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In-Class Active Engagement Strategies to Enhance Student Participation During Lectures : A Systematic Review

Zubia Waqar, Shafaq Sultana, Madiha Ata

ABSTRACT

Improving students' engagement in lectures has been a challenge in higher education. This systematic review aims to synthesize evidence on active engagement strategies, including technology-enhanced tools, interactive pedagogies, and classroom modifications alongside an evaluation of their effectiveness and determinants. Following the PRISMA 2020 guidelines, 36 peer-reviewed articles were identified through systematic searching in PubMed, ERIC, and Google Scholar (2014–2024). The quality of studies was evaluated using validated appraisal tools, with high interrater reliability (Cohen's Kappa = 0.82) and methodological rigor. The evidence shows that technology-enhanced tools like polling systems, Socrative, and Kahoot support real-time interaction and feedback but are challenging to use in resource-limited environments. Interactive strategies like Think-Pair-Share and Buzz Groups enhance collaboration and critical thinking but are more effective in smaller class sizes. Classroom modifications like flexible seating improve inclusivity. The effectiveness of these strategies depends on instructor preparation, class size, and the infrastructure of the institution. Future studies should investigate multimodal strategies, low-tech options, and long-term effects to promote sustainability and wider applicability.

Keywords: Education, Engagement, Interaction, Instruction/Teaching Methods, Student Participation, Lectures

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INTRODUCTION

Student engagement is the force that drives the academic success of students, and it is often described as "a student's intellectual commitment and effort to learn, understand or become an expert in the skills, information, or trades that academic activities need to foster."[1] This definition highlights the complex construct of engagement as it has behavioral, emotional, and cognitive dimensions. The behavioral aspect of engagement reflects one's active participation in academic activities, and the emotional aspect relates to the learner's motivation and interests. Lastly, the cognitive aspect concerns one's intellectual or psychological investment in learning.[2] These three separate yet interconnected dimensions indicate the importance of fostering environments and strategies that actively encourage student participation in the educational process. Since engagement is reported to be associated with improved learning outcomes, student retention, and overall academic achievement, educators and institutions should focus on strategies that improve engagement across these three dimensions.

Following the critique over lectures, several other pedagogical approaches have been introduced, but lectures are still regarded as fundamental instructional methods. Although few perceive lectures as an outdated instruction method, there are still many reasons for which the lectures are valued: these include their ability to convey complex information efficiently to large audiences, having a good alignment with curriculum, their structured & consistent format, and the ability to set clear learning objectives, making them indispensable in the academic setting.[3,4]

Moreover, it is evident that in STEM fields, including education, science, and clinical studies, lectures provide a structured platform for disseminating foundational and advanced knowledge.[5] Nevertheless, engagement during lectures is another important aspect of their effectiveness. An engaging lecture enables educators to capture students' attention, stimulate curiosity, and maintain interest through dynamic and well-organized presentations.[6] Similarly, few interactive elements have been reported to help educators transform passive listening into an active learning experience by promoting a deeper connection between students and the material being taught.[7] Despite these advantages, lectures are not without their challenges. The traditional lecture

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format often limits opportunities for student participation, resulting in passive learning.[8,9] Research suggests that students who passively listen to lectures may struggle with information retention and application, particularly when the content is dense or abstract.[3,4] Furthermore, students with diverse learning styles may find lectures less effective compared to other interactive or discussion-based methods. Therefore, the passive nature of traditional lectures demands educators to integrate strategies that encourage active engagement, leading to an improved retention of information.

The research exploring the teachers' and students' perceptions emphasized the importance of strategies or tools used to engage students.[8,9] However, engaging students during large sessions remains a challenge for the teaching faculty. This challenge has been reported to have maximized effects in large classroom settings, where it is not convenient for educators to assess the engagement level of individual students.[10] In 2019, Bond & Bedenlier presented a student engagement framework that emphasized three main aspects: behavior, emotions, and thinking. Based on this framework, behavioral engagement describes participation, effort, and persistence in academic and social activities. Emotional engagement reflects affective reactions, a sense of belonging, and overall attitudes toward learning, and cognitive engagement focuses on deep learning strategies, self-regulation, and metacognition.

Moreover, this framework provides educators and institutions a holistic understanding of engagement by taking account of the broader context, including the institutional environment, teaching practices, social environment, and technological environment, all influencing student engagement.

The foundations of this review, built on Bonds & Bedenlier's framework, aim to provide a comprehensive understanding of the various methods, their effectiveness, and the perceptions of both students and faculty regarding these strategies. It explores different engagement strategies used in lecture settings and the impact of these strategies on student participation and learning outcomes.

