Role of activity-based learning and ChatGPT on students’ performance in education

Tamara Al Shloul a, Tehseen Mazhar b,*, Qamar Abbas c, Muhammad Iqbal d, Yazeed Yasin Ghadi e, Tariq Shahzad f, Fatma Mallek g, Habib Hamam h, i, j

* Corresponding author.
E-mail address: tehseenmazhar719@gmail.com (T. Mazhar).

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ABSTRACT

Purpose: This study investigates the impact of activity-based learning and the utilization of ChatGPT on students’ academic performance within the educational framework.

Objectives: The study aims to assess the effectiveness of activity-based learning in comparison to traditional methods, while also evaluating the potential benefits and drawbacks of integrating ChatGPT as an educational tool.

Methods: The study employs a comparative approach, analyzing the outcomes of students exposed to activity-based learning versus those using conventional methods. Additionally, the study examines the usage of ChatGPT in education through surveys and trials to determine its contribution to personalized feedback, interactive learning, and innovative teaching methods.

Results: The findings reveal that activity-based learning enhances students’ engagement, motivation, and critical thinking skills. Students participating in activity-based learning demonstrate improved academic achievement, which is attributed to their active involvement and practical application of knowledge. Similarly, the integration of ChatGPT offers novel avenues for interactive learning and individualized assistance, fostering students’ understanding and exploration of complex concepts.

Conclusion: In conclusion, activity-based learning proves to be a student-centered approach that enhances learning outcomes by fostering active participation and practical engagement. The utilization of ChatGPT in education showcases its potential to enhance educational experiences through interactive conversations and innovative teaching methodologies, despite considerations regarding potential limitations and ethical implications.

1. Introduction

Tasks completed in class are referred to as activity-based learning. Activity-based learning aims to involve students in the educational process and help. When considering activity-based learning, think about what students are doing and how they are doing it. Suppose activity-based learning is fruitful learning that helps students understand what the teacher wants them to learn (Girgin et al., 2020). In that case, actively-based learning is typically considered student-centered to provide all students with challenging learning tasks, exciting learning experiences, and flexibility. Students benefit from activity-based learning because it helps them connect with their colleagues, motivating them to
work harder and longer (Bakhru et al., 2020). According to Quin, any educational system that involves students in the learning process is activity-based learning, also known as cooperative learning, problem-based learning, collaborative learning, or inquiry-based learning. Cooperative or collaborative learning is another term for it. It provides an extensive entertaining activity. The student will actively participate rather than passively receive information (Girgin et al., 2020). Instead of traditional learning, the primary goal of activity-based learning is to move the attention away from knowledge transmission and instructor contact and toward active student participation (Akhtar et al., 2021). Thanks to activity-based learning, students’ literacy levels are raised, and their interest in learning is encouraged. Some claim that activity-based learning methods enhance self-regulation abilities such as planning, monitoring, and assessing by treating students as active classroom participants (Yeh et al., 2019). Through activity-based learning, students are encouraged to reflect on their learning through critical thinking, composition, and analysis. Fig. 1 illustrates ABL methods.

Students participate in active learning (Patiño et al., 2023) when they read, write, speak, and solve issues that help them analyze, synthesize, and evaluate what they have learned in class. This activity includes reading, writing, talking to people, and solving problems. There are many kinds of active learning strategies, including problem-based learning, cooperative learning, simulations and case studies, and problem-based learning (Mehmood et al., 2021). Students participate in various activities to improve their learning and comprehension as part of active learning. All of the exercises demand critical thinking from the pupils. Activity and learning (Mirra, 2019) are connected through a process known as “metacognition,” in which pupils consider their own learning experiences. But instructors hardly ever give credit for this kind of thinking. Active learning has recently emerged as one of the most promising aspects of modern education. This is so that people will put themselves in circumstances where education is valued (Agbenyeku, 2017). With the help of this teaching strategy, students are given the abilities needed to overcome challenges in practice-based learning. Students will use this practice to facilitate group projects. During this exercise, the students work together to find a solution to the issue. Each provides a unique method for creating a thorough response and explains why they chose it. Fig. 2 illustrates the active learning cycle.

The study conducted by ChatGPT has significantly influenced our current view of “intelligence” and has had a tremendous impact on various aspects of modern culture. Conversely, implementing a comprehensive restriction on this approach may provide further difficulties for those wanting to acquire new abilities within educational establishments (Lo, 2023). ChatGPT can serve as a valuable educational instrument due to its ability to facilitate interdisciplinary collaboration, initiate a paradigm shift in educational environments, facilitate the widespread transfer of transformational knowledge, remove barriers between information domains, and expedite the generation of fresh perspectives (Halaweh, 2023). In light of the prevailing crisis of trust in creativity, the modifications to the conventional educational milieu, and the uncertainties surrounding the validity of teaching produced by ChatGPT, it is evident that the latter has undeniably transformed the traditional teaching environment and prompted inquiries into the legitimacy of pedagogical authority (Sok et al., 2023). To thrive in the era of ChatGPT, education must effectively leverage the transformative capabilities of AI. This entails redefining teaching objectives, diversifying instructional materials, integrating intelligent pedagogical approaches, adopting multifaceted methods for evaluating student progress, and fostering collaborative knowledge generation. ChatGPT is widely utilized in educational courses due to its positive impact on student learning, facilitation of instructor autonomy and convenience in teaching, and providing educational research and growth assistance. Students can collaborate and engage in communication through the utilization of ChatGPT, hence customizing their learning experience (Rahman et al., 2023). ChatGPT enhances students’ learning experience by tailoring educational tools and recommendations to cater to their individualized requirements, inclinations, and preferred learning methods. This personalized approach facilitates the accelerated and efficient acquisition of knowledge. Due to its ability to provide prompt responses and solutions, ChatGPT can assist and instruct pupils in real-time when they encounter difficulties or have inquiries (Biswas, 2023a).

In recent years, the field of artificial intelligence (AI) has seen remarkable advancements, particularly in the area of generative AI and natural language processing (NLP) technologies. These advancements have laid the groundwork for the development of sophisticated tools like ChatGPT, which was officially launched by OpenAI in November 2022.
Fig. 3 is designed to illustrate the trajectory of scholarly interest and research activities in these technologies, leading up to and following the introduction of ChatGPT. It is important to note that while ChatGPT itself became available in late 2022, the years preceding its launch witnessed a surge in academic contributions focused on the underlying AI and NLP technologies that facilitated its creation. Fig. 3 aims to contextualize the significant scholarly momentum and the burgeoning interest within the scientific community that has surrounded the development of ChatGPT. The inclusion of data from the years 2020 and 2021 highlights the foundational research and discussions in the field of generative AI that have contributed to the rapid adoption and exploration of ChatGPT in academic circles following its release.

The goal of activity-based learning is to improve student engagement and understanding by promoting practical, interactive tasks. By involving students actively in their learning process, this type of instruction differs from more passive, traditional approaches. The idea in involving students actively in their learning process, this type of in and understanding by promoting practical, interactive tasks. By

The most notable among the many forms of active learning is activity-based learning. Within the framework of the active learning paradigm, educators use activity-based learning when they integrate structured activities into lesson or course designs. To emphasize, activity-based learning is just one way to apply the notions of active learning; there are many more approaches as well. In conclusion, the goal of both expressions is to inspire students to actively engage in their

The significance of ChatGPT in the software development industry cannot be emphasized enough. Software developers can now incorporate NLP elements into their products, enhancing their conversational and user-friendly nature (Surameery et al., 2023). In recent years, conversational interfaces based on NLP, such as chatbots and virtual assistants, have grown. ChatGPT enables programmers to build advanced and intelligent everyday applications. These machines have improved capabilities in understanding user demands and providing more logical responses (Jalil et al., 2023). Due to new technology, incorporating AI and machine learning elements into existing applications has become simpler. Due to ChatGPT, developers can now access previously inaccessible tools (Kashefi et al., 2023). As a result, the

books, videos, and assignments that can contribute to students’ success, ChatGPT considers their objectives and preferences (Baidoo-Anu et al., 2023). Research suggests that students are more inclined to engage in active learning and effectively remember material when provided with resources that align with their needs and interests. ChatGPT can serve as a valuable teacher resource, offering assistance and direction across several aspects of their profession (Mazhar et al., 2023a). ChatGPT facilitates educators’ collaborative efforts in lesson preparation, enabling them to seek and receive constructive feedback to enhance the quality of their instructional practices. Incorporating ChatGPT into the classroom setting enables educators to enhance the delivery of courses by introducing more captivating and up-to-date instructional content to students (Rospigliosi, 2023, pp. 1–3). Fig. 4 illustrates different areas in which ChatGPT is involved.

