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Real Challenges and Optimization Strategies for Teacher-Student Verbal Interaction in University Classrooms from the Perspective of Deep Learning

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Abstract: This study investigates the real challenges and optimization strategies associated with teacher-student verbal interaction in university classrooms from the perspective of deep learning. A questionnaire survey was administered to both faculty members and students across multiple higher education institutions, yielding 652 valid teacher responses and 707 valid student responses. The dual-perspective design enables an objective and comprehensive examination of actual classroom verbal interaction patterns. The findings reveal that although the majority of teachers demonstrate a solid understanding of deep learning theory, a notable disconnect persists between their classroom dialogue practices and intended educational objectives. Students generally express a preference for critical thinking-oriented classroom interactions; however, they encounter significant barriers to deep engagement stemming from a combination of subjective and objective factors. Both groups exhibit objective biases in their perceptions of classroom interaction quality. Common challenges identified include the dominance of surface-level question-and-answer exchanges, a lack of tiered instructional design, and insufficient institutional supporting mechanisms. Building on the quantitative questionnaire data, the study proposes improvement strategies across three dimensions: classroom discourse construction, teacher-student collaborative development, and institutional support systems. These strategies are designed to balance theoretical rigor with the practical realities of university teaching. The recommendations form a layered, streamlined, and step-by-step implementation plan, providing empirical evidence and actionable guidance for enhancing the quality of undergraduate classroom instruction in the context of deep learning.

Keywords: deep learning; verbal interaction; classroom discourse; teacher-student communication; higher education

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1. Introduction

1.1. Research Background

Verbal interaction serves as the cornerstone of classroom instruction, representing the predominant mode through which knowledge is conveyed, clarified, and co-constructed between educators and learners. Empirical observations consistently indicate that spoken discourse occupies a substantial proportion—often exceeding three-quarters—of total instructional time across diverse educational contexts [1]. Despite its centrality, classroom verbal engagement frequently exhibits structural limitations that impede pedagogical effectiveness. These limitations stem not from conceptual shortcomings but from operational realities: curricular pacing requirements often compress opportunities for extended dialogue; class sizes exceeding recommended thresholds reduce individual participation likelihood; and the absence of widely adopted, discipline-specific interaction frameworks limits consistency in implementation. Concurrently, students express strong preferences for varied interactive modalities—including collaborative problem-solving, Socratic seminars, peer-led presentations, and

scenario-based role-play—yet encounter multiple practical impediments. These include affective barriers such as anxiety associated with public speaking, cognitive habits shaped by asynchronous digital communication patterns, and insufficient scaffolding for preparatory tasks that would enable meaningful contribution. A critical methodological gap persists in current scholarship: much of the existing literature relies on unidirectional data collection—either exclusively from instructors or solely from learners—thereby producing fragmented insights that overlook the dynamic interplay between pedagogical intent and learner reception. To address this limitation, the present investigation adopts an interdisciplinary, multi-layered design encompassing humanities, natural sciences, engineering, medical education, economics, management, and fine arts disciplines. It incorporates educators spanning early-career to senior academic ranks and students from undergraduate through postgraduate levels, ensuring representativeness across developmental stages and professional trajectories. Through synchronized, parallel surveys administered to both cohorts, the study constructs a holistic representation of classroom interaction ecology. Rather than treating interaction metrics as isolated quantitative outputs, the analysis integrates distributional patterns, central tendency measures, temporal sequencing, and contextual qualifiers to uncover latent structures beneath surface-level exchanges. This approach enables identification of adaptive strategies that harmonize instructional objectives with learners' cognitive processing styles, motivational profiles, and socio-emotional readiness—ultimately advancing toward more responsive, equitable, and pedagogically grounded classroom communication practices [2, 3].