Research Methodology

The study selection process was conducted systematically following the PRISMA 2020 guidelines to ensure transparency and reproducibility.[11] A comprehensive search including PubMed, ERIC, and Google Scholar was performed to identify relevant studies on active engagement strategies in lecture-based learning. Search terms with a combination of keywords such as "classroom interaction," "student engagement," "active learning," and "higher education" alongside Boolean operators (AND, OR, NOT) were constructed to explore the literature. The initial database search yielded a total of 2000 publication records. These records were imported into the Mendeley reference manager to facilitate the organization and removal of duplicates. Out of 2000 publications, 199 studies remained after duplicate removal. Two independent reviewers screened titles and abstracts for relevance based on predefined inclusion and exclusion criteria. The decision to include studies was based on whether the studies were published in English between 2014 and 2024 in peer-reviewed journals, focused on educators employing active engagement strategies in lecture settings, reported impacts on student participation or learning outcomes, and explored the perspectives of both students and faculty. In contrast, studies were excluded if they were focused on flipped classrooms, blended learning, or the provision of pre-class materials, opinion pieces, editorials, or non-peer-reviewed articles and were not available in full-text format. A total of 36 studies were selected for full-text review. Each excluded study was tagged with specific reasons (e.g., "focus on blended learning," "not peer-reviewed," or "non-English article") to enhance the transparency of the process. The PRISMA flow diagram (Figure 2) visually represents the study selection process, detailing the number of records identified, screened, excluded, and included at each stage.

The appraisal of included studies was conducted with the help of validated tools tailored to respective study designs to ensure methodological rigor and reliability. Two independent reviewers evaluated the selected studies, maintaining a Cohen's Kappa statistic (=0.80), which indicates strong agreement. The discrepancies were resolved through discussion and consultation with a third reviewer. For observational and quasi-experimental studies, the Newcastle-Ottawa Scale (NOS) and the ROBINS-I Tool were employed to evaluate the risk of bias. These tools have

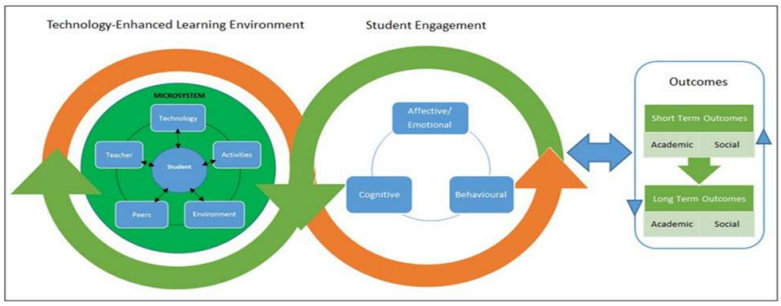

Figure 1: Student Engagement Framework adopted by Bond & Bedenlier 2019

a strong focus on selection methods, group comparability, and outcome measurement.[12,13]. discrepancies were resolved through discussion or consultation with a third reviewer.

The tools selected to appraise studies helped to compare strengths such as randomization in sampling while also identifying limitations like selection bias and confounding variables. Mixed methods studies were assessed using the Mixed Methods Appraisal Tool (MMAT), which ensured a balanced appraisal of qualitative and quantitative integration, particularly in studies evaluating polling systems like Kahoot and Socrative.[14] Qualitative studies, including those exploring storytelling techniques, were appraised using the Critical Appraisal Skills Program (CASP) Checklist, which evaluated the credibility, transferability, and dependability of findings.[15]

Additionally, educational tools and techniques, such as Learning Catalytic, Clickers, and polling systems, were critically reviewed for validation of instruments and statistical analyses, with studies using validated tools (e.g., Dvoroková & Kulhánek, 2017) demonstrating higher credibility compared to those relying on unvalidated self-reported data.

Framework for Appraisal of Diverse Studies

To ensure methodological rigor and consistency, a standardized scoring framework was applied to all included studies. Studies were evaluated across five criteria: study design, sampling method, validity of instruments, data analysis, and relevance to review objectives. Studies were appraised for quality using a scoring framework across five criteria: study design, sampling method, validity of instruments, data analysis, and relevance to review objectives. Each study was rated on a 10-point scale and categorized as Excellent (9–10), Good (7–8.9), or Fair (5–6.9) based on total scores. All studies were included in the review, with quality ratings noted to contextualize the findings. This approach enabled us to systematically appraise diverse methodologies, including experimental, quasi-experimental, mixed methods, and qualitative studies. To ensure methodological rigor, a comprehensive appraisal framework (Table 1) is tailored based on the above-mentioned tools to appraise the selected studies.