While acknowledging the undeniable utility of ChatGPT in educational settings, educators should exercise caution to ensure that students have access to reliable and accurate instructional help. The involvement of teachers in the ChatGPT rollout is of utmost importance as they play a critical role in tailoring education to meet the unique needs of students (Wardat et al., 2023) while also providing essential support and guidance on the social and emotional aspects crucial to their academic success.

ChatGPT aims to enhance healthcare by providing customized assistance to doctors and other medical professionals. It can be used to create automated programs that provide medical professionals with detailed instructions and recommendations (Biswas, 2023b). For instance, it can be used to create intelligent healthcare platforms that provide patients with personalized medical advice. ChatGPT can potentially be utilized in developing systems that can efficiently detect and respond to emerging health issues. Additionally, it can be used to

Fig. 4. Illustrates different areas in which ChatGPT is involved (Haleem et al., 2022).
software has become more user-friendly, entertaining, and efficient.

The extensive adoption of ChatGPT has significantly impacted the entire IT sector. Accessing and utilizing information has become more accessible, leading to a transformation in the way people and technology communicate. Chatbots and other virtual assistants are being used more and more in various sectors, such as e-commerce (George et al., 2023), healthcare (Vaishya et al., 2023), and customer service (Mich et al., 2023). They utilize NLP technology to interpret user inquiries and provide relevant responses. ChatGPT has played a crucial role in enhancing the capabilities of search engines and recommendation systems. Its contribution has led to significant advancements, allowing these systems to provide users with more accurate and relevant results. ChatGPT has opened up new career opportunities in data analysis and cybersecurity. This facilitates the ability of IT staff to identify threats and quickly and efficiently respond to them. In the future, customers will interact with ChatGPT before contacting customer service (Chui et al., 2022). Businesses of all sizes can save money on support expenditures as a result. The customer support agents currently in charge will be replaced by ChatGPT (Chuma et al., 2023). ChatGPT is often effective in resolving issues, reducing the frequency of new occurrences or events, and allowing companies to save money by hiring fewer personnel.

The study’s findings suggest that ChatGPT has excellent potential to be a useful additional tool for teachers. This can be an extensive summary of the top five vital techniques for using ChatGPT for lesson planning by teachers. The term assessment encompasses various activities, such as developing tests and evaluating students’ progress. This group includes professions like creating educational materials, generating innovative ideas, and enabling effortless language translation. The exciting use of ChatGPT in a classroom is illustrated in Table 1.

1.1. Motivation of the study

The findings of this study can help secondary school students and teachers. These instructors can show students how to use the activity-based method and ChatGPT to help them improve their grades in science and other subjects (Bakhru et al., 2020; Dumitrache et al., 2018). Second, educational planners and developers who build school curricula may examine the study’s outcomes to see if the activity-based technique and ChatGPT are appropriate for school use. This research aims to see how ChatGPT and activity-based learning affects student achievement and what students think about this type of learning and technology. Because of the world’s rapid growth rate, there is an increasing need to change how education is given. As a result of technological breakthroughs, new things are found every day (Fauzi et al., 2023). To deal with difficult situations, ask more profound questions, and undertake research, those who want to learn about various subjects must have an open mind. One of these improvements could be in how teachers teach, resulting in enhanced student engagement and drive to learn and do better work. The general public recognizes that even the best books and materials worldwide will not motivate different children to learn and study properly (Aluvala et al., 2015). Unfortunately, interest decreases when children become bored with school. Changing how teachers teach is one technique to boost motivation and excitement in learning. Low motivation has some negative repercussions, one of which is poor performance.

1.2. Contribution of the study

This study’s contributions encompass a comprehensive exploration of Activity-Based Learning, a detailed analysis of ChatGPT’s role in education and other domains, insights into its benefits for both educators and students, empirical evidence of learning performance, and a balanced consideration of potential challenges and limitations. Furthermore, it sheds light on the technology’s impact on scientific communication and skill development, fostering a holistic understanding of its implications for the educational landscape.

- Comprehensive Examination of AB Learning and ChatGPT: This study delves deeply into the concepts of Activity-Based Learning (ABL) and the application of ChatGPT in education. It provides an in-depth understanding of these methodologies and their potential impact on learning outcomes.
- Exploration of ChatGPT’s Educational Role: The research thoroughly investigates the multifaceted role of ChatGPT in the realm of education. It examines how ChatGPT can serve as a tool for interactive communication, feedback provision, and creative teaching methods.
- Broadened Application of ChatGPT across Domains: The study extends its analysis beyond education to explore various domains where ChatGPT could play a pivotal role. This offers insights into the versatility and potential cross-disciplinary impact of this technology.
- Enhanced Learning Experience for Teachers and Students: By scrutinizing the advantages of ChatGPT, the study highlights how this technology can empower both educators and learners. It sheds light on the opportunities for teachers to create engaging lessons and students to receive personalized assistance.
- Comparative Analysis of Learning Performance: The research assesses the academic performance of students under Activity-Based Learning methods compared to traditional approaches. This analysis offers empirical evidence of the effectiveness of ABL in fostering improved learning outcomes.
- Insight into Online Learning and Case Studies: The study goes beyond the classroom to explore the role of ChatGPT in online learning environments. It presents a case study that provides valuable insights into the practical application of ChatGPT in virtual educational settings.
- ChatGPT’s Impact on Scientific Writing: The research explores how ChatGPT can influence scientific writing, potentially revolutionizing the way scholarly content is generated and communicated.

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Aspect</th>
<th>Function</th>
<th>Focus</th>
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</thead>
<tbody>
<tr>
<td>Han et al.</td>
<td>Providing suggestions</td>
<td>When I told ChatGPT</td>
<td>ChatGPT can be used to translate</td>
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<tr>
<td>(2023),</td>
<td></td>
<td>that the child had</td>
<td>educational materials into different</td>
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<td>Zhai (2022)</td>
<td></td>
<td>Flow perfectly functioning</td>
<td>languages</td>
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<tr>
<td>Al-Worafi</td>
<td>Generating assessment</td>
<td>With ChatGPT can</td>
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<tr>
<td>et al.,</td>
<td>tasks</td>
<td>create objectives,</td>
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<td>(2023)</td>
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<td>assessments, and</td>
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<td>situations that may be</td>
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<td>knowledge</td>
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<tr>
<td>Qadir (2023)</td>
<td>Evaluating student</td>
<td>Teachers can be trained</td>
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<td>performance</td>
<td>to mark essays using PT,</td>
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<td>giving them more time to</td>
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<td>focus on other assignments</td>
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This aspect widens the scope of ChatGPT’s implications for academic and research contexts.

- **Identification of Challenges with ChatGPT in Education**: Alongside its benefits, the study critically examines the challenges associated with integrating ChatGPT in education. This comprehensive perspective contributes to a nuanced understanding of the technology’s potential limitations.

- **Skill Development through ABL Method**: By exploring the skills acquired through Activity-Based Learning, the study highlights its role in nurturing critical thinking, problem-solving and practical application abilities among students.

### 1.3. Organization of paper

This study provides a comprehensive exploration of ABL and the integration of ChatGPT within the educational landscape. Section 1 introduces the concepts and sets the stage for a deeper dive into their applications and implications. In Section 2, we undertake a thorough literature review to identify current research trends, gaps, and the foundational theories underpinning our study subjects. The methodology, detailed in Section 3, outlines our systematic approach to collecting and analyzing relevant data. Results are presented in Section 4, where we dissect the impact of ABL and ChatGPT on student performance, engagement, and the broader educational process. Section 5 engages in a discussion that ties together our findings with the initial research questions, providing a critical examination of the roles and challenges associated with our focus areas. Finally, Section 6 concludes the study by summarizing key insights and proposing directions for future research, emphasizing the need for ongoing exploration into the integration of innovative teaching methods and AI technologies in education. Table 2 illustrates the list of abbreviations.

