainly three GenAI tools (ChatGPT, Gemini, and Perplexity) for lesson planning, preparing multiple-choice questions (MCQs), classroom activities, and creating PowerPoint presentations. AI-generated materials were combined with whiteboard explanations, teacher-guided discussions, and collaborative classroom activities.

The instructional process focused on student-centered learning and constructivist learning approaches. GenAI tools were used to generate ideas for lesson plans, refine lesson plans, strengthen formative assessment practices, and provide immediate feedback opportunities. However, these tools were not used to replace the teacher's pedagogical decision-making. Instead, it was integrated as a supplementary tool. Likewise, feedback from previous classroom sections was continuously used to revise instructional strategies in subsequent lessons.

Data Collection and Analysis

Data collection was conducted through classroom observations, student interviews, teacher and student reflective notes, formative assessment results, and self-assessment activities. Classroom observations examined students' involvement, participation patterns, conceptual comprehension, and responses to GenAI-supported instruction. Throughout the teaching experiment, reflective notes were recorded of both the teacher's experiences and the students' reactions. Students' learning performance and conceptual development were evaluated using assessment results from quizzes, MCQs, and classroom activities.

Likewise, the study followed a thematic analysis approach (Braun & Clarke, 2006) to analyze qualitative data collected from interviews, observation, and reflective notes. The analysis process involved repeated readings of data sets, generating initial codes, categorizing similar patterns, and developing broader themes. Quantitative data from students' assessments were analyzed descriptively to identify patterns across the three sections.

Results

Five key themes emerged from the data: enhanced student engagement, improved conceptual understanding, impact on student learning performance, variations in learning experiences across academic sections, and implementation challenges.

Theme 1: Enhanced Student Engagement

The integration of GenAI-supported activities, including AI-generated MCQs, matching exercises, fill-in-the-blanks, and question-construction activities, significantly increased student engagement across all three sections. Students showed increased cognitive engagement that reflected in their active participation, attention, and enthusiasm during learning activities. In section 12C, students expressed engagement and excitement through informal reflections such as "fully concentrated," "felt new," and "it was fun," which indicated positive emotional engagement with the instructional approach. However, some students could not complete all the questions due to limited time and the absence of opportunities for peer interaction and group work. Due to the large class size (around 38 students) and a 40-minute period, it was difficult to conduct additional group work or extended activities. Similarly, in section 12B, the announcement of formative assessment made students more attentive and disciplined in the

classroom. The assessment results showed that 80% of students scored above 60% on the MCQs, indicating heightened student engagement with the instructional content