Findings:

A total of 36 studies were included, classified into four engagement strategies. The extracted data covered study details such as author, engagement techniques, study design, sampling, data type, analysis, conclusions, and limitations. Table 2 represents the distribution of the student engagement strategies identified through a systematic literature search. Out of these 36 studies, 7 studies were rated "Excellent" for their robust methodologies, validated tools, and high relevance, 26 studies were rated "Good" having minor limitations like convenience sampling or partial validation whereas, 3 studies were rated "Fair" because of weaker designs or analyses but provided insights.

This interrater reliability analysis Cohen's Kappa = 0.82 further confirmed the rigor and reliability of the appraisal process. Table 3 represents the details of the information appraised during the process.

1- **Technology-Enhanced Learning Tools:** Technology-enhanced learning Tools, also known as student or classroom response systems, work through handheld devices, including platforms and apps designed to promote more interaction and engagement through instant feedback. These technology-enhanced learning

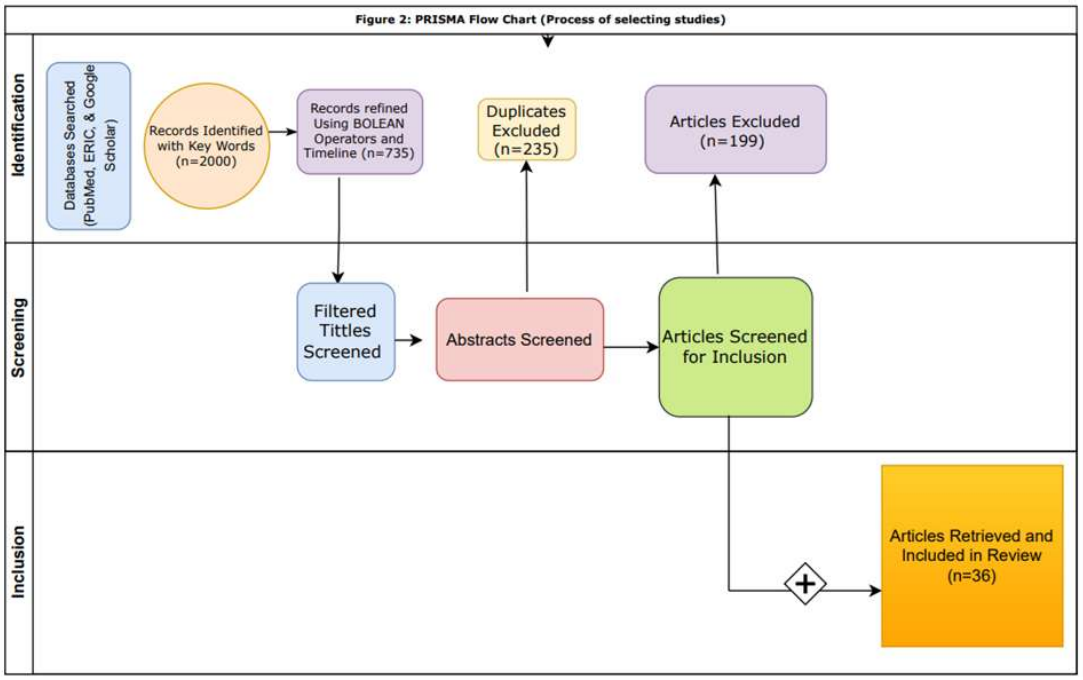

Table 1: Comprehensive Appraisal Framework

Criterion	Description	Experimental / Quasi-Experimental Studies	Mixed Methods Studies	Qualitative Studies
Study Design (2 Points)	Appropriateness and rigor of the study design	2: Randomized or well-defined quasi-experiment	2: Clear integration of qualitative & quantitative approaches	2: Robust and clearly described design (e.g., case study, ethnography)
		1.5: Partial control (e.g., quasi-experiment without randomization)	1.5: Partial integration of methods or unclear rationale	1.5: Design described but lacks sufficient detail
		1: Poorly described design or significant flaws	1: Weak integration of methods, poor rationale	1: Unclear or weak design
Sampling Method (2 Points)	Appropriateness and justification of sampling strategy	2: Random or stratified sampling	2: Justified purposive sampling and integration of sampling strategies	2: Purposive sampling with a clear rationale
		1.5: Convenience sampling with justification	1.5: Partial justification of sampling methods	1.5: Convenience sampling with some rationale
		1: Unjustified sampling or unclear method	1: Poorly justified or inconsistent sampling	1: Unclear or unjustified sampling
Validity of Instruments (2 Points)	Use of validated tools and measures	2: Fully validated and reliable tools	2: Validated tools for both quantitative and qualitative components	2: Piloted tools, and validated frameworks (e.g., interview protocols)
		1.5: Partial validation or some unclear details	1.5: Partial validation in one component	1.5: Limited description of validation
		1: Non-validated or unclear instrument validity	1: No evidence of validation in either method	1: No validation mentioned
Data Analysis (2 Points)	Appropriateness and rigor of the analysis	2: Advanced and appropriate statistical methods (e.g., ANOVA, regression)	2: Thorough integration of qualitative and quantitative findings	2: Robust analysis (e.g., thematic coding, grounded theory)
		1.5: Basic statistical methods or unclear reporting	1.5: Partial integration or basic analysis in one method	1.5: Thematic analysis with limited depth
		1: Inappropriate or missing analysis	1: Weak analysis or lack of integration	1: Limited or unclear analysis
Relevance to Review Objectives (2 Points)	Alignment with review focus	2: Highly aligned with engagement strategies	2: Both components address engagement strategies	2: Highly relevant to engagement strategies
		1.5: Moderately aligned, some gaps	1.5: Partial alignment between methods and engagement focus	1.5: Moderately relevant findings
		1: Limited or tangential relevance	1: One component relevant, overall weak relevance	1: Weak or limited relevance to review objectives