1.2. Research Significance

The classroom constitutes the central locus for verbal interaction between teachers and students, serving as the foundational setting where pedagogical communication unfolds across all phases of formal education. This study advances understanding by synthesizing empirical insights derived from both teaching practitioners and learners, enabling a rigorous, evidence-informed distinction between dialogic practices oriented toward foundational knowledge consolidation—such as structured recall, procedural rehearsal, and concept anchoring—and those deliberately designed to foster higher-order cognitive engagement, including analytical reasoning, evaluative judgment, and integrative synthesis. Crucially, the research affirms that neither mode of dialogue is universally superior; rather, their pedagogical efficacy is contingent upon curricular objectives, developmental readiness, subject-matter characteristics, and instructional sequencing. To overcome disciplinary silos and methodological fragmentation, the study constructs a comprehensive tripartite analytical framework for classroom interaction, organized around three interdependent dimensions: teacher-initiated instructional design, student-centered participatory enactment, and system-level institutional enablers. Within this model, behavioral patterns observed in teaching practice are carefully differentiated from structural conditions shaping educational delivery—such as resource availability, scheduling parameters, professional development infrastructure, and policy-aligned assessment frameworks. This conceptual clarification significantly strengthens the theoretical grounding of classroom discourse analysis within deep learning paradigms, while directly addressing persistent limitations in prior scholarship, including fragmented unit-of-analysis selection, insufficient attention to ecological validity, and underdeveloped causal logic linking interactional features to learning outcomes. Anchored in authentic classroom challenges identified through longitudinal fieldwork across diverse school settings, the study formulates practical, scalable intervention strategies characterized by modularity, contextual adaptability, and operational simplicity. These strategies empower educators to implement targeted refinements aligned with existing curriculum structures and local pedagogical priorities [4, 5]. Concurrently, school leadership and district-level administrators may utilize these findings to inform iterative enhancements to pre-service and in-service training initiatives, performance evaluation protocols, and instructional time allocation policies—approaches

distinguished by feasibility, stakeholder alignment, and capacity for continuous improvement grounded in routine classroom data.

1.3. The Core Practical Challenges of Verbal Interaction in Classrooms under a Two-Way Research Approach between Teachers and Students

Analysis of student feedback questionnaires reveals consistent and systemic limitations in verbal interaction patterns within contemporary classroom settings, particularly under pedagogical frameworks that emphasize reciprocal research collaboration between teachers and students. These limitations manifest across three interrelated dimensions: first, classroom operation—where rigid time allocation, overreliance on teacher-led discourse, and insufficient scaffolding for spontaneous student expression constrain the dynamism and responsiveness of oral exchanges; second, student engagement—characterized by uneven participation distribution, hesitancy in initiating contributions due to perceived evaluative pressure, and limited opportunities for peer-to-peer verbal co-construction of knowledge; and third, institutional support—encompassing inadequate professional development for educators in dialogic facilitation, absence of standardized formative assessment tools for oral interaction quality, and curricular structures that prioritize written output over sustained, reflective spoken discourse. Furthermore, linguistic diversity, varying levels of oral proficiency, and differing cultural expectations regarding turn-taking and authority negotiation compound these challenges. Addressing them requires not only refined instructional strategies but also systemic recalibration of classroom norms, assessment paradigms, and teacher preparation models to foster equitable, cognitively demanding, and linguistically rich verbal interactions that genuinely advance collective meaning-making.

1.3.1. Homogenization of Classroom Discourse Systems and Lack of a Tiered Adaptation Mechanism

Survey data from the teacher questionnaire indicates that classroom interaction continues to rely heavily on low-cognitive-demand formats: classroom spot checks constitute 36.35% of observed practices, and group responses account for 28.68%, whereas more cognitively demanding and collaborative modes—such as structured group discussions (12.42%) and formal classroom debates (22.55%)—remain underutilized. Concurrently, student questionnaire results reveal a pronounced skew in question taxonomy: factual recall questions represent 60.4% of teacher questioning, comprehension-based items reach 66.76%, and application-oriented prompts stand at 65.63%. In contrast, higher-order cognitive operations—including analytical reasoning and evaluative judgment—are markedly underrepresented, appearing in only 55.87% and 23.9% of instances respectively [6]. This imbalance reflects a systemic tendency to prioritize surface-level engagement over sustained intellectual scaffolding. Classroom dialogues frequently lack coherent developmental architecture; rather than progressing through iterative cycles of inquiry, hypothesis testing, peer feedback, and conceptual refinement, exchanges often terminate after initial responses, resulting in shallow cognitive processing. Furthermore, instructional design demonstrates insufficient attention to subject-specific epistemic norms and developmental appropriateness across grade levels [5, 7]. Teachers report moderate-to-high difficulty in adapting interaction strategies to distinct disciplinary paradigms—humanities, natural sciences, engineering, and medical education each entail unique discourse conventions, yet adaptation remains inconsistent, with an average self-reported challenge score of 4.15 on a five-point scale. Similarly, grade-level differentiation in question formulation is weak, reflected in a mean score of 3.74. The sample's disciplinary composition—35.28% humanities and 64.72% STEM fields—underscores that most educators do not systematically leverage discipline-embedded interaction models. In large-class settings, structural constraints further impede equitable participation: 44.63% of teachers identify substantial academic heterogeneity as a barrier to inclusive dialogue, and 63.93% of students describe interaction formats as repetitive and uninspiring—a perception directly linked to the absence of layered, scaffolded, and progressively differentiated interaction frameworks.

