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Classroom Interaction in Higher Education in the Context of Large Language Models: A Qualitative Study of the Knowledge Construction Process

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Abstract In recent years, the application of large language models (LLMs) in university classroom interactions has been increasingly widespread. This study employs a qualitative research methodology, conducting semi-structured in-depth interviews with 58 undergraduate students from the School of Management at University A, with the aim of thoroughly exploring the patterns and motivations underlying students' use of LLMs in classroom interactions. Drawing upon constructivist learning theory, this paper elucidates the knowledge construction process in university classroom interactions facilitated by LLMs and proposes strategies for teachers to effectively guide students in collaborating with LLMs. The research findings indicate that, with the assistance of LLMs, the knowledge construction process in university classroom interactions is characterized by a student-centered approach. Teachers create interactive classroom scenarios, and under the dual influence of interactive requirements and time constraints, students collaborate and communicate with LLMs to construct knowledge regarding new domains and complex problems. LLMs play a significant mediating role in the classroom interactions between students and teachers. This study offers a novel perspective to traditional classroom interaction theories and deepens our understanding of the mechanisms of knowledge construction in classroom interactions.

Index Terms Higher Education, Classroom Interaction, Knowledge Construction, Large Language Models, Qualitative Research

I. Introduction

With the rapid development of artificial intelligence technology, large language models have become an undeniable new force in the field of education. These models, with their powerful natural language processing capabilities, provide unprecedented tools and resources for educators and students. In university classroom interactions, the application of large language models offers new avenues and methods for students' knowledge construction. Traditional classroom interactions, primarily face-to-face exchanges between teachers and students, are limited by time and space, and students' knowledge construction often relies on online information searches and one-way teaching from teachers, which has certain limitations. In contrast, classroom interactions under the background of large language models make the process of knowledge construction more diverse. Through interactions with large language models, students can not only receive immediate feedback but also collaborate and communicate deeply with the models under the guidance of teachers, achieving active knowledge construction.

The current academic research on the integration of large language models (LLMs) into classroom interactions primarily focuses on the technological functions of LLMs and the impact of their usage strategies on classroom interactions. Tan (2023) proposed that LLMs can efficiently generate student questions, which can be used for peer teaching, enhance teacher-student communication, improve student classroom participation, and stimulate students' interest in learning [1]. Zhang et al. (2024) pioneered the application of LLM-empowered multi-agent systems in virtual classroom teaching, enhancing student participation and sense of presence through the simulation of vivid learning environments, and promoting interactions among teachers, students, and peers [2]. Guevarra et al. (2025) introduced an innovative LLM-guided teaching system that creates interactive scenarios and provides feedback strategies, fulfilling the one-on-one interactive training needs that traditional teaching struggles to achieve [3]. Kumar et al. (2024) indicated through formative research and controlled experiments that different instructional strategies for LLM usage by teachers have varying impacts on classroom interactions and student learning performance [4]. Gumina et al. (2023) also highlighted the importance of LLM usage policies in various aspects of IT course teaching [5]. Zhang et al. (2024) found that the majority of teachers and students recognize the role of LLMs in enhancing personalized learning and classroom participation, but they also acknowledge the limitations of LLMs in complex cognitive tasks [6].

Academic research on knowledge construction is an interdisciplinary field involving education, psychology, cognitive science, information science, and more. Current research in this field mainly focuses on cognitive processes and knowledge construction, knowledge construction from a socio-cultural perspective, educational technology applications of knowledge construction, assessment and measurement of knowledge construction, and knowledge construction with artificial intelligence. Gan et al. (2020) focused on modeling the dynamic knowledge construction process and cognitive item difficulty in knowledge tracing, revealing the cognitive processes involved in knowledge construction [7]. Floren et al. (2020) introduced Gunawardena's Interaction Analysis Model (IAM) to assess the knowledge construction process in interprofessional education [8]. Mutiaraningrum et al. (2020) investigated the social construction of knowledge in synchronous text-based discussions during English language learning, believing that such discussions help students construct knowledge [9]. Zhou Pinghong et al. (2021) used the Social Cognitive Network Analysis (SENS) method to visualize the social cognitive evolution trajectory of students' collaborative knowledge construction [10].

A review of the existing literature reveals that while significant progress has been made in the integration of large language models (LLMs) with knowledge graph construction across various fields, there remains a notable gap in research concerning the relationship between LLMs and knowledge construction. Particularly within the context of university classroom interactions, the exploration of knowledge construction processes facilitated by LLMs is still in its infancy, with many areas awaiting further investigation. This study employs a qualitative research methodology and incorporates constructivist learning theory to analyze the knowledge construction process in university classroom interactions underpinned by LLMs. Through qualitative analysis, this research uncovers the mediating role of LLMs in university classroom interactions, thereby providing new theoretical evidence for the application of constructivist learning theory in technology-assisted teaching. This work further extends our understanding of the knowledge construction process.

II. Research Design

This paper takes University A as an example, selecting 58 undergraduate students from the School of Management's Big Data Management and Application major across three grades for semi-structured in-depth interviews. The main reason for selecting students from this major is that students in this major have a broader application and a deeper understanding of cutting-edge artificial intelligence technology and tools. The interview outline mainly revolves around the following questions: 1. Do you use large language models in classroom interactions? 2. What large language models do you use in classroom interactions, and how do you feel about using them? 3. What kind of classroom interaction forms would make you want to use or even rely on large language models to solve problems? 4. How do you handle the information provided by large language models after obtaining it? 5. What do you think are the biggest advantages and disadvantages of large language models in classroom interactions [11]?

