Proceeding International Conference on Religion, Science and Education (2025) **4**, 1247-1252

Leveraging Internet of Things (IoT) for Enhanced English Language Learning: Opportunities and Challenges in Modern Classrooms

Ria Fakhrurriana, Griselda Gian Heris Herdina*
Department of English Education, State Islamic Institute of Kediri, IAIN Kediri,
Jl. Sunan Ampel No.7, Ngronggo, Kec. Kota, Kota Kediri, Jawa Timur, Indonesia, 64127. Telp. (0354) 689282.

Corresponding author*
griseldagian285@gmail.com

Abstract: The technological revolution in various sectors continues to change including in the education sector. The Internet of Things (IoT) holds new opportunities for English language students in the digital era by offering a variety of personalised and integrated interactive experiences. This conceptual article discusses how IoT can be integrated with English language learning classrooms in an effort to improve teaching and learning effectiveness starting from a basic understanding of IoT and its potential in education. The article will discuss various IoT applications such as smart devices, automated assessment systems, and adaptive learning platforms that create efficient learning. In addition, this article also focuses to discuss the challenges faced in implementing IoT in the educational environment. This conceptual article explores how IoT can be effectively integrated into English language classrooms to boost teaching and learning efficiency.

Keywords: Challenge, Internet of Things (IoT), Learning English, Modern Classrooms, Technology.

Introduction

The development of Internet of Things (IoT) technology has revolutionised the way humans interact with the world around them. IoT connects physical devices to the internet, allowing them to share data and information automatically without human intervention. These devices include a wide variety of objects, ranging from smartphones, home appliances, to complex industrial systems (Holler et al., 2014; Kopetz & Steiner, 2022). According to research, the number of devices connected to the IoT is expected to continue to increase exponentially, having a huge impact on various sectors of life (Lampropoulos et al., 2019; Shafique et al., 2020).

In the context of education, IoT is also starting to show its significant potential. In schools and universities, IoT devices can assist in monitoring student attendance, organising classrooms, and supporting distance learning by facilitating the use of directly connected devices (Tariq et al., 2024; Willis, 1994). The use of IoT in educational environments also enables real-time tracking of student performance, providing accurate data for teachers to assess and adjust their teaching methods.

IoT technology in education offers opportunities to create a more interactive and personalised learning experience. With connected devices, students can access learning materials anytime, anywhere. They can also utilise wearables to help understand complex concepts in certain subjects. Additionally, schools can use the data generated to improve the overall learning environment, from classroom lighting to temperature control, to create an atmosphere conducive to learning (Ahmed et al., 2020; Fang et al., 2023).

However, along with its benefits, IoT also comes with challenges, especially in terms of data privacy and security. The use of connected devices increases the risk of personal data leakage for both students and teachers (Hankerson et al., 2021). Therefore, the integration of IoT in the education

ISSN 2829-3355 | EISSN 2828-8467

sector must be balanced with strict security policies and awareness of the importance of protecting personal data. IoT has great potential to transform many aspects of life, including education (Nižetić et al., 2020). The integration of these technologies is expected to support smarter, more flexible, and efficient ways of learning, in line with the rapid development of the digital world (Badshah et al., 2023).

The Internet of Things (IoT) is becoming increasingly relevant in English education due to its ability to create interactive and personalised learning environments. In this digital era, learning is no longer limited to conventional classrooms. IoT enables the use of devices such as smart speakers, mobile apps, and wearable technology that can support students in accessing materials anytime and anywhere (Ahuja & Bala, 2021; Badshah et al., 2023). For example, internet-connected devices can be used to facilitate listening practice, pronunciation, and vocabulary learning through real-time interactive simulations (Holozsai & József, 2024). This makes the learning process more flexible and tailored to students' individual needs, thereby accelerating English comprehension and skills.

In addition, IoT supports teachers in monitoring student progress more effectively. Through devices integrated with IoT technology, teachers can obtain accurate data on student performance, such as learning time, material progress, and areas that need improvement (Haleem et al., 2022). This data allows teachers to provide more precise feedback and customise teaching methods according to each student's needs. With this technology, English learning can become more responsive and adaptive, increasing overall student motivation and engagement (Yu et al., 2022). Based on this, the author identifies what are the opportunities and challenges for teachers and students in applying IoT in learning by formulating the problem: How can IoT be applied in English language learning and what are the opportunities and challenges?

Literature Review

Internet of Things (IoT)

IoT is a concept that encompasses various physical devices that are used daily and can be connected to each other on the internet. With this connection, devices can exchange data and information without direct human interaction. The goal of IoT is to make life more efficient and practical (Syed et al., 2021). The way IoT works is considered quite simple. By using sensors or monitoring technology, IoT can work by sending data through the cloud (internet-based storage) (Kadhim et al., 2020). Data that has been stored in the cloud can be processed and analysed.