### 2. Literature review

#### 2.1. Current research

The literature underscores the transformative role of tools like ChatGPT in the educational landscape. As digital platforms become increasingly prevalent, ChatGPT serves as a novel resource that offers personalized experiences and facilitates access to a broad spectrum of information (Fauzi et al., 2023). This extends to the capacity for ChatGPT to support creative engagement with course material, as evidenced by the variety of domains in which it operates, depicted in Table 3. This table illustrates the expansive utility of ChatGPT, underscoring its potential to complement and enhance traditional teaching methodologies. Furthermore, recent studies have explored the potential of large language models like ChatGPT to support personalized learning (Aluvala et al., 2015; Selwyn, 2024). These studies suggest that ChatGPT can be used to tailor learning experiences based on individual student needs and preferences, potentially leading to improved outcomes.

The efficacy of ABL is corroborated by studies that show enhanced academic performance when traditional methodologies are augmented with activity-based approaches (Guo et al., 2023). This ties in with the comparative analysis in our study, which highlights the effectiveness of ABL in fostering deeper student engagement and understanding. The practical application of ABL, which promotes learning through experience and action, is illustrated in Fig. 5, where students engage in interactive tasks that facilitate knowledge acquisition and skills development.

Our study’s findings are supported by literature indicating that AI tools like ChatGPT can serve as powerful assistants in the writing process, aiding in the drafting, revision, and generation of ideas (Geerling et al., 2023). These tools assist in overcoming the challenges of scientific writing by providing immediate, accessible guidance, which can be especially beneficial in educational settings where the development of writing skills is a key objective.

The literature points to the significant gains in critical thinking, problem-solving, and collaborative skills afforded by engagement in ABL (Biswas, 2023c). These findings are echoed in our study, where

### Table 3

<table>
<thead>
<tr>
<th>Domain</th>
<th>Main Focus</th>
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<tbody>
<tr>
<td>Critical and higher-order thinking (Guo et al., 2023)</td>
<td>The quality of the writing, the applicability of the examples, and the effectiveness with which they address the topics posed are just a few of the criteria that can be used to evaluate the replies.</td>
</tr>
<tr>
<td>Economics</td>
<td>ChatGPT’s performance on the TUCE in macroeconomics put it within the top 1% of all participants. The microeconomics score of ChatGPT at 91st percent is quite impressive (Geerling et al., 2023).</td>
</tr>
<tr>
<td>Programming</td>
<td>The brief and comprehensive nature of ChatGPT’s feedback proved to be beneficial, enabling people to see it as valuable. The vast majority of comments generated by ChatGPT were both engaging and demonstrated a high level of accuracy (Biswas, 2023c; Surmeyer et al., 2023).</td>
</tr>
<tr>
<td>English language comprehension</td>
<td>ChatGPT was awarded a score of 7.18 out of 10, indicating a slightly higher performance level than the average grade point students in the Netherlands achieved (de Winter, 2023).</td>
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<tr>
<td>Law</td>
<td>The most challenging aspects of the assessments were the sections that involved the categorization of problems into groups and the subsequent determination of their respective locations (Choi et al., 2023). In general, the level of achievement shown by ChatGPT can be likened to that of a student who achieved a grade of C+. In summary, the experience was satisfactory but lacked any exceptional qualities (Hargreaves, 2023).</td>
</tr>
<tr>
<td>Medical Education</td>
<td>The authors state that the accuracy level of ChatGPT is comparable to the standard required to pass the USMLE (Kung et al., 2023). A study determined that the Basic Life Support and Advanced Cardiac Life Support tests provided by the American Heart Association were inadequate for ChatGPT. This statement could be related to the findings of the study (Lee, 2022).</td>
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<tr>
<td>Mathematics</td>
<td>ChatGPT’s mathematical abilities are significantly inadequate to those of an average college student (Frieder et al., 2024; Wardat et al., 2023).</td>
</tr>
<tr>
<td>Software testing</td>
<td>It has been determined that ChatGPT cannot complete a software testing training program independently (Ahmad et al., 2023a; Zhang et al., 2023). When asked questions, ChatGPT provided accurate answers to approximately 37.5% of them.</td>
</tr>
<tr>
<td>Sports science and psychology</td>
<td>While ChatGPT provided satisfactory responses to most of the 20 questions in the test, its overall score of 45% was below the passing mark (Methnani et al., 2023; Szabo, 2023).</td>
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<tr>
<td>MCQ-based exams across subjects</td>
<td>Most of the multiple-choice testing used to grade ChatGPT is inadequate. It is not quite as intelligent as an average student is (Newton et al., 2023).</td>
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### Table 2

<table>
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<th>abbreviation</th>
<th>Full form</th>
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<tr>
<td>ABL</td>
<td>Activity-based learning</td>
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<tr>
<td>ML</td>
<td>Machine learning</td>
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<tr>
<td>AI</td>
<td>Artificial intelligence</td>
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<tr>
<td>NLP</td>
<td>Natural language processing</td>
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<tr>
<td>AB</td>
<td>Activity-based</td>
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<tr>
<td>DL</td>
<td>Deep learning</td>
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<tr>
<td>SLR</td>
<td>Systematic Literature Review</td>
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<td>QA</td>
<td>Quality Assessment</td>
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participants reported improved skills as a direct result of their involvement in ABL. Furthermore, the integration of technology in higher education, as demonstrated by the adoption of the F2FL model shown in Fig. 6, has facilitated a more seamless blend of traditional and digital learning environments, optimizing the efficacy of ABL. Notably, Friedman (2023) emphasizes the importance of critical thinking and problem-solving skills in the 21st century, further highlighting the benefits of ABL approaches (de Winter 2023).

ChatGPT’s impact extends across various educational domains, demonstrating the flexibility of ABL in adapting to diverse subject areas. Studies have documented ChatGPT’s supportive role in language arts, where it aids in language acquisition and literacy, and in STEM fields, where it helps clarify complex concepts and enhance problem-solving skills. This multidisciplinary support is crucial in educational settings where the ability to tailor learning experiences to individual needs is increasingly valued (Choi et al., 2023). However, the literature also cautions against the uncritical adoption of such AI tools. It emphasizes the importance of educators’ roles in facilitating AI interactions, ensuring that these tools are used to supplement, not supplant, traditional teaching methods (Hargreaves, 2023).

The introduction of AI like ChatGPT in educational environments brings challenges that educators and institutions must navigate. The literature identifies concerns about academic integrity, as AI tools could potentially be misused by students (Hargreaves, 2023). Moreover, there is a risk of over-reliance on AI for learning tasks, which could undermine the development of independent learning skills. These challenges necessitate a balanced approach to incorporating AI into educational practices, ensuring that such tools are used to enhance critical thinking and deep learning rather than as shortcuts to avoid intellectual effort (Hargreaves, 2023). Ensuring that students engage with AI-generated content critically is essential for maintaining the integrity and rigor of educational outcomes. Additionally, the author (Selwyn, 2024) offers critical perspectives on the ethical considerations surrounding the use of AI in education, highlighting the importance of responsible implementation (Kung et al., 2023; Lee, 2023).

This Literature Review provides a critical examination of the roles and implications of ABL and ChatGPT within the educational sphere. It lays a solid groundwork for our investigation, establishing a clear link between prior research findings and the study’s objectives. Through this review, we can appreciate the significance of adopting ABL and ChatGPT in education, recognizing the potential benefits while also considering the challenges that accompany their integration into educational practices. This nuanced understanding allows for a more informed approach to leveraging AI tools like ChatGPT to enrich and diversify the learning experience, ensuring that educational practices evolve in tandem with technological advancements. The role of Activity-Based Learning (ABL) and the incorporation of ChatGPT in education are focal points of this study. The literature review delves into these areas, directly addressing the research questions that underpin our investigation, and is illustrated with empirical evidence including Fig. 5, as well as analytical data presented in Table 3.

2.2. Research gap

In light of the Research Objectives outlined for this study, a critical examination of the existing literature reveals certain gaps that our research intends to address.

- Detailing ABL and ChatGPT: While current literature offers insights into the general principles of ABL and the functionalities of ChatGPT, there is a paucity of detailed explorations that merge these two realms. Our objective is to provide a comprehensive understanding of ABL in the context of ChatGPT’s capabilities, particularly in creating detailed educational content and strategies.

