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Research on the Application of AI in A-Level Biology Teaching

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Abstract: With the rapid digitalization of education, artificial intelligence (AI) has gained significant attention for its potential to transform teaching and learning. In the context of A-Level Biology, AI presents both opportunities and challenges. However, research specifically focusing on AI's application in A-Level Biology teaching remains limited. This study, employing interviews as the primary method, aims to explore how AI can address specific challenges in A-Level Biology teaching. The main objectives are to understand how AI-assisted teaching differs from traditional teaching, its impact on teaching practices, and the potential benefits and drawbacks for teachers. The research used qualitative interviews with three A-Level Biology teachers from different teaching backgrounds to explore the influence in teaching when AI is used in A-Level Biology. The research finds that teachers acknowledged both the advantages, such as personalized resources and increased efficiency, and the challenges, such as potential loss of creativity and autonomy.

Keywords: A-Level Biology Teaching, AI, Teachers

1. Introduction

Artificial intelligence (AI) refers to the capability of machines or computer systems to mimic human intelligence in solving complex problems [1][2]. In recent years, the rapid digitalization of education has marked a golden era for AI applications in teaching and learning environments[3]. AI tools are increasingly utilized to enhance both teaching efficiency and student engagement:

Teachers play a key role in integrating AI into education, benefiting from tools that enhance efficiency and interaction but facing challenges in training and infrastructure[4][5][6][7][8]. AI enhances students' learning and engagement through personalized tools, but challenges like over-reliance and privacy concerns remain [9][10][11]. AI has transformed STEM and non-STEM education with tools like LLMs and simulations, offering innovative ways to teach complex concepts and bridge theoretical and practical learning[5][12][13][7][14]. However, the effectiveness of AI tools depends on proper training, infrastructure, and addressing ethical considerations[4][6][15][11].

Despite the growing body of research on AI's role in education, studies specifically addressing its application in A-Level biology remain limited which creates a significant research gap. A-Level biology, a component of the General Certificate of Education Advanced Level (A-Level), is a senior secondary-level course in the UK designed for students aged 16-18 [16]. As an essential qualification for university admissions, the subject combines theoretical understanding with practical skills, challenging both students and teachers to meet high academic standards. This study aims to explore

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how AI can be leveraged to address the specific challenges and opportunities in A-Level biology, providing insights into its potential for transforming the teaching and learning experience.

To achieve this, the research focuses on the following questions:

1. What are the characteristics of AI-assisted A-Level biology teaching compared to traditional teaching?
2. What impact does AI-assisted teaching have on A-Level biology teachers?

2. Methods

This research utilized interviews as a key method to gain an in-depth understanding of the subject matter. During the qualitative phase, semi-structured interviews were conducted and subsequently transcribed with precision. To ensure the credibility of the data, participants were provided the opportunity to review and validate their transcripts, maintaining both accuracy and reliability [17].

This study selected three biology teachers from two institutions as interview participants, including a senior teacher with over 10 years of teaching experience, a new teacher with approximately one year of experience, and a New Oriental A-level teacher with six months of teaching experience. The interview questions focused on several key themes:

1. Whether the teachers have used AI tools during lesson preparation and the specific ways in which they were utilized;
2. How AI tools assist in teaching and their limitations;
3. The teachers' perspectives on the role of AI in teaching, particularly how AI impacts teaching efficiency and classroom performance;
4. The overall impact of AI on teachers' work, including its advantages and potential issues.

3. Findings

The participants in this research come from diverse teaching backgrounds, including teachers with extensive experience in international schools and those new to A-Level biology instruction. Their insights provide different aspect understanding of how AI-assisted teaching compares to traditional methods, highlighting both the opportunities and challenges it brings.

3.1. Characteristics of AI-Assisted A-Level Biology Teaching Compared to Traditional Teaching

3.1.1. Optimizing Preparation

Due to the unique nature of the subject, experiments are an essential part of biology teaching, with many biology textbooks incorporating numerous experimental procedures for learning[18]. According to interviewees, AI can help teachers optimize the experimental preparation process. AI is able to provide teachers with suggestions for improving experimental design, particularly regarding potential issues that may arise during the experiment. By simulating the experimental process, AI tools can predict possible experimental problems, such as unexpected chemical reactions, equipment malfunctions, or the complexity of the experimental steps. For example, when a teacher designs an experiment to observe cell division, AI can predict possible deviations based on different variables in the experiment and provide adjustment suggestions. Teachers can identify these potential problems before the experiment begins, allowing them to make the necessary preparations in advance and reduce errors during the experiment. In this way, AI not only helps teachers optimize experimental design in theory but also enhances the success rate of the experiment during actual implementation.