IoT in Education

IoT has been widely established in the scope of education and has provided many benefits and improved the learning experience. One way it is being implemented is through the use of smart devices such as digital whiteboards and smart projectors that allow teachers to deliver material in an interactive and engaging way (Tran & Nguyen, 2023). With the ability to connect these devices to the internet, students can participate and share ideas directly in collaborative learning. Through IoT, schools can automatically monitor student attendance. In addition, mobile applications integrated with IoT can also give students access to learning outside of school hours as additional material and practice independently (Fitria & Simbolon, 2023). This can provide a more responsive learning environment.

Importance IoT in Language Learning

The role of IoT in supporting English language learning is also very significant. By providing an interactive and fun learning environment. An example of the application of IoT in the English classroom is the smart speaker (Hayashi et al., 2020). It can be used to practice pronunciation and listening. Students will get immediate feedback so as to make students more confident in practising.

In addition, IoT can help personalise learning by collecting data on students' progress and difficulties through devices connected to teachers so that teachers can know the individual needs of each student. With the personalisation of learning, it is possible for teachers to design teaching materials according to students' needs. Using IoT-based learning can provide relevant and interesting learning contents such as videos, quizzes, or

supporting audio materials that can strengthen English learning (Chiang et al., 2023).

Advantages of IoT in English Language Learning

In IoT-based learning, students can practice English with real-time simulations, pronunciation exercises, and game-based applications. This kind of learning combination supports more active and interesting learning compared to conventional learning. They can also increase students' learning motivation. The ease of real-time interaction through IoT greatly facilitates teachers and students in collaboration and communication (Aldowah et al., 2017). Innovative features such as virtual classrooms, messaging apps, and document sharing devices allow students to connect more easily. IoT opens up opportunities for international classroom interaction (Nanade & Nanade, 2023). This is due to the flexibility of the platform that will always be upgraded so that teachers and students can exchange ideas globally. It also improves language skills, and can even use the IoT platform with natives directly.

Challenges in Implementing IoT in English Language Education

The main challenges of implementing IoT in English language learning are cost and accessibility. IoT technology requires expensive software, hardware and infrastructure (Gupta & Quamara, 2020). This leads to a gap where schools that have sufficient funds are able to use IoT. Another barrier is the risk of data privacy and security. The data collected by IoT includes personal information and student learning behaviour, making it vulnerable to data theft or misuse if not managed properly (Vaza et al., 2024). Therefore, educational institutions need to address this with extra protocols regarding the student data that has been collected. The success of IoT implementation largely depends on teachers' ability to apply the technology in the classroom. Many teachers still need specialised training in operating IoT devices as well as integrating them into their teaching methods (Bingimlas, 2009). Therefore, comprehensive training is needed so that teachers can optimally implement IoT-based English learning in the classroom. Maintenance and management of IoT devices are also issues that must be considered. IoT devices require regular technical maintenance to ensure their optimal performance. Schools must also have access to resources to repair or replace these devices (Minoli et al., 2017).

Future Directions of IoT in English Language Learning

New trends in IoT have great potential to change the way English is learnt in the future. The innovations offered by IoT can help students practice in everyday contexts. The simple cloud storage system allows users to implement IoT easily. IoT also gives users easy access to anytime and anywhere. The virtual reality access provided can accommodate various student responses which can make it easier for teachers to identify students' enthusiasm in using IoT as a learning medium.

Finding and Discussion

Based on the results of research from Chen & Huang (2021) with the research title "Research and Application of the Interactive English Online Teaching System Based on the Internet of Things" which has designed and developed an interactive online English teaching system based on IoT. This system is designed to improve the quality and effectiveness of online English learning by reducing access time to teaching materials, increasing student test scores, and providing an interactive learning experience that can be accessed at any time. In addition, the system is designed to fulfil the needs of students and teachers in a flexible and secure teaching environment, and improve the reliability and consistency of the teaching process. The implementation of IoT in this learning system was declared successful. This system has an internal consistency reliability that is considered quite high, reaching 96%.

Despite the advantages, IoT still has some obstacles, such as limited data security and protection, limited self-learning, and technical complexity. These things will continue to be improved over time with various evaluations that can be done.

The research from Nai (2022) with the title "The design of smart classroom for modern college English teaching under Internet of Things". This article discusses the improvement of English teaching efficiency in modern colleges by building an IoT-based smart classroom system. The application of IoT in the smart classroom system for college English teaching developed in this study was declared successful. The experimental results show that the IoT-based smart platform is able to improve system stability, reduce the average response time to 3.65 seconds when the number of users reaches 500, and lower the CPU and memory usage rate. In addition, the use of the IoT-based smart classroom was shown to improve student test results, especially for low-performing students, thereby reducing the achievement gap in the classroom. These results show that the application of IoT can effectively improve efficiency, stability, and learning experience in college English teaching.