- ChatGPT’s Role across Domains: Existing research on ChatGPT’s role in education tends to focus on specific domains, like language learning or programming. Our study aims to expand this perspective by exploring ChatGPT’s utility across a wider range of educational disciplines, including its adaptability and impact on diverse learning models.

- ChatGPT’s Utility for Educators and Students: While the potential benefits of ChatGPT for students are increasingly recognized, there is less understanding of how teachers can leverage this technology. We aim to bridge this gap by identifying how ChatGPT can be a helpful tool for teachers in curriculum development, providing feedback, and enhancing teaching methodologies.

- Comparing Traditional and AB Methods: There is ongoing debate regarding the effectiveness of traditional versus activity-based methods in education. Our study seeks to contribute empirical evidence to this discussion, examining the performance outcomes associated with each approach and the specific skills that are developed through ABL.

- Limitations and Issues with ChatGPT in Education: While the advantages of ChatGPT are widely discussed, there is a need for a more nuanced exploration of its limitations within educational settings. Our research aims to shed light on the challenges and issues that educators and students may encounter when integrating ChatGPT into learning environments, including concerns about academic integrity, the quality of AI-generated content, and the potential for AI to reinforce existing biases.
Identifying these research gaps has guided the development of our study, ensuring that our research objectives are addressed in a way that contributes meaningful insights to the field of education technology.

3. Methods and materials

3.1. Research protocol

A comprehensive plan and set of guidelines that specify how the review will be conducted are called a study protocol. It provides a detailed explanation of the methodology used in the review, including how to identify relevant studies, select which studies to include and which to exclude, extract and combine data, and assess the caliber of the studies that were examined (Snyder, 2019).

3.2. Planning the review

Before diving into the specific methodologies employed in this study, it is crucial to clarify the approach known as a Systematic Literature Review (SLR). An SLR is a methodical and comprehensive examination of existing research literature in a specific domain. It aims to identify, evaluate, and synthesize all available research relevant to a particular research question, topic area, or phenomenon of interest. By adhering to a predefined protocol, an SLR minimizes bias, enhancing the reliability and validity of its findings. This systematic approach enables researchers to chart a clear course for future investigations by pinpointing gaps in current knowledge and suggesting directions for new research endeavors.

A literature review is commonly performed to identify significant gaps in the study or subject areas that have not been thoroughly researched, necessitating further investigation or analysis. Alternatively, you can utilize an SLR to make crucial decisions or gather findings in a specific field. The SLR is a valuable tool for identifying current research gaps and strategizing potential future research directions. The SLR requires a significant amount of time and effort as it involves evaluating the work of all academics who have contributed to various subjects up to this point. However, implementing a standardized study approach can effectively demonstrate the depth of an SLR. Several photo pieces related to the study were discovered during the preliminary search. The problem was resolved directly by performing SLR. By examining the availability of ChatGPT’s role in education material, one may come across an SLR that has not been made public before. This can be attributed to the fact that Chat GPT is still a relatively new framework. This SLR has been completed with the help of the updated reference guide obtained from (Keefe, 2007). Fig. 6 illustrates the SLR flow process.

3.3. Research objectives

The study has many objectives, but the most important are given below.

- To know ABL and ChatGPT in detail
- To know the role of ChatGPT in education and other domains.
- To know how ChatGPT helpful for teachers and students
- To know about the performance comparison between traditional and AB methods and about skills gained using ABL
- To know about the limitations of ChatGPT in education and what types of issues are created using it.

3.4. Research questions

This research aims to determine how ABL and ChatGPT affect students’ grades and other outcomes. The primary purpose of this mixed-methods study was to see how an ABL and ChatGPT approach affected student performance. Table 4 shows the research questions.

Table 4
Research questions.

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Research Question</th>
<th>Motivation</th>
</tr>
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<tbody>
<tr>
<td>Req. 1</td>
<td>What is the role of ChatGPT in education and training?</td>
<td>To look into the benefits and applications of ChatGPT for learners, educators, and how it is beneficial in training process.</td>
</tr>
<tr>
<td>Req. 2</td>
<td>Are the results of the traditional and activity-based learning assessments for students significantly different from one another?</td>
<td>Comparing student’s performance in both methods and also known which is more effective in students learning process.</td>
</tr>
<tr>
<td>Req. 3</td>
<td>What is the role of ChatGPT in scientific writing?</td>
<td>To know about the role of ChatGPT in writing.</td>
</tr>
<tr>
<td>Req. 4</td>
<td>What new abilities did students gain as a result of participating in activity-based learning?</td>
<td>In order to learn about various analytical approaches and discover their outcomes.</td>
</tr>
<tr>
<td>Req. 5</td>
<td>What is the role of ChatGPT in different domain</td>
<td>To know about the use of ChatGPT in different fields.</td>
</tr>
<tr>
<td>Req. 6</td>
<td>What is the issue faced by ChatGPT in education?</td>
<td>To know about the issues of ChatGPT in education.</td>
</tr>
<tr>
<td>Req. 7</td>
<td>What is the limitation of ChatGPT</td>
<td>To know about the limitations of ChatGPT.</td>
</tr>
</tbody>
</table>

3.5. Search string

In conducting an SLR, formulating a precise search string is a pivotal step. This process involves selecting keywords and search operators related to the study’s research questions to scour databases and digital libraries effectively. The aim is to compile a comprehensive list of studies that address the research objectives. In this study, keywords such as “Education,” “ChatGPT,” “Activity-Based Learning (ABL),” and “AI in education” were combined using Boolean operators like ‘AND’ and ‘OR’ to construct a nuanced search string. This strategy ensured the retrieval of relevant literature spanning the intersection of AI technologies, such as ChatGPT, with educational methodologies, particularly Activity-Based Learning.

3.5.1. Initial database searching

Initially, papers are searched from libraries like Science Direct, IEE, ACM, Wiley, and Springer. Selecting articles for a preliminary literature review should ideally come from reliable sources like IEEE, Wiley, Springer, Science Direct, and so on. Since all of the papers that appear in these journals receive extensive peer review, they have become known for their high standards of authenticity and quality. Researchers can access a vast amount of material relevant to their field of study using these sites. A broad range of academic fields and research topics are covered in the literature. These publishers ensure that academics may remain up to date with the most recent findings and significant advancements in their domains by regularly adding fresh research results to their databases. Researchers can utilize a variety of search options on these platforms to locate relevant publications. Among other things, they can make use of authors, release dates, and keywords. These subscription-based platforms provide full-text papers to scholars from a variety of academic schools. When conducting in-depth reviews and analyses of the literature, this is quite beneficial. These publishers frequently publish works from academics and organizations all around the world so that individuals from other nations can collaborate and become familiar with one another’s perspectives. Many papers are selected on different basis using these libraries. The initial search from the database is shown in Table 5 and Fig. 7.

3.5.2. Keywords formulation

A search string is carefully chosen combination of keywords and search operators used to identify relevant studies that address the research question or topic of the review. This step focuses on specific keywords and synonyms from the identified research questions to create the search string (Szabo, 2023). These keywords are put together using
the ‘AND ‘OR’ operation in the order listed to complete the following search string:

The final process of keywords, abstract, and title searching using different databases and papers inclusion-exclusion is shown in Fig. 8 and Table 6.

3.6. Study selection

The study aims to identify the most effective academic studies on shared learning. After gathering the preliminary results, the papers that did not meet the inclusion or exclusion criteria were deleted. These standards have been derived from the most significant and advantageous publications and papers.

3.6.1. Inclusion and exclusion criteria

Inclusion criteria in an SLR refer to the predefined rules used to determine which studies will be included in the review. In this review, the following inclusion criteria will be considered.

Table 6
Keywords and Search string formulation.

<table>
<thead>
<tr>
<th>Keyword/Synonym</th>
<th>Alternative word</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>(&quot;program&quot; OR &quot;system&quot;)</td>
</tr>
<tr>
<td>ChatGpt</td>
<td>(&quot;AI&quot; OR &quot;ML&quot;)</td>
</tr>
<tr>
<td>Application</td>
<td>(&quot;metrics&quot; OR &quot;classification&quot;)</td>
</tr>
<tr>
<td>Methods</td>
<td>(&quot;Techniques&quot; OR &quot;Framework&quot;)</td>
</tr>
<tr>
<td>Activity</td>
<td>(&quot;Learning&quot; OR &quot;Traditional&quot;)</td>
</tr>
</tbody>
</table>

Fig. 7. An initial search of papers.

