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A Framework for integrating Active Learning principles in Lecture-Based Teaching: Opportunities and challenges.

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ABSTRACT:

- Purpose: This review examines the integration of active learning strategies within traditional lecture formats in higher education, focusing on enhancing student engagement and academic outcomes.
- Methodology: A comprehensive literature search was conducted in key academic databases including PubMed, ScienceDirect, EBSCO, and ProQuest, covering publications from the past ten years. Relevant articles on the integration of active learning strategies within traditional lecture formats were screened for inclusion based on their focus, methodology, and contribution to the topic. The selected studies from diverse disciplines such as medical, dental, and STEM education were then analyzed. The review synthesizes theoretical foundations, empirical findings, and practical considerations to evaluate the effectiveness and implementation of active learning approaches in traditional higher education lectures.
- Findings:Active learning approaches significantly improve both student satisfaction and performance. Multi-dimensional engagement like behavioral, cognitive, emotional, social with skilled facilitation are critical to maximizing the benefits of active learning principles within traditional lecture settings.

Implications: Challenges related to curricular constraints, physical classroom design, resource allocation, and faculty workload are identified. Strategies to overcome resistance among instructors and learners include comprehensive faculty development, peer mentoring, and institutional support. These insights provide guidance to sustain pedagogical innovation and enhance educational quality across varied contexts

1. Introduction

Student learning is a multifaceted process influenced by pedagogical strategies, institutional contexts, and individual learner characteristics. The shift from passive lecture-based instruction to active engagement methods reflects an evolving understanding of how knowledge is acquired, retained, and applied in professional contexts (Bavishi et al., 2022). Traditional lectures often prioritize information transmission over interaction, which can limit opportunities for learners to apply concepts, analyze problems, and develop higher-order thinking skills. In contrast, active learning approaches integrate elements such as collaborative exercises, problem-solving tasks, and reflective activities that engage students cognitively and socially (Evans, 2022). This shift is particularly relevant in disciplines where practical application of theoretical knowledge is essential for professional competence.

The significance of student learning extends beyond immediate academic outcomes to encompass the development of skills required for complex decision-making and lifelong adaptability. For example, in medical education, competencies such as clinical reasoning, diagnostic accuracy, and patient communication depend on the ability to synthesize information from multiple sources under time constraints. Approaches that encourage active participation, such as case-based discussions or laboratory simulations, can strengthen these competencies by situating learning within contextually

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rich scenarios (Elendu et al., 2024). By engaging with material actively rather than passively receiving it, students are more likely to form durable cognitive connections that support long-term retention. Empirical evidence underscores the benefits of structured active learning interventions on academic performance (Majdi et al., 2025).

Studies comparing traditional lecture formats with interactive sessions have reported measurable improvements in both immediate assessment scores and conceptual understanding. These findings highlight a critical connection between engagement level and mastery of subject matter (Sahito et al., 2025). The quality of student learning also depends on the degree to which instructional design aligns with learner's needs. Another important aspect concerns learner perceptions and attitudes toward different teaching formats. While many students report increased satisfaction and confidence when engaged in interactive sessions, variability exists in how individuals respond to such methods (Bergdahl et al., 2024). Some may thrive in collaborative environments, whereas others might prefer structured lectures supplemented by optional engagement opportunities. This suggests that adaptive instructional models capable of accommodating diverse preferences could maximize overall gains in student learning.

2. Literature Review

The traditional lecture method has long been the dominant instructional approach in higher education, particularly in disciplines with large student enrollments and content-heavy curricula. This method typically involves a one-way transmission of information from instructor to students, with limited opportunities for interaction during the session(Evans, 2022). Its persistence can be attributed to factors such as institutional norms, logistical constraints, and perceptions of efficiency in covering extensive material within fixed timeframes. In many undergraduate STEM and professional programs, lectures remain the primary format despite increasing evidence that active learning strategies can yield superior outcomes. One characteristic advantage of the lecture format is its scalability (Klein et al., 2023). A single instructor can address hundreds of students simultaneously, ensuring consistent delivery of core content. This is particularly useful in settings where faculty numbers are limited or where physical resources constrain the adoption of more interactive formats (Klein et al., 2023).