To ensure the comprehensiveness of the sample coverage, the author first conducted preliminary research and found that more than 90% of students in the three grades of this major have used large language models, and more than 60% of students have installed large language model apps on their smartphones. The author conducted random sampling of students who have used large language models and also selected three students who have not yet started using large language models. The interview period was three months, with the author inviting five students to the office for interviews each week, controlling the interview time between 40 and 60 minutes. With the students' consent, the interview content was recorded. After all the students' interviews, the interview materials were sorted out in time and transferred to a text form for subsequent coding analysis. This interview collected about 40,000 words of interview text. During the coding process, for some materials with doubts, students were invited again for supplementary explanations. This interview sample involved 58 students from the Big Data Management and Application major of the 2021, 2022, and 2023 grades, aged 20-22 years old, with 25 males and 33 females.

This paper employs the constant comparative method for the coding analysis of interview data, which is a core analytical technique of grounded theory in qualitative research. By systematically comparing different segments of the data, this method reveals patterns, relationships, and concepts within the data. Specifically, a bottom-up three-level coding approach is adopted, namely open coding, axial coding, and selective coding. This coding method is clear in hierarchy and convenient in operation, and it can more standardly abstract relevant concepts and categories and reveal the intrinsic relationships between categories [12], [13]. To ensure the correctness and validity of the coding and analysis process, the author also invited the full-time teachers who teach this major to verify the interview data based on their classroom interaction situations during teaching, and jointly discuss and determine the abstract concepts and relevant categories, striving to reflect the real situation more objectively from different subjects and different channels. In this paper, 50 samples were randomly selected from the interview data for formal coding, and the remaining 8 samples were used for saturation test to determine whether the research has reached a saturated state.

III. Interview Data Coding

III. A. Open Coding

Open coding is a crucial step in qualitative research, aimed at analyzing raw interview data word by word and extracting important concepts. Elements with similar nature and content are then recombined to form initial categories [14]. In this study, we used the Nvivo11.0 software to perform open coding on the raw interview data, extracting a total of 58 important concepts and 16 initial categories. Due to space limitations, only a selection of raw sentences, important concepts, and initial categories are listed in Table 1 below.

Table 1: Partial Results of Open Coding

Original Statements	Key Concepts	Initial Categories
S2: Occasionally, the issues discussed in classroom settings delve into highly cutting-edge topics not yet covered in textbooks, prompting me to seek assistance from large language models. S5: Encountering obscure interdisciplinary knowledge questions that exceed my knowledge base and time constraints for consulting specialized literature, I find large language models particularly useful. S29: Recently, the term "neural networks" has frequently been mentioned in class, a concept I was previously unfamiliar with, leading me to utilize Wenxin Yiyan to gain insights into this algorithm. S58: In our major of big data management, we encounter numerous industries, and it is impractical to have in-depth knowledge of each. When faced with industry-specific business issues, I resort to AI tools to research relevant industry contexts.	a2: Cutting-edge Knowledge Assistance a5: Frontier Knowledge Acquisition a29: Novel Concept Exploration a58: New Knowledge Exploration	A2: Exploration of Interdisciplinary and Frontier Knowledge
S7: I perceive large language models as effective tools for knowledge enlightenment, providing responses that are generally accurate. S33: My poor memory leads to frequent forgetting of learned material, and I often rely on Doubao to recall key points from previous lectures. S57: During classroom discussions, when faced with vague knowledge points or uncertain answers, I turn to large language models for clarification. S31: In our big data management information systems course, interactive sessions include challenging knowledge quizzes. Occasionally, I consult Kimi for answers, achieving an accuracy rate exceeding 90%.	a7: Knowledge Enlightenme-nt a33: Coping with Forgetfulness a57: Resolving Knowledge Blind Spots a31: Accurate Answer Retrieval	A5: Removal of Knowledge Blind Spots
S9: Often, I struggle to articulate my thoughts clearly, but large language models significantly assist me in this regard. S27: Large language models are invaluable for refining and professionalizing the language of my responses, avoiding overly colloquial expressions. S55: Abstract topics such as entrepreneurship and market adaptation are challenging to address without the aid of large language models like Wenxin Yiyan.	a9: Language Organization Assistance a27: Content Refinement a55: Abstract Issue Language Organization	A6: Language Organization
S12: When encountering incomprehensible code or errors, I seek AI assistance for explanations and corrections. S13: During the setup of Hadoop environments, I utilize Kimi for code analysis to identify and resolve issues, saving considerable time. S20: In courses involving R and Python, when my code fails to execute properly, I seek assistance from large language models to rectify and optimize it.	a12: Code Interpretation and Error Correction a13: Code Analysis and Issue Discovery a20: Programming Learning Assistance	A7: Learning of Programming Languages
S17: Given the limitations of our knowledge base, AI tools are indispensable for questions requiring comprehensive knowledge and immediate responses, providing valuable insights. S28: The sudden questions in class, particularly those requiring extrapolation, often leave me bewildered. My classmates promptly use Doubao to search for answers on my behalf.	a17: Broad Knowledge Inquiry a28: Resource Acquisition	A8: Immediate Feedback
S36: The demanding tasks assigned during classroom interactions, such as finding case studies to validate model effectiveness, are challenging without guidance, leading me to seek assistance from Doubao and Zhi Pu Qing Yan.	a36: High-Demand Task Completion	A13: Assistance with High-Demand Tasks