Another interviewee also mentioned that AI tools can generate detailed experimental preparation checklists based on the goals and requirements of the experiment, including the types of reagents, the

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specifications, and quantities of equipment, therefore, helping teachers quickly understand the specific requirements of the experiment and avoid missing important steps or materials. This not only increases preparation efficiency but also reduces the likelihood of errors that teachers may make during preparation. By reducing repeating tasks in the preparation process, AI tools allow teachers to focus on teaching content and student needs, thereby enhancing overall teaching effectiveness. The integration of AI into preparation supports not only efficiency but also the organization of key knowledge points, as discussed in the following section.

3.1.2. Organizing Key and Challenging Knowledge Points

An interviewee stated that AI is a very effective tool in teaching, as it helps teachers organize and identify the key and challenging knowledge points. Identifying and effectively organizing key and challenging knowledge points is fundamental to delivering a successful lesson, especially in subjects like A-Level Biology that demand a deep understanding of complex concepts. A well-structured lesson that highlights these critical areas not only aids students in grasping essential content but also ensures that they can effectively apply this knowledge in examinations and practical scenarios. Teaching key points ensures that students build a solid foundation of core biological principles, while addressing challenging areas helps them overcome potential learning barriers and promotes a more comprehensive understanding of the subject.

Interviewees also mentioned that AI can assist in analyzing past exam papers and exercises, in conjunction with textbook content, to identify challenging points in the curriculum. Additionally, given that students' native language is Chinese while A-Level biology textbooks are in English, language becomes another significant barrier. Teachers are required not only to explain the key concepts but also to take on the role of an English instructor to help students grasp subject-specific terminology. AI thus can extract rare and critical vocabulary from the course content and compile them into word lists for students. This helps mitigate the language barriers faced by non-native English speakers when learning biological concepts, enabling students to achieve the dual-task goal of mastering both language and subject knowledge [19].

3.1.3. Assisting in Lesson Material Design

Some interviewees mentioned that teachers require the use of lesson materials during class, such as slides and educational videos. AI can suggest slide layouts, recommend the most effective use of visuals, and even generate animations to illustrate biological processes such as DNA replication or photosynthesis. For instance, when preparing a lesson on cell division, AI can provide templates and animations that visually demonstrate each phase of mitosis, allowing students to observe these processes in a dynamic and interactive format.

Additionally, designing such materials involves integrating knowledge points and reflecting logical coherence, as knowledge must be conveyed progressively, from simple to complex, and from superficial to in-depth. This aligns with students' cognitive patterns. In such cases, AI can assist teachers in designing lesson materials by organizing classroom knowledge points and clarifying the logic and methods of material design. AI can also provide suggestions for lesson material design, such as the use of mind maps and multimedia resources to visualize knowledge and stimulate students' visual engagement. These features not only make lessons more engaging but also ensure that complex topics are communicated effectively[20].

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3.2. The Impact of AI on Teachers Engaged in A-Level Biology Teaching

3.2.1. Benefits of AI for Teachers

AI has provided significant conveniences for A-Level biology teachers by simplifying their workflows and improving teaching precision. For instance, AI generates structured lesson plans, enabling teachers to spend more time to classroom interaction and personalized student support [21]. Another teacher pointed out that AI's ability to quickly process and organize information reduces repetitive tasks, allowing teachers to conduct lessons more efficiently and focus on key content.

Another major advantage is AI's role in meeting diverse student needs. Some teachers recognized that AI can generate personalized resources, such as vocabulary lists for students with language barriers, since it can translate accurately to achieve the state-of-art result [22]. This feature helps non-native English-speaking students reduce the cognitive load caused by language difficulties, fostering a more inclusive learning environment. Furthermore, AI's data-driven insights enable teachers to monitor student performance and adjust teaching strategies, achieving personalized and efficient education[23].

Additionally, AI provides teachers with real-time feedback on lesson delivery and student engagement. By analyzing classroom data that teachers provide, such as student comprehension levels, AI tools can offer suggestions on how to adjust lesson pacing or emphasize specific topics. Moreover, by sharing lesson plans and teaching strategies through platforms, educators can learn from each other's experiences and incorporate best practices into their own teaching.