However, this efficiency often comes at the expense of student engagement. The passive nature of listening without active participation may limit cognitive processing, reducing opportunities for learners to apply concepts or receive immediate feedback. Over time, this can contribute to lower retention rates and diminished mastery of course objectives (Bergdahl, 2022). Despite these limitations, traditional lectures still hold pedagogical value under certain conditions. For complex topics requiring precise explanations or sequential reasoning guided by an expert, a structured lecture can provide clarity and coherence that might be harder to achieve in more fragmented interactive settings. Furthermore, some learners prefer the predictability and organization offered by lectures, particularly when they align with their preferred study habits or when they serve as a foundation before engaging in applied activities(Hattie and O'Leary, 2025). This suggests that rather than being entirely replaced, lectures may function most effectively as part of a blended instructional model. In professional education contexts such as medical training, lectures often form the backbone of curriculum delivery. These sessions are sometimes supplemented with optional laboratory work or case discussions but remain central to the dissemination of baseline knowledge (Liu et al., 2016). Yet research indicates that relying solely on this method may not adequately prepare students for tasks requiring critical thinking and problem-solving under real-world conditions. Institutional inertia plays a significant role in maintaining lecture dominance.

Nevertheless, there is growing recognition that traditional lectures can be modified to incorporate elements that promote engagement without fully abandoning their structure. Integrating brief interactive components such as embedded quizzes or mini-case discussions within a lecture has been shown to improve immediate mastery of learning objectives and increase participation rates compared to purely didactic sessions (Chan et al., 2023). These incremental changes can serve as an entry point for instructors who are hesitant about fully transitioning to alternative models like team-based learning (TBL) or flipped classrooms.

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Thejaswini et al. (6) highlight how structured collaborative formats such as TBL differ fundamentally from standard lectures by embedding pre-class preparation and continuous feedback mechanisms into the learning process. While these approaches demand greater student involvement during class time, their principles, active participation and iterative assessment, can inform enhancements to conventional lectures as well. By strategically integrating short peer interactions or reflective pauses into otherwise linear presentations, educators can stimulate deeper processing of material while retaining the logistical benefits of large-group instruction (Thejaswini et al., 2025).

From a curricular perspective, lectures also play an important role in establishing a shared knowledge base across diverse cohorts. However, ensuring that this exposure translates into long-term retention remains a challenge without supplementary active reinforcement strategies. Ultimately, while criticisms of the traditional lecture focus on its passivity and limited adaptability to individual learner needs, its continued prevalence reflects both practical constraints and enduring strengths in certain contexts (Felemban et al., 2025). The challenge lies not necessarily in eliminating the lecture but in evolving it, aligning its delivery with modern pedagogical insights while acknowledging institutional realities. By doing so, higher education can preserve the efficiencies inherent in large-scale content delivery while addressing demands for more interactive and cognitively engaging experiences that better prepare students for professional practice (Blackley et al., 2020).

2.1 The Foundational Evidence: Why Interactive Lectures Drive Superior Learning Outcomes

Comparative analyses of active learning strategies and traditional lecture formats reveal consistent patterns favoring interactive approaches across a range of performance metrics. Studies comparing pre- and post-test outcomes demonstrate that both didactic lectures and team-based learning (TBL) can enhance student performance; however, when normalized gains are considered, TBL and other active methods often yield superior relative improvements (Boedeker et al., 2025).

Evidence from multi-year studies in medical education further supports the advantage of active methodologies. Marshall et al. reported that lower-performing students benefited disproportionately from active learning interventions compared to their peers in traditional lecture settings. In a pharmacology course spanning two academic years, students assigned to a case-oriented self-learning and review group consistently outperformed those in a standard lecture group on mid-term examinations, though differences on final exams were smaller. These findings imply that active learning may accelerate early comprehension and application skills, potentially narrowing achievement gaps between different performance strata (Marshall et al., 2014). The impact of specific active learning enhancements within otherwise lecture-based courses has also been examined. Incorporating student response systems (SRS) into lectures led to higher immediate quiz scores compared to lectures without this technology.

By contrast, learners exposed exclusively to didactic delivery often perform well on recognition-based test items but underperform on scenario-based tasks requiring synthesis and judgment under uncertainty. The differential effects observed across assessment types highlight an important methodological consideration: outcome measures must align with targeted competencies. When evaluations focus narrowly on rote memorization, differences between lecture and active methods may appear modest or negligible (Sushama et al., 2023). However, when assessments incorporate applied problem-solving or integrative reasoning elements, performance gaps tend to widen in favor of active approaches.

In a similar vein, lower-achieving students tend to exhibit larger relative improvements in active settings compared to high-achievers who may already possess effective independent study strategies. This suggests a compensatory effect wherein structured interactivity provides scaffolding that disproportionately benefits those lacking prior mastery or robust metacognitive skills. Conversely, high-achieving students still benefit from increased engagement but may show smaller marginal gains due to ceiling effects on certain measures (Han, 2021).