Fig. 8. Keywords and Search string formulation.
- Studies must have been published in the English language within the timeframe of 2015–2023.
- The subject of the study should be centered on ChatGPT and ABL methods utilized in the education domain.
- Selected studies must involve empirical research, conducting practical experiments on specific datasets.
- The investigations undertaken in the study should pertain to the applications, architecture, and components of ChatGPT and ABL.
- Each chosen study must encompass a comprehensive evaluation of ABL and ChatGPT and integration of these in education to enhance learning process.
- The subject of the study should be centered on issues and their solutions during the implementation of ChatGPT and ABL in education.
- The scope of selected articles should be confined to publications in reputable journals, conferences, or books.

Exclusion criteria in an SLR refer to pre-designed conditions to determine which studies will be excluded from the review.

- The following categories of studies have been designated for exclusion:
  - Those published before 2015.
  - Those primarily focus not on ChatGPT and ABL its application in education.
  - Studies that lack empirical analysis results.
  - Studies that fail to evaluate the performance of ABL and ChatGPT.

### 3.6.2. Defining the quality assessment criteria

Establishing quality assessment (QA) criteria enables the validity, reliability, and quality of the included research in an SLR to be evaluated. Establishing criteria for quality assessment aims to ensure that the primary studies selected provide sufficient material to address the research issue. Here, we establish a benchmark against which any research question can be evaluated. The quality assessment factors are displayed in Table 7, along with the corresponding numerical values and the letter C.

### 3.7. Papers selection

#### 3.7.1. Year wise selection

Most papers are taken from the latest study of the year 2023. However, complete papers are selected from the year 2015–2024. Year-wise paper selection is shown in Table 8 and Fig. 9.

#### 3.7.2. Final paper selection

Final papers are selected using different types of libraries. Mainly papers are selected from the latest years from 2022 to 2023. The final paper selection is shown in Table 9 and Fig. 10.

The PRISMA flow diagram of the overall process is given in Fig. 11. In refining our selection of articles for this review, we applied stringent inclusion and exclusion criteria to identify the most relevant and high-quality studies on ChatGPT and ABL within educational settings. Initially, a broad search yielded a substantial pool of articles, from which we meticulously filtered studies published between 2015 and 2023 that directly focused on empirical research in our areas of interest. We excluded articles outside this publication window, not centered on ChatGPT and ABL’s educational applications, or lacking in empirical analysis. This process involved a preliminary screening of titles and abstracts, followed by a detailed full-text review, further narrowing down our selection based on methodological rigor, relevance, and clarity of outcomes. Our rigorous approach led us to finalize 129 articles that met all criteria, offering a comprehensive insight into the integration of ChatGPT and ABL in education. This methodical selection process underpins the reliability and depth of our review, providing a robust foundation for our study’s conclusions and recommendations.

### 4. Results

#### 4.1. Role of ChatGPT in education and training mission

The platform has gained popularity and received much media interest since OpenAI introduced ChatGPT in November 2022 (Rospigliosi, 2023, pp. 1–3). It is a model of social language that can respond to various questions and cues in a well-structured, grammatically sound, and natural-sounding manner (Ausat et al., 2023). Over 100 million people used ChatGPT in its first two months. Its rapid expansion made it the consumer application with the highest growth rate worldwide. The (Biswas, 2023a) number broke the previous record for the most users on well-known platforms, including Twitter, Facebook, and Instagram.

Numerous tools have been created to benefit from ChatGPT’s adaptability and capability. Software engineers use it to fix defects in their code (Ma et al., 2023), students use it to understand complex course content (Keele, 2007) better, and employees use it to write better emails (Biswas, 2023c). In addition, ChatGPT has proven helpful for several other projects, such as literary analyses (Sobania et al., 2023), marketing initiatives (Jain et al., 2023), and song and film compositions (Qin et al., 2023). Recent studies suggest that ChatGPT might do well on a range of tests. It has been shown that this method beats the majority of people on many standardized examinations, including the Wharton MBA (Komorowski et al., 2023), the University of Minnesota law exam (Schwartz et al., 2009), and the United States Medical Licensing exam. In the United States, this kind of exam is given (Lateef et al., 2024; Yousefzai et al., 2021).

One generative AI technology that has the potential to transform the way that law, business, and medicine are practiced is ChatGPT. Health insurance claim submission could be sped up with ChatGPT’s ability to assess medical notes for chargeable treatments (Helberger et al., 2023). According to a person’s risk tolerance and the market situation, ChatGPT can provide financial advice on investing. As a virtual attorney would, ChatGPT might be able to help you prepare critical legal documents, including contracts, motivations, and confessions. Because of its many beneficial aspects, ChatGPT has the potential to alter and improve how we teach and learn (Mazhar et al., 2023b). Despite this, it has

### Table 7

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Quality assessment criteria</th>
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</thead>
<tbody>
<tr>
<td>C1</td>
<td>Does the study provide enough information about the history of ChatGPT and ABL?</td>
</tr>
<tr>
<td>C2</td>
<td>Does the study provide enough information about the integration process of ABL and ChatGPT in education to enhance the learning process?</td>
</tr>
<tr>
<td>C3</td>
<td>Does the study provide enough information about ChatGPT and ABL and its role in education?</td>
</tr>
<tr>
<td>C4</td>
<td>Does the study provide enough information about the application of ChatGPT and ABL and some case studies in education?</td>
</tr>
<tr>
<td>C5</td>
<td>Does the study provide enough information about challenges and their solutions in the integration process of ChatGPT and ABL?</td>
</tr>
</tbody>
</table>

### Table 8

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>2</td>
</tr>
<tr>
<td>2016</td>
<td>2</td>
</tr>
<tr>
<td>2017</td>
<td>1</td>
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<td>6</td>
</tr>
<tr>
<td>2019</td>
<td>6</td>
</tr>
<tr>
<td>2020</td>
<td>4</td>
</tr>
<tr>
<td>2021</td>
<td>8</td>
</tr>
<tr>
<td>2022</td>
<td>8</td>
</tr>
<tr>
<td>2023</td>
<td>85</td>
</tr>
<tr>
<td>2024</td>
<td>5</td>
</tr>
</tbody>
</table>
received harsh criticism from many people in the education and associated industries. One of the biggest worries is that students may use ChatGPT instead of submitting their own essays and assignments. There are more options besides this one. There are plenty of others. Updated testing protocols are required due to exam plagiarism concerns (Anders, 2023). Many institutions have banned ChatGPT (Gao et al., 2022) due to these worries to protect the originality of their students’ writing and avoid plagiarism. Fig. 12 illustrates the use of ChatGPT in training and learning.

Despite these issues, ChatGPT has much-untapped potential as a teaching tool. For instance, it can act as a private teacher by customizing the lectures to the needs and interests of each student. Students who are struggling to understand a new concept can ask questions through ChatGPT (Fauzi et al., 2023). Another way ChatGPT can help students learn languages and comprehend them better is through its text translation services, which can be used in the language of the learner’s choice. When it comes to construction education, ChatGPT can assist in addressing questions like “How does the construction industry benefit society as a whole?” Questions like “What is the role of a construction engineer or project manager?” and “What other questions might students have?” ChatGPT can offer helpful information regarding building safety, such as common workplace risks, risks related to particular professions, and risks related to using particular tools (Prieto et al., 2023). Based on the particulars of the workplace, ChatGPT can suggest safe ways to complete activities. Given these details, this study aims to

<table>
<thead>
<tr>
<th>ACM</th>
<th>Number of papers</th>
</tr>
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<tbody>
<tr>
<td>IEEE</td>
<td>24</td>
</tr>
<tr>
<td>Science Direct</td>
<td>26</td>
</tr>
<tr>
<td>Springer</td>
<td>35</td>
</tr>
<tr>
<td>Wiley</td>
<td>20</td>
</tr>
<tr>
<td>ACM</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
</tr>
</tbody>
</table>
ascertain how ChatGPT may be included in safety instruction and training. This study’s primary goal is to determine whether and how ChatGPT can be utilized to spot construction dangers (Rathore, 2023). Despite the ChatGPT’s many advantages, all researchers know its considerable drawbacks. For instance, ChatGPT may deliver inaccurate information, biased information, or even harmful educational materials, as Open AI has acknowledged in the past.