tools include learning catalytic, clickers, polling, Socrative, and Kahoot. Learning Catalytic is defined as a tool that can be used for real-time polling and assessment.[16,17,18] Another technology-based tool that can be employed to engage students and provide instant feedback in a lecture is Clickers, which are believed to provide instant feedback.[19,20,21] General Polling Systems are another example of real-time questioning and feedback.[22,23,24] Over the years, Socrative and Kahoot, which rely on game-based approaches to facilitate engagement and learning through quizzes and other interactive endeavors, have emerged as the dominant trend in educational technology.[25,26,27,28,29]

2- **Interactive Teaching Strategies**: The Interactive Teaching Strategies aiming to increase students' interaction through collaborative methods include activities such as Buzz Groups; a technique where the students all engage in a group discussion[30,31,32], and Think-Pair-Share; where the students first think independently and then discuss with their partner afterward followed by sharing in the big class to gain further understanding.[33,34,35,36]

3- **Educational Methodologies:** Educational Methodologies use innovative approaches to ensure the inculcation of interest, including Storytelling, in which the use of narratives makes learning more relational and memorable.[37,38,39,40] Concept and Mind Mapping helped the students organize information visually[41,42,43,44]; the Minute Paper Review was a quick assessment of student understanding.[45,46,47]

4- **Classroom Environment & Seating Arrangement:** Lastly, the studies also examine optimizing the classroom environment and seating arrangement, especially with proper seating arrangements for better interaction and engagement among students.[48,49,50]

DISCUSSION

Student engagement during lectures is an essential component of effective learning. This review critically examines strategies such as technology-enhanced tools, interactive teaching methodologies, storytelling, concept mapping, and classroom environmental changes, drawing on the studies summarized in the table. A comparative yet critical analysis of these strategies reveals their effectiveness and limitations, providing an advanced understanding of their applications in different educational contexts.

Evidence indicates that student participation increased by employing technology-enhanced tools, including Learning Catalytic, Clickers, and polling systems like Socrative and Kahoot. For example, Rogerson and Chomicz (2014) observed that Learning Catalytic fosters student learning experiences through real-time feedback. Similarly, Dvoroková and Kulhánek (2017) determined that learning catalytic improved course delivery. However, individual institution-focused findings and the educator's ability to employ these tools vary across these studies.

Subsequently, Heaslip et al. (2014) found Clickers to facilitate engagement in large classes by encouraging interaction through anonymous responses. Furthermore, Walklet et al. (2016), while extending these findings to psychology lectures, emphasized peer learning and engagement without fear of judgment. However, the small sample sizes and discipline-specific applications of these tools limit the generalizability of their outcomes.[19,20]

An in-depth analysis across the methodologies employed reflects differences that ultimately influence the external validity of these research studies. To include this, Rogerson and Chomicz (2014) adopted a qualitative case study approach, providing rich contextual insights but lacking statistical generalizability. In contrast, Dvoroková and Kulhánek (2017) used a quasi-experimental design, combining objective pre- and post-test scores with subjective survey data, adding depth to their analysis but raising questions about replicability across different institutions. Meanwhile, some of these researchers incorporated mixed methods, strengthening their ability to triangulate data but introducing complexity in data synthesis.[19,20] However, most of the studies relied heavily on convenience sampling, a consistent limitation, leading to a reduced external validity.

Subsequently, the outcomes of the studies employing different technology-enhanced tools vary from one study to another. For example, the studies incorporating polling systems, such as Poll Everywhere, Socrative, and Kahoot, enhance interaction in large classes[22], while Sedghi et al. (2021) observed high overall engagement levels among large cohorts. A study conducted by Arjomandi et al. (2023) established a positive correlation between polling and academic performance in statistics students, using controlled trials to support causal inferences.