The influence of instructional format on assessment and examination performance has been a focal point in comparative studies between active learning approaches and traditional lecture delivery. Evidence indicates that active learning interventions often yield measurable

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advantages in both formative and summative assessments, though the magnitude and persistence of these benefits can vary depending on the nature of the evaluation, the subject matter, and the implementation quality (Kozanitis and Nenciovici, 2023). In this vein the next section discusses the ten essential guidelines for incorporating active learning principles in traditional lectures.

3. Methodology

A comprehensive literature search was conducted in key academic databases including PubMed, ScienceDirect, EBSCO, and ProQuest, covering publications from the past ten years. Relevant articles on the integration of active learning strategies within traditional lecture formats were screened for inclusion based on their focus, methodology, and contribution to the topic. The selected studies from diverse disciplines such as medical, dental, and STEM education were then analyzed. The review synthesizes theoretical foundations, empirical findings, and practical considerations to evaluate the effectiveness and implementation of active learning approaches in traditional higher education lectures.

4. Discussion

4.1 Ten Essential Guidelines for Designing and Delivering Highly Effective Interactive Lectures

Guideline 1: Define clear learning objectives and share them upfront

Explicitly stating learning goals at the start of every lecture provides students with a clear purpose and helps focus their attention. This transparency enhances motivation and aligns with outcome-based curricula. Objectives should be SMART (Specific, Measurable, Achievable, Relevant, Time-bound) and clearly displayed (Nguyen et al., 2021).

Guideline 2: Chunk content and break the Lecture into manageable segments

Organize material into 5–15-minute segments, each with a defined focus. This addresses attention declines and manages cognitive load. Incorporate active learning tasks or discussions between segments to maintain engagement (Nivetha and Prashanth, 2025).

Guideline 3: Start with an engaging prompt or Mini-Case

Begin with a clinical scenario, provocative question, or quick quiz to stimulate curiosity and contextualize material. Case-based introductions connect learning to real-world situations, improving retention (Qablan et al., 2024).

Guideline 4: Integrate active learning techniques frequently

Integrate active learning techniques every 10–15 minutes to maximize engagement and retention. This promotes deeper learning, sustains attention, and provides real-time feedback. High-impact strategies include Think-Pair-Share, mini quizzes/polls, small group problem-solving, and brief pauses for reflection or "minute papers" (Martinez and Gomez, 2025).

Table 1

Diverse Active Learning Techniques for Lecture Integration

Technique Name	Brief Description	Primary Pedagogical Benefit
Think-Pair-Share (TPS)	Individual thought, paired discussion, then whole-class sharing.	Critical thinking, peer collaboration, articulation of ideas.
Mini Quizzes/Polls	Short, quick questions using response systems to check	Formative assessment, immediate feedback, engagement.

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	understanding.	
Small Group Problem-Solving	Students work in small groups to solve a problem or case.	Collaborative problem-solving, application, critical thinking.
Minute Papers/Reflection Pauses	Students write briefly on key takeaways or "muddiest points."	Self-assessment, comprehension check, consolidation.
Jigsaw Learning	Students become experts on a topic and teach it to peers.	Peer instruction, collaborative learning, deep understanding.
Role Play	Students act out scenarios to practice skills.	Skill development, empathy, application.
Case Studies/Simulations	Presenting real-life scenarios for analysis and discussion.	Critical thinking, problem-solving, real-world application.
Skeleton Notes	Handouts with key points, space for student notes and comparison.	Note-taking, active listening, content review.
Correct the Error	Students identify and fix intentional errors in material.	Critical analysis, attention to detail, conceptual understanding.
Student-Created Visuals	Small groups create flowcharts, diagrams, maps, etc.	Synthesis, conceptual organization, peer teaching.

Guideline 5: Incorporate multimedia and technology wisely

Integrate visuals, videos, polls, and simulations to reinforce key points and enable real-time feedback. Interactive technologies enhance learning attitudes, self-efficacy, and outcomes.Polling systems like Menti meter, Wooclap, and Poll Everywhere provide real-time insights into student comprehension (Khan, 2025; Malekjafarian and Gordan, 2024; Wood, 2020).