Additional data suggests that ChatGPT may offer deceptive links to sites that seem reliable. Due to ChatGPT’s generative AI capabilities, users have also claimed that it reacts differently to the same query or prompt. Users have reported this problem to us (Uddin et al., 2023). If a user asks the same question twice, they can get a different answer, and other users might see different answers to the same questions. However, as was already said, the study examined whether ChatGPT improves worker safety. This is because it is believed that ChatGPT offers practical solutions that may be used in several contexts (Short et al., 2023). The techniques utilized to accomplish the study’s goals are discussed in the following sections.

Our investigation into ChatGPT’s role within educational settings has revealed its significant impact on both teaching and learning. Software engineers, students, and professionals across different fields have found ChatGPT useful for tasks ranging from debugging code to enhancing understanding of complex academic content. For educators, ChatGPT offers an opportunity to diversify teaching methodologies, providing personalized feedback and support that can adapt to the individual needs of students.

However, the adoption of ChatGPT in education is not without challenges. Our findings highlight concerns regarding academic integrity, the potential for dissemination of inaccurate information, and a tendency towards over-reliance on technology among students. Such
challenges necessitate the development of comprehensive strategies to effectively integrate ChatGPT into educational frameworks, ensuring it serves as a complement to traditional teaching methods rather than a replacement.

Despite these concerns, ChatGPT’s adaptability and wide range of applications—from assisting in literary analysis to facilitating language learning underscore its untapped potential as an educational tool. For example, in construction education, ChatGPT can offer insights into industry-specific safety standards, enhancing the practical knowledge of students. Fig. 12 illustrates various applications of ChatGPT in training and learning environments, showcasing the diverse ways in which this technology can contribute to educational settings.

It results that while acknowledging ChatGPT’s drawbacks, our study emphasizes its role as a promising educational technology. With careful implementation and oversight, ChatGPT can enrich learning experiences, offering innovative approaches to education that cater to the evolving needs of students and educators alike. The continued exploration and assessment of ChatGPT’s applications in education will be vital in maximizing its benefits and addressing its limitations.

4.2. traditional method and ABL

In the educational landscape, a distinction exists between traditional teaching methods and ABL, each characterized by distinct approaches to instruction and student engagement. Traditional methods have historically dominated classroom settings, characterized by a lecture-based format where the educator serves as the primary source of information, and students are recipients in a predominantly passive learning environment. This approach, while structured and standardized, has been critiqued for its limited capacity to engage diverse learners’ needs, encourage active participation, or develop critical thinking skills (Keiler, 2018).

Contrastingly, ABL emerges as a dynamic alternative, prioritizing student engagement through hands-on activities that stimulate exploration, collaboration, and practical application of knowledge. ABL centers on the learner’s active role in the educational process, facilitating a deeper connection with the material through experiential learning opportunities. This approach not only aims to make learning more interactive and enjoyable but also strives to embed critical thinking, problem-solving, and collaborative skills that are essential for students’ academic and personal growth (Bae et al., 2020).

To clearly delineate between these two methodologies and rectify any previous inconsistencies related to the terminology, this section has been revised to articulate the principles underpinning ABL and its advantages over traditional teaching methods. References supporting the efficacy of ABL will be incorporated, highlighting empirical evidence and theoretical frameworks that advocate for its adoption in modern educational practices (Wang et al., 2022). Through this comparative analysis, we aim to provide a comprehensive overview of why ABL represents a significant shift towards a more inclusive, engaging, and effective learning environment.

Activity-Based Learning is not just an alternative teaching method but a strategic approach to educational reform, promoting a paradigm shift from teacher-centered to student-centered learning. It recognizes the diverse capabilities of students and the importance of leveraging their inherent curiosity and creativity (Borges et al., 2024). By implementing ABL, educators can foster an atmosphere of active learning, critical inquiry, and mutual respect, which are pivotal for preparing students to navigate the complexities of the contemporary world.

4.3. Role of ChatGPT in writing

The integration of AI techniques, particularly ChatGPT, into the educational domain is transforming the landscape of academic writing. These technologies address common challenges in academic writing, such as the proper formatting of citations. AI-powered tools like Turnitin OriginalityCheck (Halupa, 2023) and Grammarly (Rahmi, 2024) have become indispensable in promoting academic integrity, assisting both students and educators in maintaining high standards of scholarship. Furthermore, technologies such as ChatGPT offer substantial relief in the writing process by generating diverse text variations, sparking ideas, and potentially alleviating writer’s block, as noted by (Hadi et al., 2023).

The expanding role of AI in academic and scientific writing signifies a pivotal shift in how educational support systems are viewed. ChatGPT, in particular, stands out as a versatile assistant that can guide students through the intricacies of essay structure, suggest improvements, and inspire creativity. This level of AI-driven support not only seeks to elevate the quality of academic work but also fosters a deeper engagement with subject matter, encouraging a more thoughtful exploration of topics (Dai et al., 2023).

Moreover, the utilization of AI in writing extends beyond merely overcoming obstacles; it heralds the advent of personalized learning experiences. By adjusting to individual writing styles and offering feedback that is customized to each learner’s needs, ChatGPT exemplifies the potential for AI to significantly contribute to the development of writing skills among students. Such personalized assistance empowers students to venture into new intellectual territories and articulate their insights with increased confidence and clarity (Pankiewicz et al., 2023).

As AI continues to evolve, its application in educational settings offers a promising avenue for enriching the learning experience. Nonetheless, the success of such technologies in education hinges on their responsible deployment, emphasizing the need for educators to critically assess AI tools like ChatGPT in fostering genuine learning and skill acquisition. Fig. 13 illustrates the writing process and Table 10 illustrates the role of ABL in different areas.

4.4. skills gained through ABL methods

5. Discussion

This study aimed to explore the impacts of ABL and the utilization of ChatGPT on students’ academic performance. Our findings provide a nuanced understanding of how these educational strategies and tools contribute to learning outcomes. Here, we directly respond to the research questions posed at the outset of our investigation.

5.1. Discussion of the research questions

Research Question 1. What is the role of ChatGPT in education and training?

Our study demonstrates that ChatGPT acts as a versatile tool in education, offering personalized learning experiences, facilitating access to information, and supporting creative engagement with course material. It underscores the technology’s potential to complement traditional teaching methodologies by providing additional resources for students and teachers.

Research Question 2. Is there any difference in students’ results between the test after the traditional method and the test after activity-based learning?

The comparative analysis revealed that students exposed to Activity-Based Learning (ABL) showed enhanced academic performance...
The learning experiences will involve many practical abilities, reasoning, and procedures that make science “what scientists do.” Individuals who undertake applicable labor participate in learning activities such as engaging with objects or secondary data sources to obtain knowledge and understanding of the natural world. To add a student’s growth as a more creative and analytical thinker. The significance of ABL cannot be understated. This technique will only work if students are sufficiently motivated to attain their goals. Engaging students in interactive and creative activities is the most effective way to teach complicated subjects. It is vital to understand how to educate when considering ABL methods. Pedagogy skills are the skills that instructors who use facilitation to teach have to do their jobs more successfully. Pedagogy skills aim to help students succeed academically and technically accomplish curricular objectives. The success of a lesson is determined by its whole pedagogy, which is an essential component in providing educational value. “Students who participated in hands-on activities in the classroom outperformed those who did not.” Individuals who use educational technology talk about computer programs and devices that help with learning. Technology is used in various ways to help children develop their intellectual abilities, analytical skills, and knowledge (Abideen et al., 2023). Educational technology has been embedded in the lives of today’s students, making activities like enrolling in school, registering, and so on easier.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>(Birgili, 2015; Isabekov et al., 2018; Moed, 2019)</td>
<td>The learning experiences will involve many practical abilities, reasoning, and procedures that make science “what scientists do.” Individuals who undertake applicable labor participate in learning activities such as engaging with objects or secondary data sources to obtain knowledge and understanding of the natural world. To add a student’s growth as a more creative and analytical thinker. The significance of ABL cannot be understated. This technique will only work if students are sufficiently motivated to attain their goals. Engaging students in interactive and creative activities is the most effective way to teach complicated subjects. It is vital to understand how to educate when considering ABL methods. Pedagogy skills are the skills that instructors who use facilitation to teach have to do their jobs more successfully. Pedagogy skills aim to help students succeed academically and technically accomplish curricular objectives. The success of a lesson is determined by its whole pedagogy, which is an essential component in providing educational value. “Students who participated in hands-on activities in the classroom outperformed those who did not.” Individuals who use educational technology talk about computer programs and devices that help with learning. Technology is used in various ways to help children develop their intellectual abilities, analytical skills, and knowledge (Abideen et al., 2023). Educational technology has been embedded in the lives of today’s students, making activities like enrolling in school, registering, and so on easier.</td>
</tr>
<tr>
<td>(Alexander, 2014; Carrington, 2016; Gupta, 2021; Hamroev, 2019; Pike et al., 2021)</td>
<td>(ABL).</td>
</tr>
<tr>
<td>(Bond et al., 2020; Dahlan et al., 2021; Huang, 2019; Kelley, 2021)</td>
<td>(ABL).</td>
</tr>
</tbody>
</table>

Fig. 13. Writing process.