Evidence indicates that the use of validated tools significantly enhances the credibility and reliability of studies by ensuring consistent, accurate, and reproducible results.[51] For example, studies employing validated questionnaires or systems, such as Rinaldi et al. (2017) and Dervan (2014), provide robust evidence of student engagement and academic performance improvements. In contrast, studies lacking tool validation, such as Sedghi et al. (2021), raise reliability concerns, with findings possibly skewed by biases inherent in unvalidated instruments. Additionally, the infrastructure requirements for these tools highlight the challenges of implementing technology in resource-constrained environments.[29] However, there certainly is variability from employing a wide range of methodologies, choice of validated questionnaires[22] to a reliance on self-reported data, which may lead to bias.[23]

Similarly, interactive teaching strategies, including Buzz Groups and Think-Pair-Share, seemed to help students shift the focus to active and collaborative learning. The studies conducted by Ihsan (2019) illustrate an improved vocabulary among secondary school students through Buzz Groups, whilst Romeike and Fischer (2019) observed that these teaching strategies help in enhancing histopathological competencies in medical students. Considering the choice of study design, the use of quasi-experimental designs across these studies provides a controlled yet flexible framework for intervention assessment. However, on the other hand, the absence of randomization, as seen in Afifah (2019), carries potential selection bias.

Likewise, Think-Pair-Share, as highlighted by Vázquez-García (2018), showed improved knowledge retention in

Table 2: No. Of Studies Included in this Review

Student Engagement Strategies:	**No. of Studies**
Technology-Enhanced Learning Tools	
Learning Catalytic	3
Clickers	3
Polling	3
Socrative	3
Kahoot	3
Interactive Teaching Strategies	
Buzz Groups	3
Think-Pair-Share Activities	4
Educational Methodologies	
Storytelling	4
Concept & Mind Mapping	4
One Minute Paper Review	3
Classroom Environment & Seating Arrangements	**3**
Total Number of Studies Included in Review:	**36**

Table- 3 Summary of Studies on Student Engagement Strategies during Lectures

Specific Engagement Strategy	Study Reference	Study Design	Sampling Population	Sampling Technique	Type of Data	Validity of Instruments	Data Analysis	Outcomes	Study Limitations	Score & Ratings
Learning Catalytic	Rogerson C, Chomicz G. (2014)	Case study	One institution	Not Specified	Qualitative	Not Applicable	Thematic analysis	Enhanced student learning experience	Limited to one setting; lacks broader applicability.	6.0 Fair
	Dvoroková K, Kulhánek L. (2017).	Quasi-experimental	University students, varied class sizes	Unclear	Objective (test scores), subjective (surveys)	Pearson's interactive response system	Quantitative (pre/post-test scores)	Improved course delivery	Limited to one institution; results may not be replicable	9.5 Excellent
	Abdulla MH. (2018).	Quasi-experimental	Medical students	Convenience Sampling	Quantitative	Validated questionnaire	Descriptive statistics	Improved understanding of physiology	Limited to physiology; may not generalize to other subjects.	8.0 Good
Clickers	Heaslip G, et al. (2014).	Mixed methods	Large classes	Convenience Sampling	Mixed	Self-reported	Qualitative & Quantitative	Increased engagement in large classes	Small sample size; limited to specific courses.	7.5 Good
	Walklet et al. (2016)	Quasi-experimental (Clickers in psychology lectures)	Undergraduate psychology students	Convenience Sampling	Objective (MCQ responses), subjective (feedback)	Validated clicker system	Quantitative (MCQ performance, feedback surveys)	Fostered peer learning, and enhanced engagement without fear of judgment	Small sample size, limited to psychology students, potential over-reliance on clicker technology.	8.5 Good
	Rinaldi VD, et al. (2017).	Quasi-experimental	Histology students	Convenience	Quantitative	Validated instrument	Inferential statistics	Improved student performance	Laboratory settings may affect engagement outcomes.	7.5 Good