Table 2

Key Technology Tools for Enhancing Lecture Interaction

Tool Category	Specific Tools	Key Features	Primary Use Cases/Benefits	Considerations/Limitations
Polling Systems	Menti meter	MCQ, Word Clouds, Live Q&A,	Formative Assessment, Icebreakers,	Free version limits participants/activities

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		Surveys, Templates	Feedback, Engagement	vs. paid
	Wooclap	Online Quizzes (MCQ, custom), Surveys, Brainstorming	Assessment, Critical Thinking, Group Bonds, Idea Generation	Strong alternative to Kahoot! More features in free version
	Kahoot!	Quizzes, Polls, Jumbles, Discussions (game-based)	Fun, dynamic learning, content memorization	No real-time question management, brainstorming, or slide control
	Poll Everywhere	MCQ, Open-ended, Word Clouds, Live Visualizations	Real-time feedback, anonymous polling, discussion facilitation	Free for up to 40 students; paid for larger classes
	Zoom Polls	MCQ, Anonymous options, Single/Multiple select	Quick checks, engagement in virtual meetings	Must be hosted to launch; limited question types
Collaborative Platforms	Google Docs, Microsoft Word, Padlet	Shared documents, real-time editing, virtual whiteboards	Group problem-solving, shared notetaking, brainstorming	Requires internet access; potential for distraction
Backchannel Communication	X (Twitter), Google Moderator	Real-time text-based conversations during lectures	Anonymous questions, broader participation, trend identification	Requires careful moderation to stay on topic
Pre-Class	Just-in-Time	Pre-class quizzes, class	Active preparation,	Requires student accountability for pre-

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Engagement	Teaching (JiTT)	time for misconceptions	targeted instruction, deep learning	reading
Interactive Simulations	Labster, Play Posit Live Broadcast	Hands-on exploration of complex concepts	Skill practice, application of knowledge, conceptual understanding	Requires specific software/tools; content-dependent

Guideline 6: Foster two-way communication throughout

Encourage students to ask questions, discuss concepts, and share perspectives This dynamic interaction enhances critical thinking and builds stronger connections among students. Techniques include open-ended questions, classroom response systems for anonymous participation and backchannel communication (Ghafar and Hazaymeh, 2024).

Guideline 7: Connect theory to practice with relevant examples and clinical cases

Use relevant examples and clinical cases to illustrate abstract ideas and highlight their application to professional contexts. This improves the transfer of learning and deepens understanding. Examples include Interactive Case Studies (ICS) from the University of Cincinnati and Open Case Studies (OCS) from Johns Hopkins and Harvard (Amelia et al., 2024).

Guideline 8: Manage cognitive load and avoid information overload

Focus on essential concepts, eliminating non-critical information. Provide concise summaries, clear visual aids, and regular pauses for students to process and consolidate knowledge. Intentional slowing of pace improves comprehension (Arnold et al., 2009).

Guideline 9: Assess learning and provide formative feedback in-class

Integrate in-class questions, audience response systems, or short assessments to check understanding, provide immediate feedback, and inform teaching adjustments. Formative assessment offers insight into student comprehension, allowing real-time adjustments (Schildkamp et al., 2020).

Guideline 10: Conclude with a clear summary and action points

End by summarizing key takeaways, clarifying unresolved questions, and suggesting follow-up activities (readings, practice, reflection). This enhances knowledge consolidation and supports continued learning. A "power closing" connects back to the beginning and sets up future work(Córdova-Esparza et al., 2024).

4.2. Common Challenges and solutions for Implementing Interactive Lectures

A. Navigating Time Constraints and Pacing Effectively

Challenge: Active learning can seem to consume valuable lecture time, leading to concerns about covering material. Time and workload considerations represent a significant deterrent for faculty contemplating the integration of active learning strategies into their teaching practice. The transition from conventional lecture delivery to more interactive formats typically demand greater preparation time, both in the initial design phase and in ongoing refinement across course iterations. This front-loaded investment can be particularly burdensome for instructors already managing heavy teaching loads or balancing substantial research obligations, especially in institutional contexts where pedagogical innovation is not formally recognized or rewarded (Syeda et al., 2025).

Solution Strategies: Use shorter, targeted "lecturettes", build in strategic pauses, prioritize essential content, and plan meticulously.

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B. Strategies for Large Classrooms: Maximizing Engagement and Managing Logistics

Challenge: Physical classroom constraints impose tangible barriers to the effective adoption of active learning strategies, particularly when attempting to transition from lecture-centric delivery to more interactive formats. One of the most prominent limitations lies in the fixed architectural design of many traditional lecture halls. Seating arrangements in tiered auditoriums are often bolted in place, oriented toward a single focal point at the front of the room. This configuration optimizes visibility for didactic presentations but significantly impedes face-to-face interaction among students(Olawumi, 2022).

