

ISSN 2821-9074 (Online)

ISSN 2730-2601 (Print)

RICE Journal of Creative Entrepreneurship and Management, Vol. 5, No.3, pp. 70-76,

September-December 2024

© 2024 Rajamangala University of Technology Rattanakosin, Thailand

doi: 10.14456/rjcm.2024.18

Received 11.05.24/ Revised 29.10.24/ Accepted 30.11.24

Academic Paper

**Internet of Things (IoT) Technology
for a Creative Intelligent Interactive Classroom**

Thanarak Santhuenkaew

Faculty of Education

Ramkhamhaeng University, Bangkok, Thailand

Thanarak.s@rumail.ru.ac.th

Abstract

The new era of digital technology has revealed its important role in every aspect of life. The application of technology in the education sector is essential to modernize the efficiency and quality of learning. One technology that is gaining a lot of attention for use in the classroom is the Internet of Things (IoT), a system that connects electronic devices and tools to be able to exchange information and execute tasks between them. This paper reports the IoT implementation in the classroom how it helps create intelligent and interactive learning environments that can respond to the needs of each student. The key elements are discussed: (1) installing sensors and behavioral tracking devices to collect data, (2) processing data with cloud and artificial intelligence, (3) providing advice on how to optimize the environment, teaching process, and activities. and (4) creating interactions between teachers, students, and various devices through control and display devices. Smart classrooms and IoT interactions monitor and optimize the environment by tracking and analyzing learner behavior in order to provide individual study advice and motivate learners through interesting interactions. The expected learning experience as such, however, still carries some limitations and challenges in many areas that must be taken into account, such as investment budget, technical complexity and security, and privacy issues. But overall, IoT is considered one of the most interesting innovations for educational reformation in the digital age.

Keywords: *Internet of Things, smart classroom, interactive learning environment, quality of learning*

1. Introduction: Background

The world has fully entered the digital age in which digital technology has played an important role in every aspect of life. Technology is used to support the learning process for efficiency, motivate and enhance the learning experience even further (Ejaz & Anpalagan, 2019; Phakamach & Senarith, 2022). One of the technologies with high potential to be used in the classroom is the Internet of Things (IoT) technology.

IoT is the concept of connecting various electronic devices into the internet system. This allows those devices to send and receive data, command work, and control each other's work. This technology has great potential to be applied to create smart and

interactive learning environments that can respond and adapt to the needs of individual learners (Qiao, 2020; Ghashim & Arshad, 2023).

Using IoT in the classroom will allow tracking and analyzing the learning behavior of students. Teachers can monitor and adjust the environment to suit learning, such as temperature, lighting, noise levels, and air quality in the classroom. IoT systems can also make recommendations and adjust content, activities, and teaching methods to suit abilities and learning styles of each student with a smart system that can interact with students closely. It will help create an interesting learning atmosphere, increase motivation and significantly raise the level of learning efficiency (Digital Government Development Agency, 2022)

In addition, IoT allows students to more conveniently access information and interact with lessons through various mobile devices, such as tablets and smartphones - promoting blended learning between classroom and outside classroom. With these benefits, IoT helps raise the quality of education to modernity and effectively meet the needs of today's learners (Ejaz & Anpalagan, 2019). Although the application of IoT in the education sector is relatively new and presents challenges in many areas, including budget, technical, and security aspects, but such technology can offer options for educational reform in the digital age for a new and modern learning experience (Phakamach & Senarith, 2022). IoT responds to the needs of learners in the digital age and increases the educational competitiveness of the country by leaps and bounds.

In this paper, the author reports the IoT implementation in the classroom how it helps create intelligent and interactive learning environments that can respond to the needs of each student. The author will also discuss the key elements: (1) installing sensors and behavioral tracking devices to collect data, (2) processing data with cloud and artificial intelligence, (3) providing advice on how to optimize the environment, teaching process, and activities. and (4) creating interactions between teachers, students, and various devices through control and display devices. Emphasis will be on smart classrooms and IoT interactions monitored and optimized for the learning environment, but still with some limitations and challenges that deserve attention from teachers and school administrators concerned.

2. Definition of IoT and Its Application in the Education Sector

IoT is a system that consists of various devices and tools that can connect to the internet and exchange information with each other in the education sector Applications of IoT can take many forms, such as:

(1) Sensor equipment:

Sensors can be installed to measure classroom environments, such as temperature, humidity, air quality, noise levels, and adjust the environment to suit learning.

(2) Devices for tracking student behavior:

Video cameras and motion sensors are used to collect behavioral data level of intention and student interaction during teaching and learning.

(3) Interactive devices:

Smart screens tablets or smartphones can be connected to the IoT system to receive data from various sensors and send data back to control other devices.

3. Creating a Smart and Interactive Classroom with IoT

Creating an intelligent interactive classroom using Internet of Things (IoT) technology consists of the following key elements:

(1) Connecting IoT devices

- Install various sensor devices, such as sensors to measure temperature, humidity, air quality, and sound level in the classroom area.