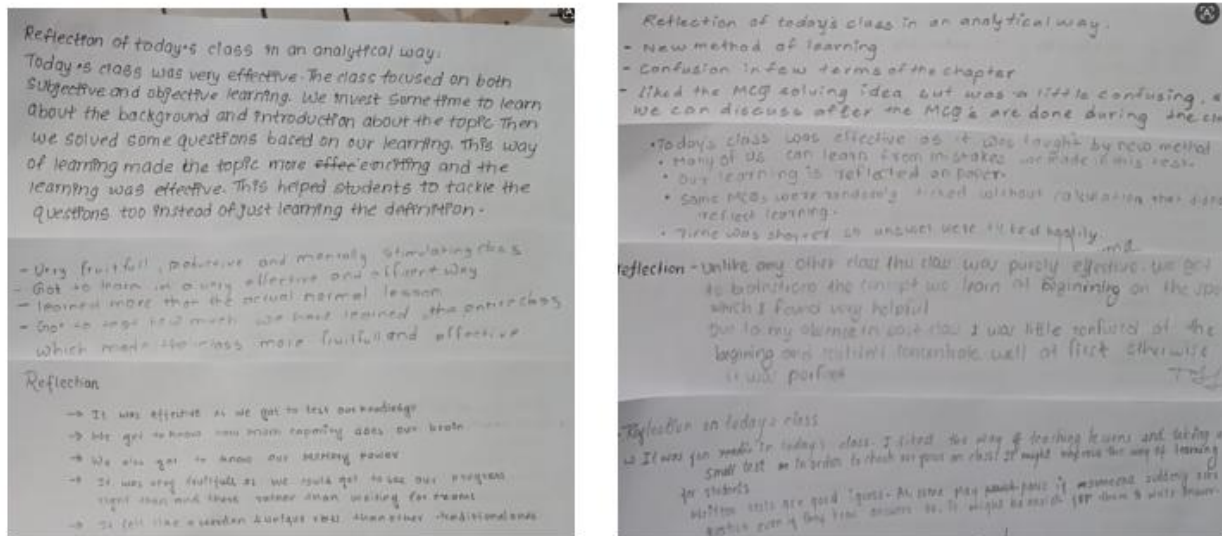


Figure 1. Students of 12B reflecting on their feelings about the class

One of the students remarked that “the class was very effective, focused on both subjective and objective knowledge”. This suggests that the emphasis on diverse learning and assessment strategies supported by AI enabled the students to master the class material. Another student stated, “Sir, keep today's record than yesterday because I did well obtain 34 out of 36 in today's test”. The student's desire to track and celebrate her progress in learning highlights her strong engagement in the learning process. However, in section 12D, students expressed limited affective engagement, suggesting a mismatch between instructional strategies and the cognitive needs of a talented learner group, although they were fully engaged while solving the objective questions displayed on the screen. Overall results show that, with the help of GenAI, supported by student-centered teaching strategies and assessment processes, lesson planning can be modified and developed to enhance student engagement in the classroom.

Theme 2: Improved Conceptual Understanding

GenAI-generated questions and examples deepened students' grasp of probability concepts, including basic terminology, sample space, exhaustive cases, mutually exclusive and independent events, conditional probability, combinations, and tree diagrams. Initial sessions revealed partial understanding, such as confusion between mutually exclusive and independent events. The use of AI-generated examples helped in clarifying these abstract concepts by connecting it with real-world situations.

In all sections, most students were confused about the relationships or differences between the sample space and exhaustive cases. GenAI supported the teacher as well as students to obtain detailed information that was not clearly stated in the textbook and reference books traditionally used in the classroom.

Likewise, students independently identified an error in a GenAI-generated MCQ about the probability of drawing a red ball without replacement. The correct probability was $1/7$, but it was not among the presented possibilities in the MCQ, as pointed out by the student. This incident demonstrates the importance of students' critical thinking in adopting GenAI-generated content in classrooms and underscores the need to evaluate AI-generated educational content. Overall, students demonstrated greater conceptual clarity through guided explanation, error analysis, and contextual problem-solving.