*Solution Strategies:*Crucial instructor preparation, early tone setting, interactive lectures with chunking and group activities, effective questioning techniques (e.g., anonymous polling), and leveraging technology for scalability.

C. Overcoming Student and Faculty Resistance to Active Learning

Student affective and behavioral responses to the integration of active learning strategies into traditionally lecture-based courses are complex and can vary considerably across individuals and contexts. These responses encompass emotional reactions such as enthusiasm, anxiety, frustration, or enjoyment, as well as observable behaviors including participation levels, persistence in tasks, and willingness to engage with peers during collaborative activities(Martinez and Gomez, 2025). The interplay between affective states and behavioral patterns is critical because emotions can directly influence the depth and sustainability of participation. For instance, positive affective responses, such as increased interest or a sense of accomplishment, tend to reinforce active behaviors like contributing to discussions or volunteering answers, creating a feedback loop that strengthens overall engagement (Cents-Boonstra et al., 2021). Conversely, negative emotions such as confusion or apprehension may lead to withdrawal behaviors, minimal verbal contributions, or reliance on passive observation rather than active involvement. Initial exposure to active learning often triggers mixed affective responses shaped by prior educational experiences. Students accustomed to passive lecture formats may feel discomfort when asked to assume greater responsibility for knowledge construction (Cents-Boonstra et al., 2021).

Faculty perceptions of the efficacy of active learning strategies are shaped by a combination of personal teaching experiences, observed student outcomes, disciplinary norms, and institutional signals regarding pedagogical priorities. These perceptions often determine whether instructors choose to adopt, persist with, or abandon interactive methods in favor of more familiar lecture-based delivery. Conversely, when outcomes do not align with expectations, such as minimal change in exam performance or continued disengagement among certain subgroups, faculty may question the value of active approaches relative to their resource demands (Aksoy, 2025).

Solution Strategies: Educate on benefits, ensure transparency and clear expectations, start with small, low-risk techniques, and foster instructor enthusiasm.

D. Thoughtful Technology Integration: Selection, Implementation, and Support

Challenge: In many higher education settings, the proliferation of technologies can overwhelm instructors and disrupt the learning experience, as educators face frustrating integration issues and misaligned tools that distract from pedagogical goals. Peer-reviewed literature highlights that this technological overload, compounded by insufficient training and support, undermines both teaching effectiveness and student engagement (Dr. Ranbir, 2024).

Solution Strategies: Strategically select easy-to-use tools, provide comprehensive technical support, prioritize accessibility, and align technology with pedagogical goals.

E. Adapting Interactive Lectures for Hybrid and Online Learning Environments

Challenge: Hybrid and online learners often experience a pronounced sense of isolation, as technological constraints hinder their ability to observe classroom dynamics or participate fully. This is compounded by unclear pacing and diminished face-to-face contact, which can lead to confusion and disengagement (Bergdahl, 2022).

Solution Strategies: Establish clear expectations and consistency, prioritize active learning and interaction

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(e.g., mixed breakout rooms), balance synchronous and asynchronous learning, and foster a sense of community.

4.3. Practical Implementation and Continuous Professional Development

The goals and learning outcomes of faculty development programs aimed at supporting the integration of active learning strategies into lecture-based teaching must be defined with precision to ensure alignment between training content, pedagogical intent, and measurable instructional improvements. A primary goal is to equip instructors with both the theoretical grounding and practical competencies necessary to design, facilitate, and evaluate active learning activities that address the multidimensional nature of student engagement, behavioral, cognitive, emotional, and social (Bilal et al., 2019).

A further program goal is to enhance faculty proficiency in aligning active learning designs with assessment structures. Misalignment between in-class activities emphasizing higher-order thinking and summative evaluations focused on recall has been shown to undermine student motivation for participation. Development initiatives should therefore train instructors to map intended learning outcomes for each activity onto corresponding formative or summative assessment items. This mapping process reinforces constructive alignment principles by ensuring that the skills practiced actively are those rewarded in evaluation. A measurable outcome here would be participants demonstrated ability to redesign at least one existing assessment item set so that it authentically evaluates competencies fostered through active engagement(Hamdoun, 2023).

Training should introduce frameworks for collecting multi-dimensional engagement data (e.g., combining behavioral indicators like attendance with self-reported cognitive investment) and using these insights for iterative improvement cycles. The expected outcome here is that participants will develop a post-implementation review protocol incorporating both quantitative performance metrics and qualitative feedback from students, peers, or self-observation logs. (Kleimola and Leppisaari, 2022).