S53: When faced with difficult and highly specialized questions for which I lack a foundational understanding, I struggle to provide examples and thus consult large language models.	a53: Challenging Questions and Required Answers	
S54: After the teacher poses a question, it necessitates verification, practical operation, and discussion, during which I rely on large language models. S37: For courses involving experiments, a single demonstration by the teacher is insufficient for mastering the experimental procedures. I find it more effective to use large language models to solve experimental issues independently.	a54: Problem Verification and Practical Discussion a37: Solving Experimental Operation Issues	A16: Submission of Practical Operations

III. B. Axial Coding

Axial coding aims to connect initial categories by constructing causal relationships or situational connections between them, thereby forming higher-level main categories [15]. Based on the 16 initial categories obtained from open coding, this study analyzed the intrinsic relationships among these categories and constructed 5 main categories, namely: Exploration of New Domain Knowledge, Problem Solving, Public Communication and Expression, Technical Operation Submission, and Perception of Time Pressure. The correspondence between main categories and initial categories is shown in Table 2.

Table 2: Results of Axial Coding

Main Categories	Subcategories
AA1: Exploration of New Domain Knowledge	A2: Exploration of Interdisciplinary and Frontier Knowledge A3: Inquiry and Resolution in Uncharted Knowledge Areas
AA2: Resolution of Complex Issues	A1: Resolution of Challenging Problems A5: Removal of Knowledge Blind Spots A9: Understanding of Complex Knowledge A10: Interpretation of Professional Terminology and Theoretical Concepts A13: Assistance with High-Demand Tasks A14: Resolution of Homework Queries
AA3: Public Communication and Expression	A4: Expression of Views A6: Language Organization
AA4: Technical Practical Submissions	A7: Learning of Programming Languages A11: Data Analysis A16: Submission of Practical Operations
AA5: Perception of Time Pressure	A8: Immediate Feedback A15: Management of Unexpected Issues A12: Enhancement of Efficiency and Creativity

III. C. Selective Coding

Selective coding is based on axial coding and involves clarifying the logical relationships between categories through a "storyline" approach, thereby identifying the core category and constructing a theoretical framework [16]. In this study, we conducted a detailed analysis of the logical relationships between categories and repeatedly verified the raw data. During this process, relying on constructivist learning theory, we ultimately developed a comprehensive understanding of the knowledge construction process in classroom interactions in higher education in the context of large language models. This process is detailed in Figure 1, which illustrates how students construct knowledge with the assistance of large language models in classroom interactions.

As shown in Figure 1, the triadic interaction model of knowledge construction has emerged in the context of large language models (LLMs). Teachers act as the creators of interactive scenarios, students are the main participants in interactions, and LLMs play the role of mediators. There is a close relationship between the content of the interactive scenarios created by teachers in classroom interactions and the behavior of students using LLMs to construct knowledge. When the scenario content involves new domain knowledge or complex problems, students actively seek the assistance of LLMs, which becomes the core link in their meaning construction. Additionally, the stress that students face in classroom interactions is also an important factor that drives them to use and even depend on LLMs for knowledge construction. In classroom interactions, students are usually under dual pressure from teachers' interaction requirements and time constraints. Especially when teachers set high interaction requirements, such as asking students to publicly express their views, engage in face-to-face communication, or submit technically challenging tasks, students' willingness to use LLMs is stronger, and dependency may even occur. Therefore, in the context of LLMs, the knowledge construction process in university classroom interactions is a process in which teachers create interactive scenarios, and students actively seek help from LLMs for new domain knowledge or complex problems under dual pressure, thereby constructing meaning and providing feedback to teachers.

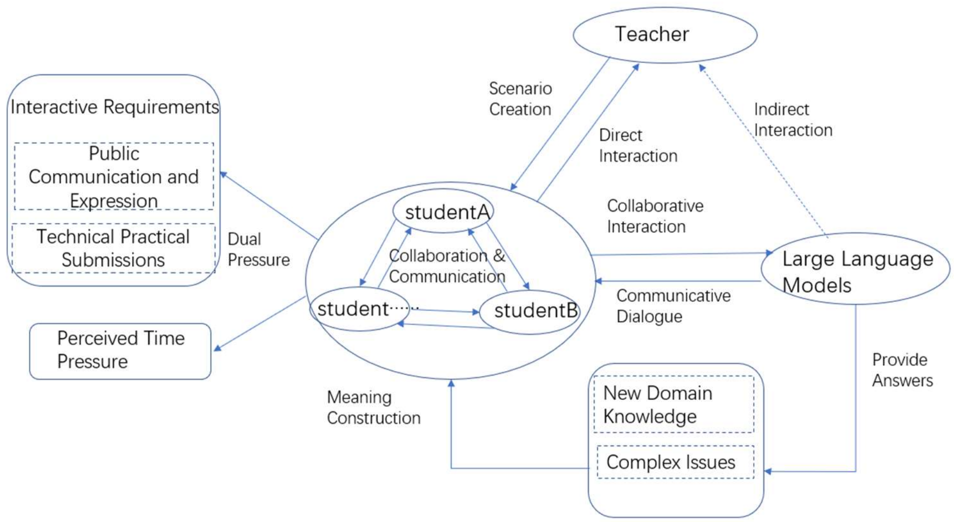

Figure 1: Knowledge Construction Processes in the Context of LLMs

This process not only reflects the core view of constructivist learning theory that students actively construct knowledge but also reveals the mediating role of LLMs in knowledge construction.