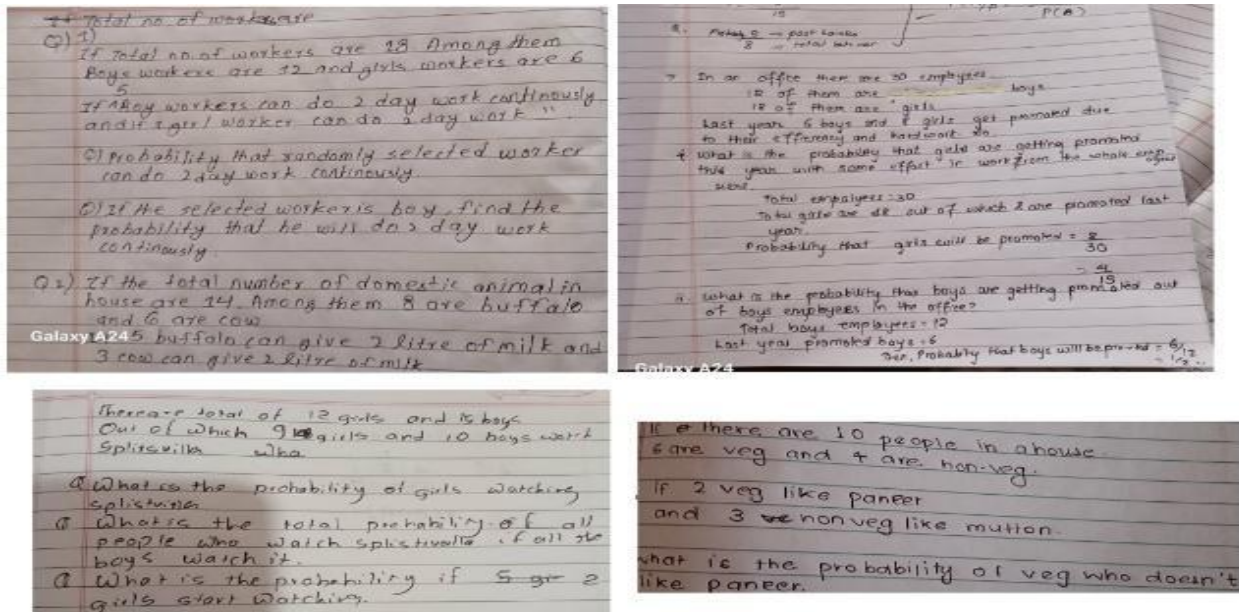


Figure 2. Students made the questions after getting the knowledge of conditional probability.

Theme 3: Impact on Student Learning Performance

Formative assessments conducted across multiple instructional days indicated gradual improvement in students' performance across all three sections. The details are given in the table below.

Second Day: Score of all Sections

Introduction of the Lesson and Definition of the Basic Terminologies

Table 1. Result of Matching Questions

Marks	1	2	3	4	5	6	7	8	9	10	11	12	Total no of students
12B				2	2		2	4	2	8		16	36
12C		2		2	1	1		1	6	6		14	33
12D							1		2	4	3	29	39

Table 2. Result of Multiple-Choice Questions

Marks	1	2	3	4	5	6	7	8	9	10	Total no of students
12B	1	2	1	6	6	6	3	6	3	2	36
12C		3	2	5	3	4	10	4	2		33
12D	1	1	2		8	9	9	6	3		39

Third Day: Score of 12D

Table 3. Mutually Exclusive Events

Marks	Less than 20	20 -25	25-30	30-35	Above 35
No. of Students 12B		5	21	9	
No. of Students 12C	4	6	18	8	
No. of Students 12 D	3	2	10	18	3

Fourth Day: Score of all Sections

Table 4. Conditional Probability

Marks	1	2	3	4	5	6	7	8	9	10	Total no of students
12B			2		5	11	5	10	3		36
12C			1	1	1	5	11	10	4	2	35
12D	Lack of time to complete the Lesson due to the large discussion on a problem										

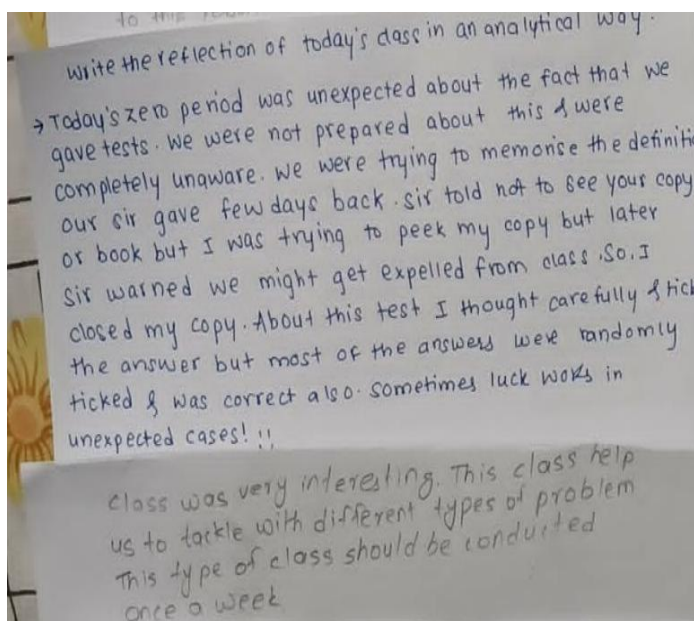
Assessment data from MCQs and structured activities indicated that the majority of students achieved moderate to high scores, with accuracy improving across subsequent classes. While Sections 12B and 12C had more dispersed performance patterns, a large percentage of students in Section 12D received full marks in early formative activities. Immediate feedback through GenAI tools enables students to identify errors. Students applied reasoning to verify their answers, aligning with the benefits of formative assessment for metacognitive awareness. High-performing students noted immediate self-realization through MCQs, though some lower performers felt uncomfortable with the exposure of their weaknesses. Overall, frequent assessments supported monitoring and improved outcomes through practice and feedback.