- Install equipment for tracking student behavior, such as video cameras and motion sensors.

- Install interactive devices, such as smart displays, tablets, smartphones for displaying and receiving commands.

- Connect these IoT devices to the cloud and shared internet networks.

(2) Data collection and processing

- Data from sensors and behavioral tracking devices is continuously sent to the cloud

- Statistical and artificial intelligence techniques, such as machine learning are used to process and analyze the data.

- Analyze data to understand each student's environment, behavior, and problems.

(3) Giving advice and improvements

- The system will process information and provide recommendations for improvement and control as follows:

- (i) Adjust the physical environment to be suitable for learning, such as controlling temperature, lighting, and air quality.

- (ii) Adjust the teaching process, content, activities, and teaching methods to suit the abilities and learning styles of each student.

- (iii) Provide advice to teachers and students to improve their weaknesses and develop their learning potential.

(4) Interaction

- Teachers and students can interact with the system through various devices, such as:

- (i) View environmental information, instructions and other information on display.

- (ii) Send commands to control other devices, such as adjusting the temperature and lighting levels.

- (iii) Interact with the system through voice or other means.

- (iv) Create a more lively and interesting learning atmosphere.

These processes will help create smart classrooms that can adapt to the situation. Teachers can track and analyze each student in detail as well as create interaction and learning motivation for students.

4. The Key Elements of Implementing IoT in the Classroom to Create an Intelligent Interactive Learning Environment

The key elements are as follows:

(1) Connecting IoT devices: Installing sensors and control devices in the classroom, and connecting them to the cloud and the internet.

(2) Data collection and analysis: Data from IoT devices is sent to the cloud and processed, using statistical algorithms and artificial intelligence.

(3) Providing suggestions and improvements: The system analyzes the data and sends suggestions to adjust the environment, teaching process and various activities as appropriate for each student.

(4) Interaction: Teachers and learners can interact with IoT devices through various displays or controls—in receiving information and sending orders.

5. Benefits of Smart Interactive Classroom and IoT

Applying Internet of Things (IoT) technology to create an intelligent interactive classroom has important benefits:

(1) Create an environment suitable for learning

- IoT systems can monitor and adjust the physical environment in the classroom, such as temperature, lighting, air quality, and noise levels, to a level appropriate for continuous learning.

- IoT systems help create a learning environment that is comfortable and conducive to student perception and memory.

(2) Track and analyze student behavior in detail

- Behavior tracking devices, such as video cameras, motion sensors can collect data on each student's behavior and level of learning intention.

- These data will be analyzed to understand the problems, strengths and weaknesses in students' learning style and the specific needs of individual learners.

(3) Adjust the teaching and learning process to suit individual differences

- From data analysis, the system provides recommendations for adjusting the teaching process, activities, and content to suit each student's abilities and learning style.

- The system helps learners receive learning according to their individual potential and needs, resulting in higher learning efficiency.

(4) Increase interaction and motivation for learning

- Teachers and students can interact with the IoT system through various devices, such as displays and tablets.

- Teachers and students can control and operate the equipment by themselves--making the learning environment livelier and more interesting for better learning motivation.

(5) Raise the quality and achievement of education

- Creating the right environment for individual teaching, and increasing students' motivation. This will result in learners progressing and achieving their learning goals as expected.

- Overall, smart interactive classrooms can effectively improve students' learning quality and achievement in education.

Therefore, applying IoT in the classroom is very useful in creating a new learning environment that meets the needs of today's learners. Promoting individual learning leads to good learning motivation and significantly raise educational achievement levels.

Table 1: Examples of Applications of Internet of Things (IoT) Technology for Intelligent Interactive Learning

Devices/ IoT Technology	Description	Benefits for Learning
1. Smart Monitor	Large display that can receive commands via touch or voice.	Display lesson content and multimedia in an interesting way. Increase interaction between students and lessons.
2. Motion Sensor	Installed in various areas of the classroom.	Detect student movement, assess student interest and participation levels to adjust teaching methods appropriately.
3. Closed-circuit Camera	A camera that can track movement and record video.	Analyze the learning behavior of students, such as their level of intention, problems encountered, etc.
4. Tablet or Portable Computer.	Devices that students can connect to the IoT system.	In the classroom, students can access lesson content, do exercises, and interact with the lesson.
5. Temperature and Lighting Control System	Control the temperature and lighting levels in the classroom through the IoT system.	Create an appropriate learning atmosphere. Help students concentrate and increases learning efficiency.
6. Mobile Learning Application	Applications that connect to IoT systems in the classroom.	Allow students to access lesson content, do exercises, and receive additional guidance. through their mobile phones.

Table 1 shows IoT Technology applied in the classroom can help create a learning environment that is modern, interesting, and more interactive among students. This will result in students being motivated to learn and feel positive toward the lesson content.