This study also identified some shortcomings in the application of IoT to smart classroom systems, namely system security and constraints, user experience, and maintenance management technical standards. These shortcomings and advantages will also continue to be improved so as to achieve the optimal performance of IoT.

Research conducted by Huani Chen and Jian Huang and Ruihua Nai provides insight into the potential and challenges of integrating IoT in English language teaching. Both show the successes and limitations of IoT-based solutions in educational environments, especially in improving the teaching-learning experience for English language learners. In terms of implementation success, the application of IoT in both studies provided significant improvements in learning quality and system performance. The system developed by Huani Chen and Jian Huang focuses on improving the overall online learning experience by reducing access time to teaching materials, improving student test scores, and providing an interactive learning platform that can be accessed at any time. In addition, the system achieved a high reliability rate of 96%, demonstrating the potential of IoT in improving consistency in teaching and learning environments. On the other hand, Ruihua Nai's research focusing on a smart classroom system for college English teaching showed improved system stability, fast response times, and effective resource management, with response times reaching 3.65 seconds for 500 users. These improvements not only enabled more effective learning sessions, but also helped reduce the achievement gap by improving the learning outcomes of low-achieving students.

Despite the prominence of IoT in educational environments, both studies also found challenges that affect the full optimisation of IoT-based systems. Huani Chen and Jian Huang identified challenges in data security and protection, limitations of self-learning, and technical complexities of IoT that need to be further addressed. Meanwhile, Ruihua Nai's research highlights the need for improvements in system security, user experience, and maintenance management standards in IoT-based smart classroom systems. These limitations point to the need to balance technological advancement with practical user experience and strong security measures. Both studies emphasise the importance of continuous evaluation and development for IoT systems to achieve optimal performance in teaching environments.

Conclusion

In conclusion, this article has outlined the transformative potential of IoT in English language learning, emphasizing its ability to create interactive and personalized educational experiences. By facilitating real-time feedback and collaboration, IoT can significantly enhance student engagement and performance. However, challenges such as cost, data security, and the need for teacher training must be addressed to ensure effective implementation. To fully realize IoT's advantages, further research is recommended to explore cost-effective solutions and develop IoT-based curricula, along with comprehensive training programs for educators, thereby fostering a more accessible and effective language learning environment.

References

Ahmed, G., Tayyub, M., & Ismail, R. (2020). Effects of Classroom Environment for Improving Students' Learning at Secondary Level in Punjab Province, Pakistan. *Sci Academique*, *1*(1), 2–15. https://scienceacademique.com/effects-of-classroom-environment-for-improving-students-learning-at-secondary-level-in-punjab-province-pakistan/

Ahuja, K., & Bala, I. (2021). Role of artificial intelligence and IoT in next generation education system. *Intelligence of Things: AI-IoT Based Critical-Applications and Innovations*, 189–208. https://doi.org/10.1007/978-3-030-82800-4_8

Aldowah, H., Ul Rehman, S., Ghazal, S., & Naufal Umar, I. (2017). Internet of Things in Higher Education: A Study on Future Learning. *Journal of Physics: Conference Series*, *892*(1), 12017. https://doi.org/10.1088/1742-6596/892/1/012017

Badshah, A., Rehman, G. U., Farman, H., Ghani, A., Sultan, S., Zubair, M., & Nasralla, M. M. (2023). Transforming educational institutions: harnessing the power of internet of things, cloud, and fog computing. *Future Internet*, *15*(11), 367.

Bingimlas, K. A. (2009). Barriers to the successful integration of ICT in teaching and learning environments: A review of the literature. *Eurasia Journal of Mathematics, Science and Technology Education*, *5*(3), 235–245. https://doi.org/10.12973/ejmste/75275

Chen, H., & Huang, J. (2021). Research and application of the interactive English online teaching system based on the internet of things. *Scientific Programming*, *2021*(1), 3636533.

Chiang, Y. hui V., Cheng, Y. W., & Chen, N. S. (2023). Improving Language Learning Activity Design through Identifying Learning Difficulties in a Platform Using Educational Robots and IoTbased Tangible Objects. *Educational Technology and Society*, *26*(3), 84–100. https://doi.org/10.30191/ETS.202307_26(3).0007

Fang, Y., Luo, X., & Lu, J. (2023). A review of research on the impact of the classroom physical environment on schoolchildren's health. *Journal of Building Engineering*, *65*, 105430. https://doi.org/10.1016/j.jobe.2022.105430

Fitria, T. N., & Simbolon, N. E. (2023). Internet of Things (IoT) in Education: Opportunities and Challenges. *Prosiding Seminar Nasional & Call for Paper STIE AAS*, *6*(1).