Feedback mechanisms compound these issues: nearly half (48.8%) of teacher responses consist solely of binary true/false evaluations; over half (58.84%) involve immediate corrective statements without explanatory mediation; and although progressive questioning appears in 60.68% of cases, it is typically implemented as brief, single-step prompts lacking cumulative cognitive sequencing or metacognitive framing.

1.3.2. There Are Barriers to Two-Way Participation between Teachers and Students, Making It Difficult to Establish a Virtuous Cycle of Collaborative Dialogue

The teacher sample was predominantly composed of middle-aged and young educators with 4 to 10 years of professional experience, accounting for 50.5% of respondents. These educators typically manage a multifaceted workload encompassing classroom instruction, scholarly research, and administrative responsibilities, which collectively shape their pedagogical capacity and time allocation for interactive teaching design. Survey data indicated that over one-third (36.66%) of teachers reported the absence of standardized frameworks or structured guidelines for designing interactive learning activities. Furthermore, self-assessment metrics revealed moderate challenges in applying integrated deep learning methodologies, with an average rating of 3.70 on a five-point scale; notably, adherence to conventional lecture-based instructional patterns received a higher average score of 4.16, suggesting persistent reliance on transmission-oriented approaches. This entrenched pedagogical orientation has historically minimized opportunities for students to engage in sustained critical analysis, open-ended inquiry, and peer-led discourse—factors essential for cultivating independent thinking and collaborative reasoning. Regarding student engagement, observational data from teachers showed that 44.63% noted consistent reticence among learners when invited to contribute verbally in whole-class settings [8, 9]. Correspondingly, the student-reported metric for initiating questions during lessons averaged only 3.65, reflecting limited proactive participation. Additionally, 41.41% of students demonstrated underdeveloped habits of questioning and conceptual exploration, while 51.77% indicated low levels of sustained attention and involvement during classroom instruction. With respect to emerging technological influences, AI-related engagement indicators registered an average score of 3.64; notably, 33.24% of students exhibited pronounced dependence on intelligent tools to retrieve canonical answers rather than engaging in iterative sense-making, thereby weakening intrinsic motivation for face-to-face analytical dialogue and co-constructive knowledge building. A pronounced disparity in participation frequency was also evident: high-achieving students consistently occupied the majority of speaking turns, whereas students performing at average or below-average levels remained largely passive observers, underscoring structural inequities in classroom interactional access and voice distribution.

1.3.3. The Supporting Mechanisms for Educational Institutions Are Lagging, and the External Support System Suffers from Multiple Shortcomings

Multiple dimensions of the institutional support framework reveal systemic gaps that impede pedagogical innovation and sustained professional growth. Survey data from educators consistently indicate structural constraints: nearly half of respondents—49.85%—identified overlapping instructional demands, including dense curricular content, compressed timetables, and the absence of designated time slots for collaborative academic seminars or reflective practice sessions. Furthermore, quantitative assessments of support adequacy yielded notably high mean scores—3.71 for insufficient access to discipline-specific pedagogical training and curated case-based teaching materials, and 3.73 for the omission of deep interaction metrics in formal teaching evaluations—both measured on a five-point Likert scale where higher values signify greater perceived deficiency. In-school capacity-building initiatives remain disproportionately oriented toward technical competencies, particularly digital tool operation and basic presentation software proficiency, while neglecting foundational areas such as discourse analysis, dialogic scaffolding strategies, and subject-specific questioning frameworks. Evaluation protocols for classroom observation and annual performance reviews continue to

prioritize procedural fidelity—such as syllabus coverage rate and lesson pacing—over qualitative indicators of cognitive engagement. Critically, no standardized metrics currently track student participation intensity, the frequency or sophistication of higher-order questions posed by learners, or the distribution of speaking time across diverse learner profiles. This misalignment between support mechanisms and contemporary pedagogical imperatives constrains the realization of student-centered, inquiry-driven learning environments and limits opportunities for evidence-informed refinement of instructional practice across institutional levels.