Specific Engagement Strategy	Study Reference	Study Design	Sampling Population	Sampling Technique	Type of Data	Validity of Instruments	Data Analysis	Outcomes	Study Limitations	Score & Ratings
Polling	Voelkel S, Bennett D. (2014).	Experimental	Large classes	Convenience	Quantitative	Validated questionnaire	Descriptive statistics	Enhanced interaction in lectures	Potential bias in self-reported data	8.0 Good
	Sedghi N, et al. (2021).	Experimental	Large cohorts	Purposive	Quantitative	Not specified	Descriptive statistics	High levels of student engagement	Same cohort; longitudinal effects not assessed.	7.5 Good
	Arjomandi A, Paloyo AR, Suardi S. (2023).	Experimental	Statistics students	Controlled Trial but Convenienc e Sampling	Quantitative	Not specified	ANOVA	Positive correlation with academic performance	Focused on statistics; may not represent all disciplines	8.5 Good
Socrative	Dervan P. (2014).	Quasi-experimental	Nursing students	Convenience	Quantitative	Validated tool	Descriptive statistics	Increased engagement and participation	Limited to specific student population; narrow focus.	7.0 Good
	Guarascio AJ, et al. (2017).	Comparative study	Pharmacy students	Convenience	Quantitative	Validated instrument	Descriptive statistics	Enhanced classroom engagement	Focused on pharmacy students; may not generalize.	7.5 Good
	Amoia-Watters L. (2023).	Experimental	Nursing students	Convenience	Quantitative	Validated instrument	ANOVA	Positive impact on student engagement	Focus on the nursing program; limited to a specific discipline.	8.5 Good
Kahoot	Martínez-Fernández T, et al. (2017).	Comparative study	Business students	Convenience	Quantitative	Not specified	ANOVA	Comparison of engagement levels	Focused on business subjects; results may vary in other fields.	6.5 Fair
	Kim KJ. (2019).	Experimental	Medical students	Convenience	Quantitative	Not specified	ANOVA	Increased self-efficacy and active learning	Limited to medical English; potential bias in self-reporting.	8.5 Good
	Muir S, et al. (2020).	Mixed methods	University students	Convenience	Mixed	Self-reported	Mixed methods analysis	Increased classroom engagement	Small Sample Size, Context-specific results	7.0 Good
2- Interactive Teaching Strategies										
Buzz Group	Ihsan D. (2019)	Quasi-experimental	Secondary school students	Random sampling	Quantitative	Not specified	Descriptive statistics	Improved vocabulary mastery among students using buzz groups.	Limited to one institution, may not be generalized.	7.0 Good

Specific Engagement Strategy	Study Reference	Study Design	Sampling Population	Sampling Technique	Type of Data	Validity of Instruments	Data Analysis	Outcomes	Study Limitations	Score & Ratings
	Afifah N. (2019)	Quasi-experimental	University students	Random sampling	Quantitative	Not specified	Descriptive statistics	Enhanced reading comprehension skills through buzz group discussions.	Specific to reading comprehension, may not apply to other areas.	7.0 Good
	Romeike BF, Fischer M. (2019)	Quasi-experimental	Medical students	Convenience sampling	Quantitative	Not specified	ANOVA	Improved histopathological competencies through collaborative learning.	Focused on histopathology, may not generalize to other disciplines.	9.0 Excellent
Think-Pair Share or Collaborative Learning	Fernandez-Rio J, Sanz N, Fernandez-Cando J, Santos L. (2017)	Quasi-experimental	Secondary education students	Random sampling	Quantitative	Not specified	ANOVA	Increased student motivation following the intervention.	Limited to physical education; results may not be generalized.	7.5 Good
	Vázquez-García M. (2018)	Experimental	Second-year medical students	Random sampling	Quantitative	Validated tool	Descriptive statistics	Improved knowledge retention in human physiology topics.	Focused on medical students; may not apply to other disciplines.	9.0 Excellent
	Harahap RR, Makhroji M, Zulida E, Fadlia F, Chairuddin C. (2021)	Quasi-experimental	English as a Foreign Language (EFL) students	Random sampling	Quantitative	Not specified	Descriptive statistics	Enhanced learning outcomes in the EFL classroom through cooperative models.	Limited to EFL context; may not generalize to other educational settings.	7.5 Good
	Fernández MA, Quintana J, Dominic W, Darius L, Alexandra W. (2023)	Quasi-experimental	University students	Convenience sampling	Quantitative	Not specified	Descriptive statistics	Increased student interest and improved learning outcomes	Focused on a specific population; may not generalize to all disciplines.	7.0 Good
3- Educational Methodologies										
Story Telling	Lal S, Donnelly C, Shin J. (2015)	Mixed methods	Occupational therapy students	Purposive Sampling	Mixed (qualitative and quantitative)	Not specified	Mixed analysis	Positive outcomes in education and practice via digital storytelling.	Limited focus on one discipline.	8.0 Excellent
	Choi GY. (2018)	Qualitative	Lecture attendees	Convenience Sampling	Quantitative	Not specified	Thematic analysis	Enhanced learning experience through digital storytelling techniques.	Focused on a specific educational context.	7.0 Good