Theme 4: Variations in Learning Experiences Across Academic Sections

Students' learning experiences varied significantly throughout all three sections, affected by differences in academic aptitude, motivation, and classroom interaction patterns.

Section 12 B initially exhibited a positive response but showed mixed engagement over time, especially among lower-performing students, who expressed challenges with learning approaches based on self-evaluation.

Section 12C demonstrated strong positivity, with students aiding peers in discussions and accepting the approach for conceptual checks. Students showed positive attitudes towards GenAI-supported instruction. In this section, a few students were highly capable, while around one-fourth of the class struggled with the subject. The capable students supported the teacher during lesson delivery and assisted their peers.



12D students were relatively higher-performing students who preferred. Some reported that preparing their own questions was challenging, though all students remained actively engaged in the task. They were also encouraged to share their questions with peers and verify answers collaboratively; however, the limited time allowed only a few responses to be checked directly. Subsequently, additional examples were discussed, and multiple-choice questions were displayed on slides to strengthen students' problem-solving skills and confidence in handling examination-type questions. Unlike the earlier practice of questioning mainly high-performing students, this approach ensured that all students attempted the questions simultaneously within a limited time, helping manage classroom noise and encouraging equal participation. The responses indicated that the success of GenAI-supported teaching is influenced by student readiness, learning preferences, and classroom composition.

Theme 5: Implementation Challenges

There were many challenges in using GenAI-supported instruction, despite some positive outcomes. Differences in students' learning culture, levels of learning motivation, and adaptability influenced students' participation across all sections. While one section remained constantly engaging, another showed a lack of motivation over time and limited interest in the new instructional approach. The examination-oriented teaching and learning culture in Nepal further affected the implementation process. Some high-performing students liked the immediate feedback and self-evaluation opportunities, while others struggled with self-evaluation and preferred traditional teaching.

Similarly, inaccuracies inherent in the content generated by the free version of the GenAI tools employed in the study imposed a significant burden on the teacher to cross-verify the lesson material before implementation in classrooms. Additionally, the constraint of large class sizes and 40-minute periods hindered the effective implementation of GenAI-supported learning. Furthermore, some students expressed demotivation while engaging with the AI-generated student-centered lessons and preferred observing teacher-led demonstrations.

These findings suggest that effective integration of GenAI in mathematics classrooms requires adequate ICT infrastructure, availability of trained human resources, and supportive administrative systems. On the other hand, even when pedagogical strategies in the curriculum are revised, the evaluation system often remains unchanged. This creates difficulties for both implementing personnel and students, as the assessment practices continue to emphasize rote memorization rather than measuring students' logical reasoning, critical thinking, and conceptual understanding.

Discussion and Conclusion

The findings of this study revealed five major themes- enhanced student engagement, improved conceptual understanding, impact on students learning performance, variations in learning experience, and implementation challenges. Students' engagement was observed through cognitive, behavioral, and affective engagement. Active participation, pair discussions, feedback writing, and assessment review reflected the behavioral engagement. These findings suggested that GenAI-supported instructional activities encouraged a more interactive, and student-centered classroom environment. Earlier studies have also similarly highlighted that AI-supported learning environments can increase student interaction, participation, and learning motivation (Dabingaya, 2022; Sahin & Teke, 2025).

The classroom experiences across the three different sections showed that classroom composition influenced students' response to GenAI-integrated pedagogy. Struggling learners responded positively to guided participation activities, whereas high-performing students engaged in logical problem solving and analytical discussions. Progressive improvement in students' conceptual understanding across sections supports constructivist perspectives that emphasize active learning through collaboration and inquiry-based learning activities. Despite these positive results, the study also finds challenges related to dependence on GenAI-generated content that aligns with the research by Walkington (2025), which reveals that AI tools may sometimes provide incorrect or irrelevant information due to unfair or obsolete training data. It also suggests that teachers should evaluate AI-generated content critically and find the errors and inaccuracies to support learners effectively.