3.2.2. Challenges Posed by AI for Teachers

Despite its numerous advantages, AI also poses challenges for teachers that need attention [24]. One major issue is the potential over reliance on AI. Some teachers believe this reliance could weaken teachers' creativity and autonomy. Teachers who depend too heavily on AI tools may find it difficult to handle unexpected classroom dynamics or innovate beyond pre-designed solutions.

Additionally, the reliability of AI-generated content is a concern. According to some teachers' feedback, the precision required in biology necessitates rigorous verification of AI outputs, as inaccurate or incomplete information could lead to misconceptions among students [25]. Another teacher emphasized that this verification process could be time-consuming, offsetting the efficiency gains provided by AI.

Another challenge highlighted by teachers is the steep learning curve associated with adopting AI tools. While younger or more tech-savvy teachers may quickly adapt to these technologies, others may experience frustration or anxiety, particularly if they lack prior exposure to similar tools. This technological gap could potentially widen disparities among teachers, with those less proficient in AI struggling to integrate it effectively into their teaching practices.

Finally, integrating AI into teaching requires teachers to adapt their skill sets. Teachers must not only master traditional teaching methods but also develop critical understanding of how to use AI tools effectively while remaining pay attention to their limitations [26]. This dual responsibility adds complexity to their roles, requiring continuous professional development and adaptation.

In summary, while AI improves efficiency and supports innovative teaching approaches, its limitations highlight the need for balanced and cautious use. Teachers must critically engage with AI to maximize its benefits without compromising their professional judgment and instructional autonomy.

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4. Conclusion

This study, employing interviews as the primary method, aims to explore how AI can address specific challenges in A-Level Biology teaching. The main objectives are to understand how AI-assisted teaching differs from traditional teaching, its impact on teaching practices, and the potential benefits and drawbacks for teachers. The research findings indicate that, compared to traditional A-Level Biology teaching, AI-assisted teaching has distinct advantages. AI tools greatly improve efficiency in lesson preparation, organizing key knowledge points, and designing teaching materials. By reducing repetitive tasks during the preparation stage, AI allows teachers to spend more time engaging with students and providing personalized support, particularly in helping non-native English speakers overcome language barriers. AI also provides personalized learning resources, helping students from different backgrounds overcome learning difficulties, promoting educational equity, and improving teaching effectiveness.

However, the introduction of AI also brings challenges to teachers' instructional practices. On one hand, AI makes teaching more efficient, but there is a risk of over-reliance. If teachers become overly dependent on AI, they may lose creativity and flexibility, especially when faced with unforeseen situations in the classroom. Additionally, while AI-generated content is efficient, its accuracy remains a concern, particularly in biology, a subject that requires high precision. Teachers need to carefully verify the materials provided by AI to avoid spreading incorrect information that could affect students' understanding of key concepts. Therefore, teachers must remember that in an AI-assisted classroom, the teacher remains the central figure in the teaching process, with AI serving as a supportive tool.

This study contributes by revealing the specific applications and impacts of AI in A-Level Biology teaching, helping teachers understand both the potential and limitations of AI. The practical value of this research lies in reminding teachers how to use AI appropriately, avoiding over-dependence that could undermine their teaching autonomy. Teachers should balance the use of AI to enhance teaching efficiency while maintaining critical thinking to ensure the quality and innovation of their teaching.

However, due to time constraints, the study has a small sample size, with only three teachers participating and only used qualitative methods. Therefore, future research should expand the sample size to include more teachers and different teaching environments to gain a more comprehensive understanding. Future research could also incorporate quantitative research to further verify the effectiveness of AI-assisted teaching and explore its application in other subjects. Furthermore, since AI can provide different learning resources for different students, future studies could explore how this feature can be integrated with personalized teaching.

Overall, AI has significant potential in A-Level Biology teaching, offering opportunities to improve teaching efficiency and quality while providing teachers with more innovative teaching methods. Teachers should ensure the effective use of AI tools while avoiding over-reliance to better drive the development of educational practices.