6. How to Apply IoT in the Classroom to Create an Intelligent Interactive Learning Environment

(1) Class attendance monitoring system: Install classroom entrance and exit sensors. Connect to the database system to record the entry and exit times of each student. Help track attendance statistics accurately.

(2) System for adjusting the environment within the classroom: Using sensors to measure temperature, humidity, air quality, controlling the air conditioning system and lighting to be appropriate for teaching and learning.

(3) Teaching assistance system: Use robots, display screens to facilitate teaching, such as displaying information, accompanying videos, or voice control.

(4) Apps for students: Develop apps for mobile phones and tablets so that students can interact, do exercises, and access information on the cloud to learn at any time.

(5) Learning behavior analysis system: Take data from various sensors, such as physical activity and concentration to analyze behavior in order to adjust teaching methods to suit individual learners.

7. Limitations and Challenges in Using IoT in the Classroom

Although IoT has many benefits, there are still some limitations and challenges that need to be considered, including:

(1) Initial investment cost: Installing IoT devices and data processing systems is rather expensive, especially in the beginning.

(2) Technical challenges: Collecting, integrating, and analyzing data from multiple devices can be complex and require skilled personnel.

(3) Security and Privacy Issues: Data leakage or use by unauthorized persons may bring about privacy issues.

(4) Technology Growth Rate: The continued development of IoT technology can quickly cause installed devices and systems to become outdated.

It is vitally important to recognize that technology when applied to education requires good planning, clear-cut performance objectives, corresponding lesson plans and learning activities, learners' feedback and relevant methods of assessment and evaluation for target performances (Santhuenkaew, 2023). Students' satisfaction and follow-ups on different learning stages must be realistically managed by teachers or assigned authorities (Chanprasert, 2021). Technology when applied in the classroom needs to fit in the types of subject matters, like sciences, mathematics, languages, arts, and social sciences (Visaltanachoti, 2022; Santhuenkaew, Jaikaew & Athikiat, 2024). As known among teachers, technology could help students in terms of their adjustment in learning paces and time for sharing and interaction with their peers. These could help justify the implementing methods for education-based technology in support of students' learning as an ultimate goal.

8. Conclusion

To the author of this paper, Internet of Things (IoT) technology has great potential to create intelligent and interactive learning environments. Implementing IoT devices in the classroom can help track and analyze student behavior as instant feedback to teachers. It is essential to adjust the physical environment and learning activities to suit individual learners as well as increase their motivation and interaction in the classroom. However, teachers should note some limitations and challenges when implementing IoT at the classroom level. Above all, IoT has arrived as an option worth adapting in support of our students' learning in the digital age.

9. The Author

Thanarak Santhuenkaew is a lecturer in the Faculty of Education Ramkhamhaeng University, Bangkok, Thailand. The author has his research interest in the areas of educational technology for guidance, counseling, and instruction, as well as current issues in technology-based learning management.

10. References

Chanprasert, K. (2021). Learners' satisfaction with online teaching and learning management in a physics course. *RICE Journal of Creative Entrepreneurship and Management*, 2(2), 56-68. doi 10.14456/rjcm.2021.29.

Digital Government Development Agency. (2022). Thai language manual for digital technology. (Online). <https://www.dga.or.th/th/profile/7551>, March 19, 2024.

Ejaz, W. & Anpalagan, A. (2019). Internet of things for smart cities. *Internet of Things for Next-Generation Smart Systems*. New York: Springer, 17-30. doi:10.1007/978-3-319-95037-2_2

Ghashim, I.A. & Arshad, M. (2023). Internet of Things (IoT)-based teaching and learning: Modern trends and open challenges. *Sustainability*, 2023, 15, 15656. (Online). <https://doi.org/10.3390/su152115656>, February 23, 2024.

Phakamach, P. & Senarith, P. (2022). The metaverse in education: The future of immersive teaching & learning. *RICE Journal of Creative Entrepreneurship and Management*, 2022, 3(2), 75-88. doi 10.14456/rjcm.2022.12

Qiao X. (2020). Integration model for multimedia education resource based on internet of things. *International Journal of Continuing Engineering Education and Life Long Learning*, 2020, 31(1) 17-35. (Online). <https://doi.org/10.1504/IJCEELL.2021.111849>, March 23, 2024.

Santhuenkaew, T. (2023). Guidelines for organizing computer science courses at the elementary level. *RICE Journal of Creative Entrepreneurship and Management*, 2023, 4(2), 78-88. doi 10.14456/rjcm.2023.12

Santhuenkaew, T., Jaikaew, S. & Athikiat, K. (2024). Information technology for school guidance. *RICE Journal of Creative Entrepreneurship and Management*, 2024, 5(1), 78-88. doi:10.14456/rjcm.2024.6

Visaltanachoti, C. (2022). The use of algorithm system model in teaching English to Thai students. *RICE Journal of Creative Entrepreneurship and Management*, 2022, 3(1), 45-54. doi 10.14456/rjcm.2022.5