2. Optimization Approaches for Verbal Interaction in Classroom Settings from the Perspective of Deep Learning

2.1. Deepen the Reconstruction of Classroom Discourse and Adapt It to Various Teaching Scenarios at Different Levels

A tiered dialogue framework is established to systematically support both foundational knowledge acquisition and higher-order cognitive development, aligning pedagogical objectives with students' evolving intellectual capacities across developmental stages. This framework deliberately moves beyond conventional, episodic question-and-answer exchanges by integrating temporally coordinated discourse phases: pre-class preparation, in-class progression, and post-class extension. In the pre-class phase, structured preview tasks—such as guided reflection prompts or concept-mapping exercises—are employed to elicit authentic student inquiries, thereby transforming learners' prior uncertainties into intentional entry points for classroom dialogue. During in-class instruction, dual-layered interaction strategies are implemented: concise, high-frequency retrieval practice reinforces core factual knowledge and procedural fluency, while scaffolded, multi-step questioning sequences—comprising probing, comparative, and metacognitive prompts—facilitate deep conceptual processing and analytical reasoning. These inquiry chains are calibrated to students' zone of proximal development, ensuring cognitive challenge remains accessible yet generative. Post-class extension leverages digital learning environments—including asynchronous discussion forums, interactive annotation tools, and adaptive feedback modules—to sustain discourse continuity, broaden participation opportunities, and accommodate diverse learning rhythms and temporal availability. Crucially, this integrated approach mitigates temporal limitations inherent in fixed-duration lessons without compromising pedagogical coherence or equity of engagement. The framework further incorporates formative assessment loops at each stage, enabling real-time adjustment of discourse complexity and scaffolding intensity based on collective and individual response patterns. By embedding linguistic, cognitive, and affective dimensions within a unified architecture, the system fosters not only content mastery but also communicative competence, epistemic agency, and collaborative meaning-making—core competencies emphasized in contemporary curriculum standards.

2.2. The Curriculum Framework Establishes a Disciplinary Interaction Paradigm Tailored to Distinct Educational Objectives

A progressive feedback paradigm constitutes a pedagogically grounded instructional strategy wherein instructors systematically deploy purposefully sequenced follow-up questions to scaffold learners' cognitive development across multiple levels of Bloom's taxonomy—ranging from recall and comprehension to analysis, evaluation, and creation. This paradigm operates not as a static interrogation technique but as a dynamic, adaptive process responsive to real-time learner responses, enabling timely identification of conceptual gaps, misconceptions, or incomplete mental models. By embedding iterative questioning within lesson delivery, educators foster metacognitive awareness, encourage self-monitoring of understanding, and promote intellectual ownership of knowledge construction. Moreover, such questioning practices cultivate epistemic humility and disciplined inquiry habits essential for lifelong learning. Empirical evidence indicates that well-designed follow-up questions significantly enhance retention, transferability of

knowledge to novel contexts, and the integration of interdisciplinary concepts. When aligned with clearly articulated learning outcomes and domain-specific disciplinary norms, this approach supports equitable participation by lowering linguistic and cultural barriers through structured verbal scaffolding. It also reinforces formative assessment principles by transforming classroom dialogue into diagnostic, actionable data for instructional adjustment—thereby strengthening the coherence between curriculum design, teaching methodology, and student-centered learning progression.

2.3. Promote Two-Way Collaborative Cultivation between Teachers and Students, Breaking Down Barriers to Interactive Participation

2.4. Lightweight Solutions Empower Teachers and Reduce the Workload Associated with Classroom Optimization

Establishing low-pressure participation channels is a pedagogically grounded strategy to mitigate students' psychological barriers to expression, particularly in large-class or high-stakes learning environments where fear of judgment, concern over linguistic accuracy, or uncertainty about disciplinary norms may inhibit active engagement. Such channels include anonymous digital response tools, structured think-pair-share protocols with rotating roles, scaffolded written reflections submitted prior to discussion, and multimodal submission options (e.g., audio notes or concept sketches) that accommodate diverse cognitive and communicative preferences [8, 10]. Critically, these mechanisms must be intentionally integrated into the instructional design—not treated as optional add-ons—so that participation becomes habitual, equitable, and formative rather than performative or evaluative. Faculty training and curriculum mapping support are essential to ensure consistent implementation across courses and disciplines. Furthermore, iterative feedback loops—where student input on channel usability informs subsequent refinements—reinforce agency and co-ownership of the learning process. Empirical observation indicates that when such channels are embedded with clarity, consistency, and instructor responsiveness, measurable improvements emerge in both breadth of participation (i.e., number of contributors) and depth of contribution (i.e., conceptual sophistication and critical reasoning), thereby strengthening classroom discourse as a collective knowledge-building practice.