III. D. Theoretical Saturation Test

Saturation is an important indicator used to determine whether research data are sufficient to support theoretical construction [17]. If no new concepts or categories emerge after coding new research data using the three-level coding method of the constant comparative approach, the study is said to have reached theoretical saturation [18]. In this paper, the remaining eight samples were subjected to three-level coding, and no new concepts or categories were identified, indicating that the internal relationships in the knowledge construction process of classroom interactions in higher education in the context of large language models are sufficiently constructed. This process has passed the saturation test.

IV. An Exposition of the Knowledge Construction Process in the Context of Constructivist Learning Theory

Constructivist learning theory posits that the process of knowledge acquisition by learners is a learner-centered knowledge internalization process within a specific socioeconomic and cultural context. Learners interact with teachers and other learners, primarily through four aspects: "learning situation (context)," "collaborative interaction," "communication dialogue," and "meaning construction," to construct knowledge or the object of learning [19]. This study employs the constant comparative method to conduct three-level coding of interview data and, in conjunction with constructivist learning theory, reveals the knowledge construction process in classroom interactions in higher education in the context of large language models. The following section elaborates on this process from the four aspects of constructivist learning theory.

IV. A. Learning Situation

Within the framework of constructivist learning theory, learning situations are defined as objective environments capable of eliciting emotional responses from students, including various forms such as narrative scenarios, problem scenarios, resource scenarios, and virtual experimental scenarios. The core role of these scenarios is to provide a concrete context that enables students to accumulate experiences within specific situations, thereby facilitating the construction of knowledge [20]. This study selects students from the Big Data Management and Application program at University A as interview subjects. According to research, the curriculum design of this major emphasizes the integration of theory and practice, and the learning situations created by teachers during classroom interactions encompass a variety of methods such as individual questioning, peer or group discussions, online Q&A, case simulations, in-class quizzes, and experimental practice operations. In the process of creating these scenarios, teachers also frequently utilize large language models as auxiliary tools.

"In a theory course, the teacher designs thought-provoking and interesting discussion topics based on the key points and difficulties of the course for each class, encouraging us to engage in in-depth discussions with peers. Subsequently, the teacher invites students to share their viewpoints, which should not only include personal opinions but also integrate the perspectives of their peers," said one student in an interview. Another student commented, "I greatly appreciate the teaching method of the Python programming course; the teacher often conducts pre-class tests to assess our grasp of the content from the previous lesson. This simulated exam approach is very beneficial for us."

Analysis of the interview data reveals that students have a clear understanding of the classroom interaction methods employed by teachers and generally believe that these interactive scenarios significantly aid in the mastery of knowledge points and problem-solving, as well as positively impact learning outcomes. These findings underscore the importance of creating diverse learning situations during the teaching process and the role played by large language models, providing empirical support for enhancing the effectiveness of classroom interactions.

IV. B. Collaborative Interaction

In constructivist learning theory, collaborative interaction occupies a central position throughout the entire learning process [21]. It plays an essential role in gathering and analyzing learning materials, formulating and validating hypotheses, evaluating learning outcomes, and ultimately constructing meaning [22]. Collaborative interaction involves interactions among learners, including cooperation between teachers and students, as well as among students themselves. Prior to the popularization of large language models, collaborative interactions in college classrooms primarily took place between teachers and students. Teachers created interactive scenarios to stimulate independent thinking or group discussions among students, who mainly relied on the teacher's lectures and textbook content. The classroom interaction was lively, with proactive learners willing to share their viewpoints and present their achievements.

However, with the introduction of large language models, the pattern of collaborative interaction in college classrooms has undergone significant changes. While teachers continue to create interactive scenarios, students have begun to show a strong willingness to collaborate with large language models, especially when required to communicate publicly, submit technical practical work, and provide rapid feedback to teachers under time pressure. One student stated, "I have become very accustomed to using large language models; they are knowledgeable, offer a good communication experience, and do not challenge my positions." Another student mentioned, "Doubao (large language model) is very practical in our group discussions, helping us to build frameworks and analyze cases, which greatly improves efficiency. The answers it provides are accepted by our teachers when we feedback to them." Additionally, a student pointed out, "Large language models help me organize my language, making my expression in class more fluent and avoiding embarrassment."

Despite the increasing use of large language models in the classroom, the voices of discussions among students have weakened, sometimes leading to a dull classroom interaction atmosphere. The collaborative interaction between students and large language models has a dual nature, bringing both positive impacts and potential negative consequences. Therefore, how teachers guide effective collaboration between students and large language models in classroom interactions has become a crucial issue. Teachers need to carefully design the content and form of interactions to ensure that students can achieve the best learning outcomes in collaboration with large language models while maintaining the vitality and depth of classroom interactions.