Specific Engagement Strategy	Study Reference	Study Design	Sampling Population	Sampling Technique	Type of Data	Validity of Instruments	Data Analysis	Outcomes	Study Limitations	Score & Ratings
Story Telling	Demirci T, Okur S. (2021)	Experimental	Science students	Random sampling	Quantitative	Validated tool	ANOVA	Improved academic achievement, writing skills, and positive opinions.	Limited to a specific student population.	9.0 Excellent
	Maharaj-Sharma R. (2024)	Experimental	Physics students	Purposive sampling	Quantitative	Not specified	Thematic analysis	Positive impact of storytelling on learning physics topics.	Limited to one topic within physics.	7.0 Good
Concept or Mind Mapping	Kotze SH, Mole CG. (2015)	Case study	Histology students	Convenience sampling	Qualitative and quantitative	Not specified	Thematic analysis & descriptive statistics	Enhanced engagement and learning in large classes.	Limited to histology, lacks broad applicability.	7.5 Good
	Mathew S. (2018)	Randomized Control Study	Medical students (first year)	Random sampling	Quantitative	Not specified	ANOVA	Mind mapping was more effective than didactic lectures for knowledge gain.	Focused on anatomy students, potential for bias in self-reporting.	9.0 Excellent
	Astriani D, Herawati S, Suwono H, et al. (2020)	Quasi-experimental	University students	Random sampling	Quantitative	Not specified	Descriptive statistics	Improved metacognitive skills through mind mapping	Limited to one learning context.	7.5 Good
	Silva H, Lopes J, Dominguez C, Morais E. (2022)	Quasi-experimental	University students	Convenience sampling	Quantitative	Validated Instrument	ANOVA	Concept mapping improved both critical and creative thinking.	Single institution, limited subject areas.	8.5 Good
One-Minute Paper Review	SrivaSTava TK, Mishra V, Waghmare LS. (2018)	Controlled trial	Pre-clinical medical students	Random sampling	Quantitative	Validated tool	ANOVA	FACTs resulted in improved understanding and retention of course material.	Limited to pre-clinical education, small sample size.	9.0 Excellent
	Darnell DK, Krieg PA. (2019)	Experimental	College students	Random sampling	Quantitative	Validated heart rate monitors	Inferential statistics (t-tests)	No significant change in engagement levels during active learning.	Heart rate may not be the best indicator of engagement in, a small sample size.	6.5 Fair
	Solamo FSD. (2022)	Quasi-experimental	Undergraduate students	Convenience sampling	Quantitative	Not specified	Descriptive statistics	OMP improved formative assessment and student reflection.	Limited to a specific context, may not generalize to other settings.	7.0 Good

4- Classroom Environment & Seating Arrangement										
Specific Engagement Strategy	**Study Reference**	**Study Design**	**Sampling Population**	**Sampling Technique**	**Type of Data**	**Validity of Instruments**	**Data Analysis**	**Outcomes**	**Study Limitations**	**Score & Ratings**
Seating Arrangement	Haghighi MM, Jusan MB. (2015)	Quasi-experimental	University students	Random sampling	Quantitative	Validated questionnaire	ANOVA	Identified correlation between seat selection and academic performance.	Focused on specific classroom settings; may not generalize to other contexts.	8.0 Good
	Shekhar P, Borrego M. (2018)	Case study	Engineering students in large classes	Convenience sampling	Qualitative and quantitative	Not specified	Thematic analysis and descriptive statistics	Insights into factors affecting student engagement in large classes.	Limited sample; findings may not apply to all engineering classes.	7.5 Good
	Seet HA, Tan E, Rajalingam P. (2022)	Quasi-experimental	Medical students	Random sampling	Quantitative	Not specified	Descriptive statistics	Increased class engagement associated with specific seating arrangements.	Limited to one institution; results may not be generalized.	7.0 Good

physiology, with randomized sampling enhancing the reliability of findings. Harahap et al. (2021) further linked these benefits to English as a Foreign Language (EFL) classrooms, showcasing the adaptability of collaborative models. Nevertheless, there is a lack of longitudinal studies to evaluate sustained impact, which remains a notable gap. Subsequently, another study by Fernandez-Rio et al. (2017) addressed challenges, suggesting that smaller class sizes may be better suited for these strategies.

Similar to the choice of the study design, statistical analysis also plays a pivotal role in determining the strength and applicability of study findings.[52] The reviewed studies employed a range of statistical methods, including descriptive statistics, inferential statistics, and mixed methods analysis. Descriptive statistics, as widely used in studies such as Voelkel and Bennett (2014) and Amoia-Watters (2023), provide foundational insights but are limited to summarizing data without assessing relationships or causality. Inferential statistics, including t-tests and ANOVA, were employed in controlled or quasi-experimental studies like those of Arjomandi et al. (2023) and Mathew (2018), enhancing study quality by enabling causal inferences. However, their applicability is contingent on assumptions like normality and variance homogeneity, which require careful consideration. Mixed methods analysis, as utilized by studies such as Heaslip et al. (2014), enabled a holistic understanding of engagement strategies but complicated the synthesis of findings.