Finally, development initiatives should aim to strengthen faculty's ability to articulate the pedagogical rationale for active learning within their professional communities. This advocacy skill is vital for sustaining adoption beyond individual courses by influencing departmental culture and mentoring colleagues new to interactive methods (Zhang et al., 2025).

5. Conclusion

This comprehensive review synthesizes extensive research on integrating active learning strategies within traditional lecture-based teaching, emphasizing their capacity to enhance student engagement and academic outcomes across diverse higher education contexts. The evidence consistently indicates that active learning approaches, ranging from interactive lectures and collaborative group work to problem-based and technology-enhanced methods, offer significant advantages over conventional didactic formats, particularly in promoting deeper cognitive processing, sustained motivation, and practical skill development. These benefits are most pronounced when instructional design thoughtfully aligns activities with clear learning objectives, assessment frameworks, and the varied needs of learners.

Critical to successful implementation is the role of skilled facilitation, which encompasses both preparatory explanation and dynamic in-class guidance to maintain equitable participation and address emergent challenges. Faculty development programs that embed active learning principles experientially, coupled with ongoing peer mentoring and collaborative communities, emerge as essential mechanisms for building and sustaining instructional capacity. Institutional support, including resource allocation, infrastructural enhancements, and policy alignment, further undergirds the scalability and durability of these pedagogical innovations.

The review also highlights the importance of accommodating diverse student characteristics through inclusive design informed by universal design principles, ensuring equitable access and participation across cognitive, cultural, and technological dimensions. Transitioning students from passive recipients to active contributors requires deliberate scaffolding, clear communication of relevance, and alignment of assessment practices that reward higher-order thinking and authentic application.

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The author declares the use of Artificial Intelligence (AI) in writing this paper. In particular, the author used ChatGPT for generating table and writing the letter to the editor.

References

1. Aksoy, E., 2025. Perceptions of Active Learning among Faculty in Student-centered Universities. Lang. Teach. Educ. Res. 8, 1–12. https://doi.org/10.35207/later.1674855
2. Amelia, R., Sukroyanti, B.A., Prayogi, S., 2024. The Impact of Case-Based Learning on Students' Critical Thinking: Insights from an Experimental Study. Lensa J. Kependidikan Fis. 12, 244. https://doi.org/10.33394/j-lkf.v12i2.13371
3. Arnold, J.C., Singh, K.K., Milder, E., Spector, S.A., Sawyer, M.H., Gavali, S., Glaser, C., 2009. Human Metapneumovirus Associated With Central Nervous System Infection in Children. Pediatr. Infect. Dis. J. 28, 1057–1060. https://doi.org/10.1097/INF.0b013e3181acd221
4. Bavishi, P., Birnhak, A., Gaughan, J., Mitchell-Williams, J., Phadtare, S., 2022. Active Learning: A Shift from Passive Learning to Student Engagement Improves Understanding and Contextualization of Nutrition and Community Health. Educ. Sci. 12, 430. https://doi.org/10.3390/educsci12070430
5. Bergdahl, N., 2022. Engagement and disengagement in online learning. Comput. Educ. 188, 104561. https://doi.org/10.1016/j.compedu.2022.104561
6. Bergdahl, N., Bond, M., Sjöberg, J., Dougherty, M., Oxley, E., 2024. Unpacking student engagement in higher education learning analytics: a systematic review. Int. J. Educ. Technol. High. Educ. 21, 63. https://doi.org/10.1186/s41239-024-00493-y
7. Bilal, Guraya, S.Y., Chen, S., 2019. The impact and effectiveness of faculty development program in fostering the faculty's knowledge, skills, and professional competence: A systematic review and meta-analysis. Saudi J. Biol. Sci. 26, 688–697. https://doi.org/10.1016/j.sjbs.2017.10.024
8. Blackley, S., Luzeckyj, A., King, S., 2020. Re-valuing higher education: learning(s) and teaching(s) in contested spaces. High. Educ. Res. Dev. 39, 1–12. https://doi.org/10.1080/07294360.2020.1689604
9. Boedeker, P., Schlingmann, T., Kailin, J., Nair, A., Foldes, C., Rowley, D., Salciccioli, K., Maag, R., Moreno, N., Ismail, N., 2025. Active Versus Passive Learning in Large-Group Sessions in Medical School: A Randomized Cross-Over Trial Investigating Effects on Learning and the Feeling of Learning. Med. Sci. Educ. 35, 459–467. https://doi.org/10.1007/s40670-024-02219-1
10. Cents-Boonstra, M., Lichtwarck-Aschoff, A., Denessen, E., Aelterman, N., Haerens, L., 2021. Fostering student engagement with motivating teaching: an observation study of teacher and student behaviours. Res. Pap. Educ. 36, 754–779. https://doi.org/10.1080/02671522.2020.1767184
11. Chan, K.K.S., Fung, W.T.W., Leung, D.C.K., 2023. Self-compassion mitigates the cognitive, affective, and social impact of courtesy stigma on parents of autistic children. Soc. Psychiatry Psychiatr. Epidemiol. 58, 1649–1660. https://doi.org/10.1007/s00127-022-02413-9
12. Córdova-Esparza, D.-M., Romero-González, J.-A., Córdova-Esparza, K.-E., Terven, J., López-Martínez, R.-E., 2024. Active Learning Strategies in Computer Science Education: A Systematic Review. Multimodal Technol. Interact. 8, 50. https://doi.org/10.3390/mti8060050
13. Dr. Ranbir, 2024. Educational Technology Integration: Challenges and Opportunities.