IV. C. Communication and Dialogue

From the perspective of constructivist learning theory, communicative dialogue is a key component of the collaborative learning process, requiring group members to discuss and plan how to complete assigned learning tasks through conversation [23]. Against the backdrop of large language models, communicative dialogue in college classroom interactions has transformed into an interactive process involving teachers, students, and large language models. When teachers design and create classroom interaction scenarios, students tend to engage in preliminary textual communication with large language models. This communication primarily takes the form of questions aimed at addressing new domain knowledge and challenging issues encountered in classroom interaction tasks.

For instance, one student recalled, "In a classroom case sharing session on digital transformation, our task was to discuss the digital transformation of agriculture. Since we were not familiar with the field of agriculture, we conducted extensive questioning and searching through large language models such as Kimi, iFlytek, and Wenxin

Yayan." Another student mentioned, "In technology-oriented courses, I prefer to use AI tools because, as a liberal arts student, the professional jargon involved in technical courses is overly complex and difficult to understand."

With the assistance of large language models, communication among students takes on two distinct forms: one where individual students first communicate with the large language model in writing and then feedback the results to the group for further oral or written discussion; and another where group members engage in oral or written communication first, and then communicate with the large language model in writing for unresolved issues. Communication between students and teachers is reflected in the direct feedback on the interactive tasks proposed by the teachers, with students typically reporting the results of their communication with the large language model to the teachers. This feedback may be oral or written, depending on the nature of the interactive task. Regardless of the communication method, the large language model plays the role of an intermediary in the communication process, not only facilitating the exchange of information among students but also deepening their understanding and mastery of classroom content. Therefore, large language models play an indispensable role in communicative dialogue within college classroom interactions, changing the way communication is conducted and enriching its content and depth.

IV. D. Meaning Construction

In the field of education, meaning construction is regarded as the ultimate goal of the learning process, involving a deep understanding of the essence, patterns, and intrinsic connections of phenomena [24]. This process emphasizes the learner's ability to actively process information and construct knowledge meaning, rather than passively receiving knowledge through traditional teaching methods [25]. Prior to the emergence of large language models, students often relied on online searches, such as search engines, to obtain information when confronted with new domain knowledge and complex problems. However, this approach is not only time-consuming and labor-intensive but also often yields information that is inaccurate or irrelevant. In the time-constrained environment of classroom interactions, this traditional method of information gathering significantly limits students' ability to effectively construct knowledge, as they often depend solely on the unidirectional transmission of knowledge from teachers to build their understanding.

With the introduction of large language models, students can now leverage these tools to assist in addressing new domain knowledge and challenging issues encountered during classroom interactions. Through question-and-answer interactions with large language models, students can save considerable time in gathering information, thus enabling them to engage in knowledge construction more rapidly and efficiently. The key lies in students learning how to effectively pose questions to large language models, as the manner of questioning directly influences the quality of the answers received. One student shared their experience: "When I first started using large language models, I was not very skilled at asking questions, which often resulted in answers that seemed hollow. Therefore, the quality of the user experience largely depends on your questioning skills."

After obtaining answers from large language models, students need to engage in critical thinking, analyzing and processing these answers while relating and comparing them to their existing knowledge framework. This process typically requires multiple rounds of question-and-answer interactions with the large language model. According to interview data, approximately 74% of students further process the answers provided by large language models, either by incorporating their own perspectives or by posing new supplementary questions. Through such iterative reflection, comparison, and questioning, students can form a new cognitive structure of current knowledge and actively construct knowledge meaning. Another student noted, "I have compared the responses of different large language models to the same question and found that there are certain differences among them. You can ask multiple models and then synthesize their answers, or have the same large language model respond repeatedly to gain a more comprehensive understanding."

In summary, the ability of students to effectively utilize large language models for meaning construction during classroom interactions depends on their level of cognition regarding this tool and their capacity for deep thinking. Teachers should encourage students to develop these abilities to foster deeper learning and growth.

V. Strategies for Teachers to Effectively Facilitate Student Collaboration with Large Language Models

Based on the interview results and the analysis of the knowledge construction process, it can be concluded that, in the context of large language models (LLMs), the knowledge construction in higher education classroom interactions is a student-centered process. This process encompasses the learning situations created by teachers, the collaborative communication between students and LLMs, and the active meaning construction by students. Undoubtedly, LLMs play a positive role in promoting students' knowledge construction. However, they may also bring about some negative impacts.

For instance, some students have developed an over-reliance on large language models, tending to seek answers directly from these models when faced with classroom interaction tasks, rather than engaging in independent thinking first. This could lead to a gradual decline in students' logical thinking abilities. Interview data indicates that approximately 26% of students are inclined to use answers provided by large language models as feedback to teachers. When students fail to form a basic understanding of a problem in their minds or adopt answers from large language models without critical thinking, they are essentially engaging in passive knowledge construction. In such cases, large language models may replace students as the main drivers of classroom interaction.

Furthermore, an over-reliance on large language models may also reduce students' willingness to discuss with peers during classroom interactions, making them less inclined to express their own opinions, as they might assume that their views align with the answers provided by large language models. This situation can lead to a dull classroom interaction atmosphere, significantly reducing the effectiveness of classroom interactions.