Studies utilizing advanced statistical techniques, particularly inferential methods, exhibit greater rigor by addressing causal relationships and controlling for confounding variables. Conversely, reliance solely on descriptive statistics or subjective data without rigorous validation limits the generalizability and robustness of findings. A comprehensive approach integrating robust statistical methods with validated tools is critical for advancing research quality and applicability. [52]

Storytelling, as an instructional methodology, bridges cognitive and emotional engagement. Lal et al. (2015) demonstrated its effectiveness in fostering reflective thinking in occupational therapy students, employing a mixed-methods approach to capture both quantitative outcomes and qualitative nuances. Demirci and Okur (2021) validated the role of storytelling in improving academic achievement and writing skills among science students, utilizing controlled experiments to establish causal links. Choi (2018), through qualitative thematic analysis, explored the subjective impact of digital storytelling on lecture attendees. However, the heavy reliance on instructor creativity and the novelty effect, as noted by Maharaj-Sharma (2024), limits its scalability and long-term efficacy. Comparing these methodologies, Lal et al.'s mixed-methods design offers a more comprehensive evaluation, while Choi's qualitative focus highlights contextual richness but lacks broader applicability. Future research could benefit from integrating experimental controls to assess the comparative impact of storytelling against other engagement strategies.

Concept and mind-mapping techniques structure information to promote critical thinking and comprehension. Kotze and Mole (2015) demonstrated significantly improved

engagement in histology classes through draw-along mapping, utilizing case studies to contextualize their findings. Silva et al. (2022), while extending these benefits to university students, reported enhanced critical and creative thinking through concept mapping. Astriani et al. (2020) explored the effect of digital adaptations in concept mapping and revealed that these innovations help foster metacognitive skills and collaborative learning. Methodologically, these studies predominantly employed quasi-experimental designs with varying levels of rigor. For example, Mathew (2018) adopted a randomized controlled approach, providing robust evidence for mind mapping's effectiveness in anatomy education. However, the common reliance on single-institution samples limits the external validity of these findings. Expanding sample diversity and incorporating cross-disciplinary comparisons would strengthen the generalizability of future research.

The classroom environment and seating arrangements also significantly influence engagement outcomes. Seet et al. (2022) observed that flexible seating arrangements foster inclusivity and active participation, particularly in medical education. Another study by Haghighi and Jusan (2015) observed a positive correlation between seat selection and academic performance. However, the traditional seating arrangement of lecture halls often restricts these benefits, particularly in large class settings. A comparative analysis reveals that while Seet et al. highlighted interaction benefits, Haghighi and Jusan emphasized individual academic outcomes. Despite a difference between outcomes, both studies underline the need for modular seating designs to facilitate collaborative activities. Nevertheless, the methodological limitations, such as small sample sizes and single-institution settings, remain consistent challenges across this research domain.

Future Directions

Based on the findings of this systematic review, several recommendations are proposed to enhance student engagement in lecture-based settings.

- Educators should be trained and facilitated to develop structured and integrated multimodal engagement strategies by combining storytelling, polling, and collaborative learning techniques within a single group.
- The institutions need to have reconfigurable seating arrangements that facilitate seamless transitions between lectures, group discussions, and individual reflection.
- Future research should assess the long-term impact of engagement strategies on student learning, knowledge retention, and professional readiness to evaluate the effectiveness.
- There is a need to implement structured training programs to equip educators with the skills needed to integrate and adapt engagement strategies effectively

CONCLUSION

This critical exploration of research reveals that lectures are a foundation of higher education, valued for their efficiency and ability to convey complex information to large groups. However, to remain relevant and impactful, lectures must evolve by addressing their limitations and incorporating active learning techniques. By fostering student engagement through interactive strategies, leveraging technology, and tailoring content to meet diverse learning needs, lecturers can continue to play a vital role in promoting academic success. Engagement, in all its dimensions, remains the key to unlocking the full potential of this timeless instructional method.

By addressing the above-mentioned future directions, educational institutions can refine and adapt engagement strategies to diverse environments, ensuring broader applicability and improved learning experiences.

Authors Contribution:
Zubia Waqar: Conducted a detailed review of the literature, contributed to the synthesis of the findings, and helped in writing and revising sections related to methodology and critical discussions.
Shafaq Sultana: Conceived the initial idea, designed the structure of the review, and was responsible for drafting the manuscript, including the literature search and analysis of key studies.
Madiha Ata: Assisted with the data analysis, contributed to the interpretation of results, and was involved in editing and revising the manuscript for clarity and consistency.

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