Innov. Res. Thoughts 10, 75–79. https://doi.org/10.36676/irt.v10.i2.1406
14. Elendu, C., Amaechi, D.C., Okatta, A.U., Amaechi, E.C., Elendu, T.C., Ezeh, C.P., Elendu, I.D., 2024. The impact of simulation-based training in medical education: A review. Medicine (Baltimore) 103, e38813. https://doi.org/10.1097/MD.0000000000038813
15. Evans, T., 2022. Traditional lectures versus active learning – A false dichotomy? STEM Educ. 2, 275–292. https://doi.org/10.3934/steme.2022017
16. Felemban, R.A., Khan, M.A., Alharbi, N.S., 2025. Comparing Case-Based and Lecture-Based Learning Methods in Pharmacology Teaching: Assessing Learning Outcomes, Memory Retention, and Student Satisfaction at the College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Jeddah, Saudi Arabia. J. Med. Educ. Curric. Dev. 12, 23821205251332814. https://doi.org/10.1177/23821205251332814
17. Ghafar, Z.N., Hazaymeh, O., 2024. Effective Questioning in the Classroom: An Overview of the Techniques Used by Instructors. Int. J. Child. Educ. 5, 1–14. https://doi.org/10.33422/ijce.v5i2.676
18. Hamdoun, W.M.A., 2023. Constructive Alignment Approach: Enhancing Learning and Teaching. Br. J. Multidiscip. Adv. Stud. 4, 162–170. https://doi.org/10.37745/bjmas.2022.0173
19. Han, F., 2021. The Relations between Teaching Strategies, Students' Engagement in Learning, and Teachers' Self-Concept. Sustainability 13, 5020. https://doi.org/10.3390/su13095020
20. Hattie, J., O'Leary, T., 2025. Learning Styles, Preferences, or Strategies? An Explanation for the Resurgence of Styles Across Many Meta-analyses. Educ. Psychol. Rev. 37, 31. https://doi.org/10.1007/s10648-025-10002-w
21. Khan, M.A., 2025. Mentimeter Tool for Enhancing Student Engagement and Active Learning: A Literature Review. Int. J. Chang. Educ. https://doi.org/10.47852/bonviewIJCE52023801
22. Kleimola, R., Leppisaari, I., 2022. Learning analytics to develop future competences in higher education: a case study. Int. J. Educ. Technol. High. Educ. 19, 17. https://doi.org/10.1186/s41239-022-00318-w
23. Klein, K., Calabrese, J., Aguiar, A., Mathew, S., Ajani, K., Almajid, R., Aarons, J., 2023. Evaluating Active Lecture and Traditional Lecture in Higher Education. https://doi.org/10.26077/BA42-A5CC
24. Kozanitis, A., Nenciovici, L., 2023. Effect of active learning versus traditional lecturing on the learning achievement of college students in humanities and social sciences: a meta-analysis. High. Educ. 86, 1377–1394. https://doi.org/10.1007/s10734-022-00977-8
25. Liu, Q., Peng, W., Zhang, F., Hu, R., Li, Y., Yan, W., 2016. The Effectiveness of Blended Learning in Health Professions: Systematic Review and Meta-Analysis. J. Med. Internet Res. 18, e2. https://doi.org/10.2196/jmir.4807
26. Majdi, Z., Khalili Sabet, M., Mahdavi-Zafarghandi, A., 2025. Exploring the effect of using active learning strategies on Iranian intermediate female EFL learners reading comprehension: a mixed methods study. Front. Educ. 10, 1539722. https://doi.org/10.3389/feduc.2025.1539722
27. Malekjafarian, A., Gordan, M., 2024. On the Use of an Online Polling Platform for Enhancing Student Engagement in an Engineering Module. Educ. Sci. 14, 536. https://doi.org/10.3390/educsci14050536
28. Marshall, L.L., Nykamp, D.L., Momary, K.M., 2014. Impact of abbreviated lecture with interactive mini-cases vs traditional lecture on student performance in the large classroom. Am. J. Pharm. Educ. 78, 189. https://doi.org/10.5688/ajpe7810189
29. Martinez, M.E., Gomez, V., 2025. Active Learning Strategies: A Mini Review of Evidence-Based Approaches. Acta Pedagog. Asiana 4, 43–54. https://doi.org/10.53623/apga.v4i1.555
30. Nguyen, K.A., Borrego, M., Finelli, C.J., DeMonbrun, M., Crockett, C., Tharayil, S., Shekhar, P., Waters, C., Rosenberg, R., 2021. Instructor strategies to aid implementation of