In light of these challenges, teachers can develop a series of classroom interaction strategies to guide students. These strategies should aim to cultivate students' critical thinking and independent thinking abilities, encouraging them to develop their own insights and understandings while utilizing large language models. Teachers can design more challenging and interactive tasks, encourage students to actively contribute their ideas in group discussions, and create more opportunities for students to showcase their thought processes during classroom interactions, rather than just the final answers. Through these methods, teachers can help students better utilize large language models as Auxiliary tools instead of substitutes for their own thinking, thereby enhancing the quality and effectiveness of classroom interactions.

(1) High-quality classroom interaction content. In constructing high-quality classroom interaction content, teachers must carefully consider the characteristics and current learning status of their students, ensuring that the content designed is appropriately challenging and engaging. Educators should select open-ended discussion topics and technical practical tasks that are closely related to students' learning and life, thereby enhancing students' affinity for the topics and stimulating their interest, which in turn encourages students to draw on personal experiences when providing feedback. This approach can effectively reduce the tendency of students to immediately seek assistance from large language models when encountering problems.

When classroom interaction content involves interdisciplinary or new domain knowledge, teachers should guide students in the proper use of large language models, clarifying the boundaries of questioning and requiring students to detail the specific questions they posed to the models, the answers provided, and how they integrated this information to form their own viewpoints. This strategy not only fosters critical thinking among students but also strengthens their abilities to Screen and integrate information. For interactive content that requires immediate feedback, especially closed-choice questions, teachers can employ group response methods, such as "group color response," to increase student participation and alleviate individual psychological pressure. In this way, each student's contribution is included in the group's answer, encouraging active participation without the stress of individual performance.

In summary, when designing classroom interactions, teachers should focus on the relevance, appropriateness, and interactivity of the content, while also guiding students to critically utilize large language models to promote proactive learning and deep thinking. Through these strategies, teachers can stimulate student enthusiasm, cultivate their ability to solve problems independently, and thereby enhance the quality and effectiveness of classroom interactions.

(2) Diversified classroom interaction forms. Diversification of classroom interaction formats is crucial for enhancing students' learning experiences, as it facilitates more effective mastery and absorption of knowledge during the interaction process. Traditional interaction patterns, which primarily involve student discussions, problem-solving, and feedback to teachers, often lead students to focus on completing tasks quickly, thereby increasing dependence on auxiliary tools. To ameliorate this phenomenon, teachers can innovate and adjust the forms of interaction. For instance, educators can select appropriate classroom environments for interaction and schedule specific class periods for open discussions, ensuring that students have ample time for in-depth exploration and fostering a relaxed and enjoyable discussion atmosphere. In this process, students can freely form groups for discussion, and teachers can participate to promote deeper communication. Additionally, teachers can introduce a variety of interaction methods such as debates, competitions, and role-playing to stimulate students' interest and enthusiasm in learning. Students can also use online course platforms to share their perspectives, achieving knowledge sharing. In this process, teachers act as facilitators and observers, responsible for maintaining discussion order, recording the content of discussions, and providing praise and point rewards to students who actively share knowledge, encouraging their active participation and contributions.

In summary, by introducing diverse classroom interaction formats, teachers can not only increase students' motivation and participation but also promote the development of critical and creative thinking, thereby achieving in-depth understanding and application of knowledge through interaction. This diversified teaching strategy helps to build a more dynamic and productive learning environment.

(3) Personalized classroom interaction requirements. When formulating classroom interaction requirements, teachers must carefully consider students' knowledge levels and learning abilities, granting them Moderate choice rights to accommodate the personalized needs of different students. For instance, teachers can design two sets of interactive tasks with varying levels of difficulty, allowing students to choose tasks suitable for their abilities. This flexible strategy helps students challenge themselves within their comfort zones while avoiding frustration from tasks that are too difficult. Regarding student feedback methods, teachers should not impose overly strict regulations. Students should have the option to submit feedback through online platforms or to submit their opinions on paper after class. This diversified feedback approach provides students with expression channels that better fit their personal habits, thereby increasing the participation and effectiveness of feedback. In situations requiring public communication and expression, teachers can designate in advance, giving priority to students with more extroverted personalities. Such arrangements help balance classroom dynamics while providing introverted students with more opportunities to observe and learn. For technical practical tasks, especially programming tests, teachers must recognize that students may be inclined to directly copy and paste code provided by large language models under time pressure. To avoid this, teachers can design open-ended programming tasks, such as requiring students to develop a small game they are interested in. Students must form teams, collaborate on various stages of game development, and engage in collaborative communication with large language models about errors in the code. Ultimately, students must submit records of the entire collaboration process and list weak knowledge points encountered during programming. This method not only promotes students' proactive learning and problem-solving abilities but also helps teachers better understand students' learning conditions. For students with stronger programming abilities, teachers can set up more challenging classroom oral code interaction sessions to further stimulate their enthusiasm for learning and innovative thinking. In this way, teachers can provide suitable learning opportunities for students of different levels while encouraging them to continuously explore and grow in technical practice.