2.5. Implement a Tiered Incentive Mechanism to Balance Participation Opportunities for All Students in the Class

A tiered incentive mechanism is implemented to ensure equitable participation opportunities across diverse student profiles, including those with varying levels of confidence, communication preferences, and academic preparedness. This system operates through a dual-track design: first, at the instructional level, teaching excellence is reinforced by recognizing pedagogical innovation that intentionally integrates structured, inclusive interactive activities—such as think-pair-share protocols, scaffolded questioning sequences, and collaborative digital annotation—within lesson delivery [11, 12]. These elements are evaluated as voluntary enhancement criteria in teaching quality assessments, emphasizing formative feedback and professional growth rather than compliance-based evaluation, thereby safeguarding instructional autonomy and preventing unintended workload escalation. Second, at the learner level, assessment practices are deliberately differentiated to reflect multiple modes of intellectual engagement: students earn regular course points not solely through oral contributions in whole-class settings, but also via documented small-group dialogue, reflective written responses, annotated peer feedback, and multimodal presentation formats (e.g., infographics, short video explanations, or concept maps). Introverted, neurodiverse, or language-developing learners thus receive commensurate recognition for substantive cognitive engagement without requiring high-stakes verbal performance. This approach systematically reduces score variance attributable to interaction style rather than conceptual understanding, counters emergent dominance patterns in classroom discourse, and strengthens sustained involvement among students who typically remain peripheral

in traditional participation models—ultimately cultivating a more academically inclusive and psychologically safe learning environment.

2.6. Improve the Supporting Facilities for Educational Institutions and Establish a Sustainable Support System

2.7. Flexibly Adjust the Orientation of Teaching Evaluation to Stimulate Intrinsic Motivation for Reform

Optimizing the alignment between allocated class hours and actual class sizes is a foundational pedagogical strategy that directly enhances instructional efficacy and student engagement. When class sizes are appropriately scaled relative to time resources, educators gain sufficient temporal and cognitive bandwidth to design and implement interactive, student-centered learning activities—particularly sustained, high-quality classroom discussions that foster critical thinking, collaborative reasoning, and metacognitive development. Excessive class sizes coupled with rigid or insufficient time allocations often constrain teachers to lecture-dominated formats, limiting opportunities for formative feedback, differentiated support, and responsive pedagogy. Conversely, thoughtfully calibrated scheduling—such as integrating extended discussion blocks within weekly timetables, permitting flexible pacing across units, and ensuring adequate preparation and reflection time for both instructors and learners—creates structural conditions conducive to deeper learning. This optimization also supports equitable access: smaller effective cohort sizes and well-distributed contact hours help mitigate disparities in participation, especially among students from underrepresented backgrounds or those with diverse learning needs. Furthermore, institutional policies governing workload distribution, course load caps, and teaching assignment protocols must be systematically reviewed to ensure coherence with these pedagogical goals, thereby embedding sustainability into daily academic practice rather than treating it as an ad hoc initiative [13].

3. Conclusion

The centrality of teacher-student interaction in shaping meaningful learning experiences has been consistently affirmed across educational research, underscoring its foundational role in pedagogical effectiveness and learner development. This interaction functions not merely as a procedural feature of instruction but as a dynamic, relational process that mediates cognitive engagement, emotional safety, and identity formation within academic settings. Drawing upon empirical data from a large-scale two-way classroom ecosystem survey—comprising responses from over 600 educators and 700 students—the present study systematically maps persistent patterns of interactional constraint across three interrelated domains: the design and sequencing of instructional discourse, the distribution and quality of participatory agency among both teachers and students, and the coherence and responsiveness of institutional support structures. Within instructional discourse, recurring patterns include an overreliance on low-cognitive-demand question-and-answer exchanges, limited adaptation of dialogue strategies to discipline-specific epistemic norms, and insufficient scaffolding for students to initiate, challenge, or co-construct knowledge. Regarding participation, asymmetries persist—not as deficits of individual will, but as manifestations of entrenched pedagogical routines, time pressures, assessment expectations, and implicit assumptions about expertise and authority. Institutional mechanisms, meanwhile, often operate in silos: professional development programs rarely address interactional fluency; classroom observation protocols seldom capture dialogic quality; and resource allocation seldom prioritizes relational infrastructure such as structured feedback cycles, reflective teaching communities, or embedded instructional coaching. These challenges reflect systemic tensions rather than isolated shortcomings—arising from the complex convergence of evolving pedagogical ideals, infrastructural limitations, curricular mandates, and organizational priorities. To address these dimensions holistically, this study advances a three-tiered improvement framework grounded in feasibility, scalability, and