In diverse classrooms, GenAI-integrated instructions appeared more effective, with collaborative and cooperative activities helping learners be more actively involved. Classroom expectations also shape engagement and understanding; instructional materials alone do not ensure deep learning (Ramsden, 1997). Similarly, the findings showed that effective implementation of AI-integrated teaching requires teacher preparation and professional development, also emphasized by Oh (2025) and Normuminov (2025). According to Normuminov (2025), carefully designed prompts improved the significance and accuracy of AI-generated instructional materials. However, there are several operational challenges that limit the implementation of GenAI-integrated pedagogy in the

Nepali school context. Limited ICT infrastructure, lack of computer labs, insufficient students' access to digital devices, and limited interaction with AI technologies remain significant barriers to integrating GenAI tools in classrooms.

Finally, direct student access to digital platforms may further increase motivation and participation. Murthy et al. (2017) similarly argued that digital technologies can promote higher-order and student-centered learning when effectively integrated into instruction. Stefanova and Georgiev (2024) also emphasized the need for curriculum reform to support AI-integrated pedagogy in the classroom. Overall, teacher readiness, technological infrastructure, curriculum alignment, and instructional strategies responsive to diverse student needs are essential for the effective implementation of AI-integrated teaching and learning.

Implication

The study reveals that Generative Artificial Intelligence (GenAI) can support student-centered and constructivist approaches to mathematics instruction by enhancing student engagement, collaboration, critical thinking, and conceptual understanding. The findings suggest that diverse instructional strategies are necessary to address the learning needs of students from diverse backgrounds. Moreover, the study highlights the importance of teacher training in AI literacy, prompt design, and other relevant AI-related competencies for meaningful integration of GenAI into teaching practices. Future research could further examine the impact of GenAI on students' mathematics learning across diverse educational contexts in Nepal.

References

- Adhikari, B. P., Khare, V. K., Sapkota, N., Adhikari, S., & Bishwokarma, A. (2026). Global Readiness for AI-Integrated Education: Students' Competence and Perceptions of Generative AI in Learning and Assessment. *OCEM Journal of Management, Technology & Social Sciences*, 5(1), 129–164. <https://doi.org/10.3126/ocemjmtss.v5i1.89695>
- Ajuwon, N. O. A., Animashaun, N. E. S., & Chiekezie, N. N. R. (2024). Innovative teaching strategies in mathematics and economics education: Engaging students through technology, AI, and Effective Mentoring. *Open Access Research Journal of Science and Technology*, 11(2), 128–137. <https://doi.org/10.53022/oarjst.2024.11.2.0103>
- Batanero, C., & Sanchez, E. (2005). What is the Nature of High School Students' Conceptions and Misconceptions About Probability? In *Exploring probability in school: Challenges for teaching and learning* (pp. 241-266). Boston, MA: Springer US.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Budhathoki, T., Zirar, A., Njoya, E. T., & Timsina, A. (2024). ChatGPT adoption and anxiety: A cross-country analysis utilising the unified theory of acceptance and use of technology (UTAUT). *Studies in Higher Education*, 49(5), 831–846. <https://doi.org/10.1080/03075079.2024.2333937>
- Chiu, T. K. (2023). The impact of Generative AI (GenAI) on practices, policies and research direction in education: A case of ChatGPT and Midjourney. *Interactive Learning Environments*, 1-17. <https://doi.org/10.1080/10494820.2023.2253861>
- Chavan, J., Mankar, C., & Patil, V. (2024). Opportunities in research for generative artificial intelligence (GenAI), challenges and future direction: A study. *Int Res J Eng Technol*, 11(02), 446-51. <https://www.irjet.net/archives/V11/i2/IRJET-V11I272.pdf>
- Confrey, J., & Lachance, A. (2000). "Transformative Teaching Experiments: Underlying Principles and Essential Elements." *Handbook of Research Design in Mathematics and Science Education*. Lesh, R. & Kelly, A. E. (eds.). Hillsdale, NY: Lawrence Erlbaum.