In summary, when designing classroom interactions, teachers should fully consider students' individual differences and provide a variety of choices and feedback methods to promote students' comprehensive development and personalized learning. Through these strategies, teachers can create a more inclusive and motivational learning environment, thereby improving teaching effectiveness and student satisfaction.

VI. Conclusion

In this study, we employed qualitative research methods to thoroughly investigate the knowledge construction process in higher education classroom interactions in the context of large language models (LLMs), and analyzed it based on the four key elements of constructivist learning theory. This knowledge construction process provides a detailed explanation of how students apply LLMs in classroom interactions and elucidates the interactive mechanisms among teachers, students, and LLMs. The study reveals the motivations behind students' use of LLMs in classroom interactions, as well as the content and methods of their collaborative communication with the models. These findings offer significant insights for teachers in classroom interaction teaching. Teachers need to correctly recognize that when using LLMs for knowledge construction in classroom interactions, students are the primary constructors of knowledge, LLMs serve as auxiliary tools, and teachers play the role of facilitators. Therefore, teachers should design high-quality classroom interaction content, diverse interaction formats, and personalized interaction requirements based on students' characteristics and learning situations. This will promote effective communication between students and LLMs, thereby helping students better construct knowledge and enhancing the effectiveness of classroom interactions.

This study provides a novel perspective to traditional classroom interaction theories. Traditional theories of classroom interaction have primarily focused on the communication between teachers and students, as well as among students themselves. In contrast, this research reveals the unique role of large language models (LLMs) in classroom interactions. The interactive patterns initiated by these artificial intelligence tools have enriched the connotations of classroom interaction theories. Furthermore, this study offers an empirical foundation for the theory of educational technology integration. The findings demonstrate that the integration of educational technology requires a proper understanding of the role of technology as an auxiliary tool. Effective guidance from teachers and rational use by students are of critical importance.

The findings of this study exert a profound influence on the formulation of educational policies, providing policymakers with a solid empirical foundation. Driven by artificial intelligence technologies such as large language models, the field of education, particularly the classroom interaction segment, has undergone significant transformation, leading to a profound change in the process of student knowledge construction. Policymakers should encourage the integration of artificial intelligence technologies, including large language models, into curriculum teaching through resource support, thereby promoting the digital transformation of college classrooms. Concurrently, with the introduction of these technologies, it is imperative to ensure the security and privacy of student data, establishing ethical guidelines and privacy policies to prevent data misuse and privacy breaches.

At the policy level, furthering the development of personalized education is particularly crucial. Leveraging technological means such as large language models, we can provide more customized learning resources to meet the diverse learning needs of students, achieving widespread distribution and effective utilization of high-quality educational resources. This not only enhances the quality of teaching but also helps to bridge the technological gap between students from different regions and backgrounds, ensuring that all students can benefit equally from these technologies and preventing the formation of new digital divides. Additionally, policymakers should prioritize strengthening technological training for teachers, equipping them with the skills to effectively utilize large language models and guiding students in their proper use, thereby enhancing the professional technical level of teachers and ensuring the scientific, rational, and standardized application of large language models in education.

Furthermore, policymakers should consider promoting the development of a new curriculum assessment system, incorporating the integration of technological elements such as artificial intelligence in teaching as one of the key assessment criteria. They should also vigorously promote successful cases of higher education curriculum teaching that incorporates advanced technology, using these as models to encourage more educational institutions to adopt and utilize these technologies to improve teaching quality and efficiency. To ensure the long-term effectiveness and appropriateness of these technologies, policymakers should establish long-term assessment mechanisms to monitor the impact of technologies like large language models in education, allowing for timely policy adjustments to ensure that the application of technology continues to foster the development of education. Encouraging collaboration between the educational and technological sectors to co-develop large language models and more effective teaching tools and methods tailored for educational scenarios will contribute to the construction of a more interconnected, efficient, and personalized educational environment.

However, this study also has certain limitations. First, the study sample is limited to one major in the School of Management and does not include students from other majors or faculties. Therefore, whether other student groups hold similar views requires further investigation. This indicates that the generalizability of the study's conclusions to a broader student population still needs further validation. Second, the concepts and categories extracted in this study may have certain subjectivity and partiality. In the selective coding stage of the knowledge construction process, this study is based on constructivist learning theory, which emphasizes the active construction of knowledge. However, the actual situation may not always be so ideal. In the context of large language models (LLMs), students' knowledge construction is a complex and dynamic process influenced by multiple factors. Future research can more deeply explore the specific mechanisms by which LLMs affect students' knowledge construction, as well as how LLMs promote the development of students' critical thinking, creative thinking, and higher-order cognitive skills, and assess and quantify the effects of LLMs in actual classroom interaction teaching. These studies will provide us with a more comprehensive understanding and offer more specific guidance for educational practice.

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Conflicts of Interest Declaration

All authors declare that they have no conflicts of interest.

Informed Consent Declaration

This research involved human participation, and written informed consent was obtained from all study participants prior to their inclusion in the study.

References

[1] Tan, C. W. (2023). Large language model-driven classroom flipping: Empowering student-centric peer questioning with flipped interaction. Proceedings of the First International Workshop on Teaching Performance Analysis of Computer Systems (TeaPACS 2021), 1–13.