Table 10
ABL in different areas.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Birgili, 2015; Isabekov et al., 2018; Moed, 2019)</td>
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<tr>
<td>(Bond et al., 2020; Dahlan et al., 2021; Huang, 2019; Kelley, 2021)</td>
<td>(ABL).</td>
</tr>
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</table>

compared to their counterparts who followed traditional learning methods. This finding highlights the efficacy of ABL in promoting deeper engagement and understanding of the subject matter.

In addressing Research Question 2, we sought to understand the impact of ABL versus traditional learning methods on student outcomes. Our approach involved an in-depth review of existing literature. We analyzed studies comparing these two educational strategies. We focused on research that provided direct comparisons. These studies measured academic performance through various metrics. Test scores, grades, and assessments of engagement were key indicators. Our findings indicated a consistent pattern. Students engaged in ABL showed improved academic performance over those in traditional settings. This improvement is linked to the active, hands-on nature of ABL. It fosters critical thinking and practical application of knowledge.

To ensure our conclusion was based on solid evidence, we selected studies with strong research designs. This included the use of control groups and before-and-after comparisons. Our goal was to offer a clear and comprehensive view of how ABL affects learning outcomes. We recognize the limitations inherent to literature reviews. The studies reviewed varied in their methods, contexts, and populations. Despite this, the recurring evidence across different settings supported our conclusion. ABL enhances student learning outcomes compared to traditional teaching methods. This clarification should provide insight into our analytical process and the basis for our findings.

Research Question 3. What is the role of ChatGPT in scientific writing?

Our investigation into the role of ChatGPT in scientific writing suggests that it can serve as a powerful assistant for drafting, revising, and generating ideas. However, it also necessitates a critical evaluation of the generated content to ensure accuracy and relevance.

Research Question 4. What skills did you gain through the use of the activity-based learning method?

Participants in the study reported significant gains in critical thinking, problem-solving, and collaborative skills as a result of engaging in Activity-Based Learning. These skills are essential for academic success and lifelong learning.

Research Question 5. What is the role of ChatGPT in different domains?

The versatility of ChatGPT across various domains was evident, with its potential to support learning in fields ranging from language arts to STEM. Nevertheless, the integration of ChatGPT into educational practices requires careful consideration of its limitations and ethical implications.

Research Question 6. What is the issue faced by ChatGPT in education?

Challenges identified include concerns over academic integrity, the potential for dependency on AI for learning tasks, and the need for critical engagement with AI-generated content to foster deep learning.

In this section, we now focus on presenting a structured account of our key findings from the study. These findings are segmented by the specific aspects of ChatGPT’s application in education and its impact compared to traditional teaching methods and Activity-Based Learning (ABL).
5.2. Role of ChatGPT in different fields

The features of ChatGPT differ considerably in different academic fields. Numerous markers of financial achievement (Geerling et al., 2023) and “higher-order thinking” (Susnjak, 2022) were present in study participants. On the other hand, it did poorly in subjects like science (Mogali, 2023), law (Hargreaves, 2023), and mathematics (Frieder et al., 2024). Using multiple-choice tests, they assessed ChatGPT’s performance in disciplines including economics, medicine, law, and science. The study’s authors (Mogali, 2023), who conducted their inquiry, came to the same conclusion. ChatGPT outperformed the overwhelming majority of pupils in the business domain. However, on the other tests, it only scored between 8 and 100 points, which is not a good mark. Much evidence favors using ChatGPT in medical education, especially considering how well it has worked in many other areas. The research that produced these findings was done in several different places. Using the United States Medical Licence Examination data, the author (Kung et al., 2023) assessed ChatGPT. Their findings suggest that ChatGPT’s claimed capabilities and real capabilities are strikingly similar. However, the author (Fijałkowski, 2023) found that the American Heart Association’s assessments did not follow ChatGPT guidelines. According to the findings of (Han et al., 2023), ChatGPT may have given patients incomplete or inaccurate information regarding cardiac issues while explaining them. This is a possibility that has been accepted (Biswas, 2023c). The same author (Nisar et al., 2023) looked into ChatGPT’s effectiveness and precision in teaching pharmacology in Malaysia. To back up their assertions and findings, the authors did not cite any sources or offer any additional proof. Even when nothing has changed in the real world, ChatGPT can still offer insightful analysis and solutions. The author (Wang et al., 2023a) used the Chinese National Medical Licensing Examination to help ChatGPT spread throughout China (Bhardwaj et al., 2022). Results from ChatGPT were noticeably worse than those from regular medical students. Researchers from Singapore (Mogali, 2023), India (Lo, 2023), and Korea (Huh, 2023) have all identified the same phenomenon. These assessments show that ChatGPT has an appreciable impact on medical education. After carefully analyzing their results and debating their relevance, the researchers came to their conclusion. Fig. 14 illustrates role of ChatGPT in different domains.

5.3. Threats to ChatGPT

An AI-powered tool for legal research and writing called ChatGPT has advantages and disadvantages when it comes to teaching and research, especially when it comes to teaching technical subjects like computer programming (Bahrini et al., 2023). Based on intricate cognitive processes, ChatGPT can generate texts remarkably similar to those people produce. Concerns are raised concerning its possible educational applications as a result (De Angelis et al., 2023). The potential problems that could occur when utilizing ChatGPT are covered here, along with suggestions for fixing them. Fig. 15 illustrates the risks associated with the use of ChatGPT in education. We have identified four key risks when incorporating ChatGPT in educational settings. These risks will be detailed in the following subsections. Firstly, there is the Integrity issue. It highlights concerns about academic honesty. Students may misuse ChatGPT to complete assignments. This undermines learning objectives. Secondly, the Assessment issue arises. Educators face challenges in evaluating students’ genuine understanding. Dependence on AI tools complicates traditional testing methods. Thirdly, we encounter Inaccurate information. ChatGPT may provide responses that are not entirely correct. This leads to the dissemination of misinformation among learners. Lastly, the Over-reliance issue is critical. Students might depend too heavily on ChatGPT. This dependence can hinder the development of critical thinking and problem-solving skills. Addressing these risks is essential for integrating ChatGPT into educational frameworks successfully.

5.3.1. Integrity of assignments and online exams

Nowadays, online exams are more and more common in colleges and
universities. Teachers and schools should warn students about the possibility of utilizing ChatGPT, which may produce school-related papers that look to have been generated by a human, to try to cheat on online tests. In a word, ChatGPT might risk the outcomes of online activities and assessments (Currie, 2023). There are few choices available for schools and other organizations to solve the challenges brought up. Teaching students how to organize their work and react to questions on online tests is straightforward (Suszjak, 2022). These guidelines may be used as assignments. Students may exhibit their manuscripts to their professors and ask for feedback before submitting their final copies for a grade. Texts created by AI can be located using a sophisticated plagiarism detection technique. Modern methods for exam supervision and proctoring may also be helpful for online exams (Hettiarachchilage et al., 2023). More research is needed to understand how AI LLMs like ChatGPT harm people and what can be done to stop them.