developmental sensitivity. First, at the classroom dynamics level, it advocates for a tiered disciplinary dialogue model that sequences interactions—from foundational clarification through interpretive exchange to evaluative co-inquiry—calibrated to subject matter complexity and student readiness. Second, at the relational level, it proposes intentional structuring of bidirectional communication channels—including routine reflective dialogues, anonymized feedback loops, and shared agenda-setting protocols—to foster mutual accountability and epistemic respect. Third, at the institutional level, it recommends embedding sustainable support mechanisms such as micro-credentialing for dialogic competence, cross-departmental dialogue labs, and longitudinal classroom interaction analytics. Collectively, this framework seeks not to prescribe uniform practices, but to cultivate adaptive capacity—enabling educators to incrementally rebalance interactional emphasis away from transmission-oriented exchanges and toward sustained, equitable, and cognitively rich dialogue that advances disciplinary understanding, metacognitive awareness, and lifelong learning dispositions.

References

1. E. C. Wragg, Ed., **Classroom Teaching Skills: The Research Findings of the Teacher Education Project**. Psychology Press, 1989.
2. D. W. Otter, J. R. Medina, and J. K. Kalita, "A survey of the usages of deep learning for natural language processing," *IEEE Trans. Neural Netw. Learn. Syst.*, vol. 32, no. 2, pp. 604–624, 2020.
3. S. Singh, L. Singh, and N. Satsangee, "Automated assessment of classroom interaction based on verbal dynamics: A deep learning approach," *SN Comput. Sci.*, vol. 6, no. 3, p. 201, 2025.
4. R. A. Khalil, E. Jones, M. I. Babar, T. Jan, M. H. Zafar, and T. Alhussain, "Speech emotion recognition using deep learning techniques: A review," *IEEE Access*, vol. 7, pp. 117327–117345, 2019.
5. H. M. Fayek, M. Lech, and L. Cavedon, "Evaluating deep learning architectures for speech emotion recognition," *Neural Netw.*, vol. 92, pp. 60–68, 2017.
6. M. F. Alsharekh, "Facial emotion recognition in verbal communication based on deep learning," *Sensors*, vol. 22, no. 16, p. 6105, 2022.
7. J. Gratch, "The promise and peril of interactive embodied agents for studying non-verbal communication: A machine learning perspective," *Philos. Trans. R. Soc. B*, vol. 378, no. 1875, p. 20210475, 2023.
8. Q. Zhou, W. Suraworachet, and M. Cukurova, "Detecting non-verbal speech and gaze behaviours with multimodal data and computer vision to interpret effective collaborative learning interactions," *Educ. Inf. Technol.*, vol. 29, no. 1, pp. 1071–1098, 2024.
9. W. Feng, A. Kannan, G. Gkioxari, and C. L. Zitnick, "Learn2smile: Learning non-verbal interaction through observation," in *Proc. IEEE/RSJ Int. Conf. Intell. Robots Syst. (IROS)*, Sep. 2017, pp. 4131–4138.
10. L. Zhang, S. Wang, and B. Liu, "Deep learning for sentiment analysis: A survey," *WIREs Data Mining Knowl. Discov.*, vol. 8, no. 4, p. e1253, 2018.
11. E. Chong, K. Chanda, Z. Ye, A. Southerland, N. Ruiz, R. M. Jones, and J. M. Rehg, "Detecting gaze towards eyes in natural social interactions and its use in child assessment," *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.*, vol. 1, no. 3, pp. 1–20, 2017.
12. I. H. Sarker, "Deep learning: A comprehensive overview on techniques, taxonomy, applications and research directions," *SN Comput. Sci.*, vol. 2, no. 6, pp. 1–20, 2021.
13. S. Cairncross and M. Mannion, "Interactive multimedia and learning: Realizing the benefits," *Innov. Educ. Teach. Int.*, vol. 38, no. 2, pp. 156–164, 2001.

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