[2] Zhang, Z., Zhang-Li, D., Yu, J., Gong, L., Zhou, J., Hao, Z., Jiang, J., Cao, J., Liu, H., Liu, Z., Hou, L., & Li, J. (2024). Simulating Classroom Education with LLM-Empowered Agents. arXiv preprint arXiv:2406.19226v2.

[3] Guevarra, M., Bhattacharjee, I., Das, S., Wayllace, C., Demmans Epp, C., Taylor, M. E., & Tay, A. (2024). An LLM-Guided Tutoring System for Social Skills Training. arXiv preprint arXiv:2501.09870v1.

[4] Kumar, H., Musabirov, I., Reza, M., Shi, J., Wang, X., Williams, J. J., Kuzminykh, A., & Liut, M. (2024). Impact of guidance and interaction strategies for LLM use on learner performance and perception. Proceedings of the ACM on Human-Computer Interaction, 8(CSCW2), Article 499. https://doi.org/10.1145/3687038

[5] Gumina, S., Dalton, T., & Gerdes, J. H. (2023). Teaching IT software fundamentals: Strategies and techniques for inclusion of large language models. Proceedings of the 24th Annual Conference on Information Technology Education (SIGITE '23), 1-6. https://doi.org/10.1145/3585059.3611409

[6] Zhang, X., Zhang, X., & Liu, H. (2024). Reflections on Enhancing Higher Education Classroom Effectiveness Through the Introduction of Large Language Models. Journal of Modern Educational Research, 3(19), 1-8. https://doi.org/10.53964/jmer.2024019

[7] Gan, W., Sun, Y., Peng, X., & Sun, Y. (2020). Modeling learner's dynamic knowledge construction procedure and cognitive item difficulty for knowledge tracing. Applied Intelligence, 50, 3894–3912.

[8] Floren, L. C., ten Cate, O., Irby, D. M., & O'Brien, B. C. (2020). An interaction analysis model to study knowledge construction in interprofessional education: Proof of concept. Journal of Interprofessional Care, 35(5), 736–743.

[9] Mutiaraningrum, I., & Nugroho, A. (2020). Social construction of knowledge in synchronous text-based discussion during English language learning. Journal on English as a Foreign Language, 10(2), 315–336.

[10] Zhou, P., Zhou, H., Zhang, Y., & Lin, L. (2021). Analysis of social cognitive network characteristics in learners' collaborative knowledge construction process from the perspective of deep learning. e-Education Research, 9, 99–107.

[11] Feng, Y. (2024). Research on influencing factors of consumer loyalty in snack collection stores: Theoretical model and empirical test. Journal of Commercial Economics, 19, 67–70.

[12] Wu, J., & He, W. (2019). The methodological implications, construction, and integration of grounded theory. Journal of Soochow University (Educational Science Edition), 1, 35–49.

[13] Corbin, J., & Strauss, A. (2014). Basics of qualitative research: Techniques and procedures for developing grounded theory. Sage Publications.

[14] Chen, X. (2015). The application of grounded theory in Chinese educational research. Peking University Education Review, 13(1), 2–15.

[15] Meng, Y., Song, A., & Zhang, B. (2024). A grounded theory analysis of emotional exclusion in undergraduate cooperative learning. Heilongjiang Researches on Higher Education, 42(11), 129–136.

[16] Wu, D., Zhao, Y., & Zhang, Y. (2024). Types and influencing factors of tourism information behavior among older adults: A perspective from activity theory. Information Science. Advance online publication. https://link.cnki.net/urlid/22.1264.g2.20240315.1511.008

[17] Zhu, S., & Cheng, T. (2024). Identity construction of non-teacher professionals transitioning into teaching: A grounded theory analysis. Journal of East China Normal University (Educational Sciences), 42(10), 69–82.

[18] Ren, B., & Zhou, J. (2021). A policy tools model for local governments' River Chief System: Selection preferences and optimization paths—An empirical study based on grounded theory and policy texts. Journal of Central South University (Social Science Edition), 27(6), 145–157.

[19] Zhao, D., & Yi, J. (2023). Research on the "five-in-one" curriculum ideology and political system for postgraduate students from the perspective of constructivist learning theory. Ideological and Political Education Research, 39(6), 79–86.

[20] Forman, G. E., & Kauffman, M. S. (2020). Constructivism in education: Exploring the contributions of Piaget, Vygotsky, and Bruner. Journal of Educational Psychology, 2(35), 123–145.

[21] Lin, L., & Zhang, L. (2023). Exploring ideological and political practice in compensation management courses based on constructivism. Social Science Research, 9, 207-213.

[22] Zhang, T., Dai, Q., & Li, C. (2024). Understanding and applying Piaget's constructivist theory from the perspective of mathematics teaching. Journal of Mathematics Education, 33(3), 96-102.

[23] Ji, F., Li, X., & Luo, Q. (2023). Research on the construction of collaborative teaching model with industry experts from the perspective of multiple learning theory integration. Theory and Practice of Education, 43(9), 54-57.

[24] Song, H., & Pan, X. (2023). The theoretical foundation and application of case teaching in the new era: Based on ontological and constructivist perspectives. Journal of Management Case Studies, 16(5), 658-667.

[25] Zhao, C., & Liu, F. (2021). A blended teaching model integrating connectivism and new constructivism. Higher Education Exploration, 10, 16-21.