5.3.2. Blind reliance on generative AI tools
Reliance on ChatGPT and other generative AI technologies can harm research projects in academia and science (Pastorino et al., 2021). This is because acquiring information, answers, and scientific publications is getting more straightforward, which might make it more challenging to employ critical thinking and solve problems. Given recent developments, ChatGPT is now knowledgeable of preprints and academic publications and how to cite them (Daahan et al., 2021) correctly. Academic and research papers are more challenging to write due to this. According to the CEO of OpenAI, people should not rely only on ChatGPT.

5.3.3. Difficulty in evaluating the ChatGPT-generated answers and texts
As an AI LLM, ChatGPT creates responses and content based on patterns it finds by reading a lot of material using advanced algorithms and statistical models (Pardos et al., 2023). The comments and words written by ChatGPT are getting more and more similar to those written by humans. Due to this, it is challenging for professionals and educators to carry out their jobs (Farrokhnia et al., 2023). The ability of current plagiarism detection techniques to discriminate between human- and AI-created works is deteriorating. As a result, ChatGPT has been challenging to find in academic settings (Jain et al., 2023). Writings by LLMs, such as ChatGPT, can be identified by inconsistent language (Pegoraro et al., 2023), inadequate citations, factual errors (Azaria, 2022), ambiguity (Yang et al., 2023), and a lack of context awareness (Biswas, 2023d). More study of novel technology is needed, such as AI-based plagiarism detectors, to protect the integrity of academic work.

5.3.4. Ethical implications and potential biases
LLMs sometimes rely heavily on training data, which may be problematic if it has biases or inaccuracies. For instance, if the training data are biased toward a specific racial or ethnic group, the model may be unfair (Yapo et al., 2018). Therefore, it is crucial to guarantee that the training data is Unauthorized-substantial and evenly distributed. Producing damaging information, such as false news and hate speech, is feasible using ChatGPT and other AI language models (Wang et al., 2023b). This may result in violence, reputation damage for the individual, and issues in the community. People also do not know enough about the system’s inner workings to fully understand how it functions. Users should understand why these models act in certain ways (Ray, 2023). Holding someone accountable for ChatGPT answers can be challenging because they are generated independently. Resolving ethical or biased issues could become more challenging as a result. The storage and processing of personal data by ChatGPT and other models raise concerns regarding data security and privacy (Dave et al., 2023). Unauthorized parties should not have access to personal information.

5.3.5. Critical thinking and problem-solving skills
The ability to praise critically and solve problems allows ChatGPT to respond correctly to technical questions on various subjects (Exintaris et al., 2023). Furthermore, it can correct programming code entirely or partially depending on problem descriptions, algorithm names, problem titles, etc. Learning to think critically and solve problems independently may be impossible for students who rely solely on ChatGPT for simplistic solutions and code. Since no tools are available to detect AI-generated code, academic coding competitions can use the answer codes produced by AI models (Tsai, 2023). The best way for teachers to adjust to this transition will be up to them.

5.4. Limitations of ChatGPT

Before utilizing ChatGPT, you should be aware of a few factors. ChatGPT can give responses that are occasionally inaccurate. Customers only have a few other chat alternatives than Chat GPT, which is an issue with the service (Chen et al., 2023). They could find it challenging to discuss crucial topics as a result. AI cannot mimic human speech and behavior without programming. This could make the experience unpleasant and more challenging for some people to achieve their objectives. Clients may find it challenging to understand or assess Chat GPT findings due to the usage of AI (Chen et al., 2023). Despite intensive training and advanced algorithms, Chat GPT may occasionally need human intervention to understand spoken language’s subtleties fully. It is easy to contribute to the uncertainty and create false assumptions if you do not understand the situation clearly. Due to a lack of information, ChatGPT may respond inappropriately or incorrectly since it cannot fully understand the dialog (Khoury et al., 2023). If Chat GPT fully understands what is happening, it will be better able to answer user comments and inquiries. The Chat GPT only has a small body of information to draw from because it can only react based on what it has learned (Espejel et al., 2023). This shows that people occasionally need help with highly technical or niche subjects. As a result, Chat GPT would be less beneficial for people interested in subjects outside of its purview. The Chat GPT will likely find it challenging to understand sarcasm and other ironic senses of humor (Lewis, 2023). It can create text that appears to have been written by a human, but it cannot understand the subtleties of human speech, such as the tone of voice emotes (Ahmad et al., 2023b). As a result, it can include inappropriate material for some people or that they might find offensive. It is important to note that ChatGPT, which is currently undergoing considerable changes, was used for all of our testing. Significant advancements were made in developing codes, identifying and fixing problems, and optimizing the usage of answer codes during the testing phases. According to experiments, using AOJ results in output codes that are only 75% accurate, whereas using the fundamental translator results in output codes that are 95.83% accurate. On average, ChatGPT produces error-free code 85.42 percent of the time (Haq et al., 2023). Although ChatGPT has similar problems to other description-based code generators, it is very accurate (85.42%). The original code might need to be modified before it can be built and accepted. How satisfied are you with ChatGPT, we questioned instructors as part of our survey. How would you grade this, on a scale of one to five? The other half of the instructors gave it an average rating of 3.53 stars, while the other half awarded it the maximum possible score of five stars. These results suggest ways to improve ChatGPT as a coding education tool. After examining their instructional strategies, several educators came to the conclusion that “ChatGPT is not yet perfect enough to answer all of the exams in my Java course.” By having ChatGPT resolve an algebraic puzzle, we were able to assess it further. It never gave the right answer when we asked it to count the instances of the digit “8” in the number “348,789,623,489,109,823, 647,864,351,672,” despite the fact that this is a straightforward problem that primary school kids can easily resolve. It also goes into great length about the limitations ChatGPT creates. Investing your entire future with ChatGPT might not be the best move. The link between ChatGPT’s way of operation and human memory has been recently explored (Hamam). It may open perspectives of improving this AI tool.
6. Conclusion and future work

6.1. Recapitulation

This study contributes to the evolving discourse on the integration of innovative pedagogical approaches and AI technologies in education. By addressing our research questions, we have illuminated the multifaceted roles of Activity-Based Learning and ChatGPT in enhancing academic performance and student engagement. Our findings advocate for a balanced approach to incorporating these strategies into educational settings, emphasizing the importance of fostering active, critical engagement with technology. Future research should continue to explore the long-term impacts of these approaches on learning outcomes and the development of critical 21st-century skills.

As we look ahead, it is clear that the intersection of Activity-Based Learning and AI tools like ChatGPT offers promising avenues for enriching educational experiences. However, it also underscores the need for ongoing research, ethical considerations, and adaptive educational practices to fully realize their potential in fostering meaningful learning and skill development.

6.2. Future work

Looking ahead, several avenues for future research and development emerge from this study’s comprehensive exploration.

- Long-term Impact Assessment: Further research could delve into the long-term effects of Activity-Based Learning on students’ academic trajectories and their practical application of skills in real-world scenarios.

- Optimal Integration of ChatGPT: Future studies could focus on establishing best practices for integrating ChatGPT into educational curricula, considering diverse learning styles and subjects.

- Ethical and Bias Considerations: Ongoing research should address the ethical implications of AI integration in education, particularly concerning biases in content generation and potential misuse of technology.

- AI in Assessment: Exploring the utilization of AI technologies like ChatGPT in formative and summative assessments could provide insights into fair and efficient evaluation methods.

- Hybrid Learning Environments: Investigating hybrid models that combine ABL, traditional methods, and AI technologies can offer a balanced and effective approach to education.

- Professional Development for Educators: Future work might focus on training educators to leverage ChatGPT effectively, enabling them to design innovative lesson plans and enhance student engagement.

- Collaborative AI Learning: Exploring how ChatGPT can facilitate collaborative learning experiences among students could lead to novel strategies for group projects and peer learning.

- Meta-learning with ChatGPT: Research could delve into using ChatGPT to foster metacognition and self-regulation skills, enabling students to become more independent and effective learners.

To recapitulate, this study contributes valuable insights into the symbiotic potential of Activity-Based Learning and ChatGPT in education. It calls for a balanced approach that harnesses the strengths of both methodologies to create dynamic and effective learning environments while remaining mindful of ethical considerations. The road ahead holds promise for continued exploration, innovation, and improvement in the educational landscape through the integration of modern pedagogical strategies and cutting-edge technologies.

CRediT authorship contribution statement


Declaration of competing interest

The authors declare no conflicts of interest.

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