- Czarnocha, B. (2016). How to approach a Teaching Experiment?. In *The Creative Enterprise of Mathematics Teaching Research: Elements of Methodology and Practice—From Teachers to Teachers* (pp. 163-170). Rotterdam: SensePublishers.
- Czarnocha, B. & Prabhu, V. (2006). "Teaching Experiment/NYC Model." *Roczniki PTM Dydaktyka Matematyki*, 29, 251-272
- Dabingaya, M. (2022). Analyzing the Effectiveness of AI-Powered Adaptive Learning Platforms in Mathematics Education. *Interdisciplinary Journal Papier Human Review*, 3(1), 1–7. <https://doi.org/10.47667/ijphr.v3i1.226>
- Dhakal, B. P. (2025). AI Use in Mathematics Education: Applications, Benefits, and Challenges. *Mangal Research Journal*, 6(1), 21-32. <https://doi.org/10.3126/mrj.v6i1.88145>
- Dahal, N. (2024). How can generative AI (GenAI) enhance or hinder qualitative studies? A critical appraisal from South Asia, Nepal. *The Qualitative Report*, 29(3), 722-733. <https://doi.org/10.46743/2160-3715/2024.6637>
- Ellis, A. R., & Slade, E. (2023). A new era of learning: Considerations for ChatGPT as a tool to enhance statistics and data science education. *Journal of Statistics and Data Science Education*, 1-10. <https://doi.org/10.1080/26939169.2023.2223609>.
- Gao, Y., Tong, W., Wu, E. Q., Chen, W., Zhu, G., & Wang, F.-Y. (2023). Chat with ChatGPT on interactive engines for intelligent driving. *IEEE Transactions on Intelligent Vehicles*, 8(3), 2034–2036. <https://doi.org/10.1109/TIV.2023.3252571>
- Ghimire, P. R., Neupane, B. P., & Dahal, N. (2024). Generative AI and AI Tools in English Language Teaching and Learning: An Exploratory Research. *English Language Teaching Perspectives*, 9(1-2), 30–40. <https://doi.org/10.3126/eltp.v9i1-2.68716>
- Guler, N. K., Dertli, Z. G., Boran, E., & Yildiz, B. (2024). An artificial intelligence application in mathematics education: Evaluating ChatGPT's academic achievement in a mathematics exam. *Pedagogical Research*, 9(2). <https://doi.org/10.29333/pr/14145>.
- Hwang, G.-J., Sung, H.-Y., Chang, S.-C., & Huang, X.-C. (2020). A fuzzy expert system-based adaptive learning approach to improving students' learning performances by considering affective and cognitive factors. *Computers and Education: Artificial Intelligence*, 1, Article 100003. <https://doi.org/10.1016/j.caeai.2020.100003>
- Konold, C., Pollatsek, A., Well, A., Lohmeier, J., & Lipson, A. (1993). Inconsistencies in students' reasoning about probability. *Journal for Research in Mathematics Education*, 24(5), 392–414. <https://doi.org/10.2307/749150>
- Menon, D., & Shilpa, K. (2023). "Chatting with ChatGPT": Analyzing the factors influencing users' intention to Use the Open AI's ChatGPT using the UTAUT model. *Heliyon*, 9(11). <https://doi.org/10.1016/j.heliyon.2023.e20962>
- Shrestha, B. L., Dahal, N., Hasan, M. K., Paudel, S., & Kapar, H. (2025).| Generative AI on professional development: A narrative inquiry using TPACK framework. *Frontiers in Education*. <https://doi.org/10.3389/educ.2025.1550773>
- Neupane, B. P., Paudel, P., Dahal, N., Karki, S., Paudel, G. R., Ghimire, P., & Thapa, B. (2025). English language teaching in the age of artificial intelligence: Tools, techniques, and methodologies. *Advances in Mobile Learning Educational Research*, 5(1), Article 1. <https://doi.org/10.25082/AMLER.2025.01.011>
- Lim, W. M., Gunasekara, A., Pallant, J. L., Pallant, J. I., & Pechenkina, E. (2023). Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators. *The International Journal of Management Education*, 21(2), 100790. <https://doi.org/10.1016/j.ijme.2023.100790>
- Mredula, N. K., Jonita, N. R., & Sajja, N. P. (2024). AI-Based Tools in Mathematics Education: A Systematic review of characteristics, applications, and evaluation methods. *International*