References

[1] *Luger, G. F. (1998). Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 5/e. Pearson Education India.*

[2] *Kumar, K., & Thakur, G. S. M. (2012). Advanced applications of neural networks and artificial intelligence: A review. International journal of information technology and computer science, 4(6), 57-68.*

[3] *Loeckx, J. (2016). Blurring boundaries in education: Context and impact of MOOCs. International Review of Research in Open and Distributed Learning, 17(3), 92-121.*

[4] *Whalen, J., Grube, W., Xu, C., & Trust, T. (2024). K-12 Educators' Reactions and Responses to ChatGPT and GenAI During the 2022–2023 School Year. TechTrends, 1-13.*

[5] *Gong, X., Holmes, J., Li, Y., Liu, Z., Gan, Q., Wu, Z., ... & Yan, Y. (2023). Evaluating the potential of leading large language models in reasoning biology questions. arXiv preprint arXiv:2311.07582.*

DOI: 10.54254/2753-7048/2025.21709

[6] *Blonder, R., Feldman-Maggor, Y., & Rap, S. (2024). Are They Ready to Teach? Generative AI as a Means to Uncover Pre-Service Science Teachers' PCK and Enhance Their Preparation Program. Journal of Science Education and Technology, 1-10.*

[7] *Park, J., Teo, T. W., Teo, A., Chang, J., Huang, J. S., & Koo, S. (2023). Integrating artificial intelligence into science lessons: Teachers' experiences and views. International Journal of STEM Education, 10(1), 61.*

[8] *Memarian, B., & Doleck, T. (2024). Teaching and learning artificial intelligence: Insights from the literature. Education and Information Technologies, 1-24.*

[9] *Favero, T. G. (2024). Using artificial intelligence platforms to support student learning in physiology. Advances in Physiology Education, 48(2), 193-199.*

[10] *Son, T. (2024). Noticing classes of preservice teachers: relations to teaching moves through AI chatbot simulation. Education and Information Technologies, 1-24.*

[11] *Zhao, H., & Min, Q. (2024). Exploring continued usage of an AI teaching assistant among university students: A temporal distance perspective. Information & Management, 61(6), 104012.*

[12] *Rahioui, F., Jouti, M. A. T., & El Ghzaoui, M. (2024). Exploring Complex Biological Processes through Artificial Intelligence. Journal of Educators Online, 21(2), n2.*

[13] *Song, X. (2024). Physical education teaching mode assisted by artificial intelligence assistant under the guidance of high-order complex network. Scientific reports, 14(1), 4104.*

[14] *Zhao, L., Hussam, E., Seong, J. T., Elshenawy, A., Kamal, M., & Alshawarbeh, E. (2024). Revolutionizing art education: Integrating AI and multimedia for enhanced appreciation teaching. Alexandria Engineering Journal, 93, 33-43.*

[15] *Netland, T., von Dzengelevski, O., Tesch, K., & Kwasnitschka, D. (2025). Comparing human-made and AI-generated teaching videos: An experimental study on learning effects. Computers & Education, 224, 105164.*

[16] *Collins English Dictionary. (n.d.). A-level. In CollinsDictionary.com. Retrieved January 9, 2025, from https://www.collinsdictionary.com/dictionary/english/a-level*

[17] *Van Nes, F., Abma, T., Jonsson, H., & Deeg, D. (2010). Language differences in qualitative research: is meaning lost in translation?. European journal of ageing, 7, 313-316.*

[18] *Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons.*

[19] *Hyland, K. (2016). Academic publishing: Issues and challenges in the construction of knowledge.*

[20] *Folgert, A., & DeGroot, K. (2024). Using AI-Generated Podcasts as an Adjunct to Traditional Teaching Strategies. Nurse Educator, 10-1097.*

[21] *Mayer, R. E. (2024). The past, present, and future of the cognitive theory of multimedia learning. Educational Psychology Review, 36(1), 8.*

[22] *Wu, Y. (2016). Google's neural machine translation system: Bridging the gap between human and machine translation. arXiv preprint arXiv:1609.08144.*

[23] *Chen, Y., Chen, Y., & Heffernan, N. (2020). Personalized math tutoring with a conversational agent. arXiv preprint arXiv:2012.12121*

[24] *Woodruff, K., Hutson, J., & Arnone, K. (2023). Perceptions and barriers to adopting artificial intelligence in K-12 education: A survey of educators in fifty states.*

[25] *Xu, D., Fan, S., & Kankanhalli, M. (2023, October). Combating misinformation in the era of generative AI models. In Proceedings of the 31st ACM International Conference on Multimedia (pp. 9291-9298)*

[26] *Baidoo-Anu, D., & Ansah, L. O. (2023). Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. Journal of AI, 7(1), 52-62.*