Gupta, B. B., & Quamara, M. (2020). An overview of Internet of Things (IoT): Architectural aspects, challenges, and protocols. *Concurrency and Computation: Practice and Experience*, *32*(21), e4946. https://doi.org/10.1002/cpe.4946

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Hankerson Cody Venzke Elizabeth Laird Hugh Grant-Chapman Dhanaraj Thakur, D. L., Holden Williams, L., Montz, B., Quay-de la Vallee, H., Jain, S., & Hoagland, T. (2021). *Student Privacy Implications of School-Issued Devices and Student Activity Monitoring Software A report from*. https://cdt.org/insights/

Hayashi, V. T., Arakaki, R., & Ruggiero, W. V. (2020). OKIoT: Trade off analysis of smart speaker architecture on open knowledge IoT project. *Internet of Things (Netherlands)*, *12*, 100310. https://doi.org/10.1016/j.iot.2020.100310

Holler, J., Tsiatsis, V., Mulligan, C., Karnouskos, S., Avesand, S., & Boyle, D. (2014). *Internet of things*. Academic Press.

Holozsai, J., & József, H. (2024). *Aspects of digital learning among foreign language learners in secondary education*.

Kadhim, K. T., Alsahlany, A. M., Wadi, S. M., & Kadhum, H. T. (2020). An Overview of Patient's Health Status Monitoring System Based on Internet of Things (IoT). *Wireless Personal Communications*, *114*(3), 2235–2262. https://doi.org/10.1007/s11277-020-07474-0

Kopetz, H., & Steiner, W. (2022). Internet of things. In *Real-time systems: design principles for distributed embedded applications* (pp. 325–341). Springer.

Lampropoulos, G., Siakas, K., & Anastasiadis, T. (2019). Internet of things in the context of industry 4.0: An overview. *International Journal of Entrepreneurial Knowledge*, *7*(1).

Minoli, D., Sohraby, K., & Occhiogrosso, B. (2017). IoT Considerations, Requirements, and Architectures for Smart Buildings-Energy Optimization and Next-Generation Building Management Systems. *IEEE Internet of Things Journal*, *4*(1), 269–283. https://doi.org/10.1109/JIOT.2017.2647881

Nai, R. (2022). The design of smart classroom for modern college English teaching under Internet of Things. *Plos One*, *17*(2), e0264176.

Nanade, S., & Nanade, A. (2023). Internet of Things (IoT) and Its Important Role In The Progress of Education. *Journal of Namibian Studies: History Politics Culture*, *33*, 2197–5523.

Nižetić, S., Šolić, P., López-de-Ipiña González-de-Artaza, D., & Patrono, L. (2020). Internet of Things (IoT): Opportunities, issues and challenges towards a smart and sustainable future. *Journal of Cleaner Production*, *274*, 122877. https://doi.org/10.1016/j.jclepro.2020.122877

Shafique, K., Khawaja, B. A., Sabir, F., Qazi, S., & Mustaqim, M. (2020). Internet of things (IoT) for next-generation smart systems: A review of current challenges, future trends and prospects for emerging 5G-IoT scenarios. *Ieee Access*, *8*, 23022–23040.

Syed, A. S., Sierra-Sosa, D., Kumar, A., & Elmaghraby, A. (2021). Iot in smart cities: A survey of technologies, practices and challenges. *Smart Cities*, *4*(2), 429–475. https://doi.org/10.3390/smartcities4020024

Tariq, R., Casillas-Muñoz, F., Hassan, S., & Ramírez-Montoya, M. (2024). Synergy of Internet of Things and education: Cyber-physical systems contributing towards remote laboratories, improved learning, and school management. *Journal of Social Studies Education Research*, *15*(2), 305–352.

Tran, M. S., & Nguyen, M. T. (2023). The trend of using smart teaching devices in education in Vietnam. *GPH-International Journal of Educational Research*, *6*(10), 1–16.

Vaza, R. N., Parmar, A. B., Mishra, P. S., Abdullah, I., & Velu, C. M. (2024). Security And Privacy Concerns In AI-Enabled Iot Educational Frameworks: An In-Depth Analysis. *Educational Administration: Theory and Practice*, *30*(4), 8436–8445.

Willis, B. D. (1994). *Distance education: Strategies and tools*. Educational Technology.

Yu, Z., Yu, L., Xu, Q., Xu, W., & Wu, P. (2022). Effects of mobile learning technologies and social media tools on student engagement and learning outcomes of English learning. *Technology, Pedagogy and Education*, *31*(3), 381–398. https://doi.org/10.1080/1475939X.2022.2045215