- Research Journal on Advanced Engineering Hub (IRJAEH)*, 2(07), 1958–1967.
<https://doi.org/10.47392/irjaeh.2024.0268>
- Murthy, S., Warriem, J. M., & Iyer, S. (2017). Technology integration for student-centered learning: A model for teacher professional development programs. In S. Murthy, J. M. Warriem, & S. Iyer (Eds.), *Emerging practices in scholarship of learning and teaching in a digital era* (pp. 55–74). Springer Singapore. https://doi.org/10.1007/978-981-10-3344-5_4
- Normuminov, M. (2025). Empowering pre-service English teachers through AI-based lesson design: A case study on Curipod. *Journal of Digital Sociohumanities*, 2(2), 142–149.
<https://doi.org/10.25077/jds.2.2.142-149.2025>
- Oh, S. (2025). Integration of MATH41 and generative AI in pre-service mathematics teacher education: An empirical study on lesson design competency. *IEEE Access*, 13, 128959–128973.
<https://doi.org/10.1109/access.2025.3586593>
- Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). *Artificial intelligence in education: Challenges and opportunities for sustainable development*. UNESCO.
<https://unesdoc.unesco.org/ark:/48223/pf0000366994>
- Ramsden, P. (1997). The context of learning in academic departments. In F. Marton, D. Hounsell, & N. Entwistle (Eds.), *The experience of learning* (2nd ed., pp. 198–216). Scottish Academic Press.
- Rane, Nitin (2023) Enhancing Mathematical Capabilities through ChatGPT and Similar Generative Artificial Intelligence: Roles and Challenges in Solving Mathematical Problems.
<http://dx.doi.org/10.2139/ssrn.4603237>
- Şahin, S., & Teke, B. (2025). Artificial Intelligence Integration in Mathematics Education: A SWOT-BWM Analysis. *Journal of Learning and Teaching in Digital Age*, 10(2), 273–286.
<https://doi.org/10.53850/joltida.1667650>
- Silwal, U., Kafle, R., & Dhungana, R. (2025). Generative AI in Teaching and Learning: Benefits and Challenges. *Journal of Nepal Physical Society*, 11(1), 62-74.
<https://doi.org/10.3126/jnphysoc.v11i1.87466>
- Stefanova, T., & Georgiev, S. (2024). Possibilities for using AI in mathematics education. *Mathematics and Education in Mathematics*, 53, 117–125. <https://doi.org/10.55630/mem.2024.53.117-125>
- Steffe, L. P., & Thompson, P. W. (2000). “Teaching Experiment Methodology: Underlying Principles and Essential Elements.” *Handbook of Research Design in Mathematics and Science Education*. R. Lesh & A. E. Kelly (Eds.). Hillsdale, NJ: Lawrence Erlbaum. 267-307. Lawrence Erlbaum Associates.
- Wardat, Y., Tashtoush, M. A., AlAli, R., & Jarrah, A. M. (2023). ChatGPT: A revolutionary tool for teaching and learning mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, 19(7), em2286. <https://doi.org/10.29333/ejmste/13272>
- Walkington, C. (2025). The implications of generative artificial intelligence for mathematics education. *School Science and Mathematics*. <https://doi.org/10.1111/ssm.18356>
- Xing, W., Song, Y., Li, C., Liu, Z., Zhu, W., & Oh, H. (2025). Development of a generative AI-powered teachable agent for middle school mathematics learning: A design-based research study. *British Journal of Educational Technology*. <https://doi.org/10.1111/bjet.13586>
- Yilmaz, R., & Yilmaz, F. G. K. (2023). Augmented intelligence in programming learning: Examining student views on the use of ChatGPT for programming learning. *Computers in Human Behavior: Artificial Humans*, 1(2), 100005. <https://doi.org/10.1016/j.chbah.2023.100005>