active learning: a systematic literature review. Int. J. STEM Educ. 8, 9. https://doi.org/10.1186/s40594-021-00270-7

31. Nivetha, A.P., Prashanth, V., 2025. Improving Student Focus and Active Learning: An Investigation into the Use of Lecture Breaks in Undergraduate Education. Int. J. Res. Innov. Soc. Sci. IX, 2550–2561. https://doi.org/10.47772/IJRISS.2025.903SEDU0197
32. Olawumi, T.O., 2022. Effects of Pedagogical Transition on Classroom Design. https://doi.org/10.6084/M9.FIGSHARE.19606279
33. Qablan, A., Alkaabi, A.M., Aljanahi, M.H., Almaamari, S.A., 2024. Inquiry-Based Learning: Encouraging Exploration and Curiosity in the Classroom, in: Abdallah, A.K., Alkaabi, Ahmed Mohammed, Al-Riyami, R. (Eds.), Advances in Educational Technologies and Instructional Design. IGI Global, pp. 1–12. https://doi.org/10.4018/979-8-3693-0880-6.ch001
34. Sahito, Z.H., Khoso, F.J., Phulpoto, J., 2025. The Effectiveness of Active Learning Strategies in Enhancing Student Engagement and Academic Performance. J. Soc. Sci. Rev. 5, 110–127. https://doi.org/10.62843/jssr.v5i1.471
35. Schildkamp, K., Van Der Kleij, F.M., Heitink, M.C., Kippers, W.B., Veldkamp, B.P., 2020. Formative assessment: A systematic review of critical teacher prerequisites for classroom practice. Int. J. Educ. Res. 103, 101602. https://doi.org/10.1016/j.ijer.2020.101602
36. Sushama, J., Palappallil, D., Thomas, S., 2023. Comparison of the effectiveness between problem-based learning and lecture class in pharmacology for medical undergraduates. Natl. J. Physiol. Pharm. Pharmacol. 1. https://doi.org/10.5455/njppp.2023.13.05246202305062023
37. Syeda, S., D'Costa, M.P., Swarnadas, G.S., Leccio, B.J.M., Al-Shizawi, W.I.S., Faraj, A.M., 2025. Active Learning Strategies: Faculty Use and Their Perceived Barriers. J. Health Allied Sci. NU 0, 1–9. https://doi.org/10.25259/JHS-2024-8-28-R1-(1540)
38. Thejaswini, K., Mahantha, M., Mohan, A., Pappana, S., Sharma, S., Veeraiah, V., 2025. Evaluation of student performance: Transitioning from traditional didactic lectures to team-based learning in first-year medical education. Natl. J. Physiol. Pharm. Pharmacol. 218. https://doi.org/10.5455/NJPPP.2025.v15.i3.1
39. Wood, A., 2020. Utilizing technology-enhanced learning in geography: testing student response systems in large lectures. J. Geogr. High. Educ. 44, 160–170. https://doi.org/10.1080/03098265.2019.1697653
40. Zhang, A., Luo, X., Ying, F., Wang, J., Huang, G., 2025. Collaborative arts therapies as a supportive intervention for autism spectrum disorders: Bibliometric analysis, insights, and directions. Heliyon 11, e41333. https://doi.org/10.1016/j.heliyon.2024.e41333