

The New Concept Of 'Education 5.0' Integrates AI, Blockchain, XR, And IoT To Create Highly Personalised, Collaborative Learning That Focuses On Students' Emotional Well-being

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ABSTRACT

The Industrial Revolution 5.0 is driving the world of education to transform towards Education 5.0, a learning paradigm that emphasises a personalised, collaborative, and holistic approach by integrating advanced technologies such as Artificial Intelligence (AI), Blockchain, Extended Reality (XR), and the Internet of Things (IoT). This study aims to explore the implementation of the Education 5.0 concept in higher education settings and assess its impact on personalised learning and students' emotional well-being. The method used is a qualitative approach with case studies on three study programmes at private universities in Indonesia that have implemented Education 5.0 technology elements. The research findings indicate that AI integration can enhance the adaptability of teaching materials, Blockchain provides transparency and security for academic data, XR enriches learning experiences through interactive simulations, and IoT supports a responsive learning environment. In addition to deepening conceptual understanding, the application of these technologies also positively contributes to students' learning motivation and psychological well-being. These findings reinforce the urgency of shifting the educational paradigm toward a more humanistic, technology-based approach that aligns with the needs of the Society 5.0 era.

Keywords: Education 5.0, Artificial Intelligence, Blockchain, XR, IoT, personalised learning, emotional well-being.

Article Info:

Submitted: 12 March 2025

Reviewed: 10 April 2025

Accepted: 15 Mei 2025

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1. INTRODUCTION

Education in the 21st century has undergone a significant paradigm shift in line with the rapid development of digital technology. While education previously focused on linear knowledge transfer (Education 1.0 to 4.0), the education sector is now entering a transformative phase toward Education 5.0—a concept that not only emphasises mastery of technology but also balances cognitive, social, emotional, and humanistic aspects. Education 5.0 emerges as a response to the challenges of the Society 5.0 era, which prioritises collaboration between humans and intelligent machines to enhance the overall quality of human life.

The Education 5.0 concept integrates various cutting-edge technologies such as Artificial Intelligence (AI), Blockchain, Extended Reality (XR), and the Internet of Things (IoT) to create a learning ecosystem that is personalised, collaborative, inclusive, and focused on the emotional well-being of learners. In this context, students are not merely recipients of educational content but active participants who shape and adapt their learning processes through adaptive and real-time systems. AI is used to analyse individual learning styles and automatically tailor content. Blockchain ensures the security and transparency of the evaluation system and digital certification. XR expands learning experiences through immersive and interactive simulations, while IoT enables the creation of smart learning spaces that dynamically respond to user needs.

A. *Problem Statement*

Based on the background described above, the research questions in this study are as follows:

- a) How is the Education 5.0 concept, which integrates AI, Blockchain, XR, and IoT technologies, implemented in higher education?
- b) How does the integration of these technologies affect the personalization of student learning?
- c) To what extent does the implementation of Education 5.0 contribute to improving students' emotional well-being in the learning process?
- d) What are the challenges and opportunities faced in implementing the Education 5.0-based learning model in higher education institutions?

B. *Research Objectives*

- a) Describe the implementation of the Education 5.0 concept in higher education, particularly the integration of AI, Blockchain, XR, and IoT technologies.
- b) Analyze the impact of Education 5.0 technology integration on the personalization of the student learning process.
- c) Identify the contribution of the Education 5.0 model to student emotional well-being.
- d) Revealing the challenges and adaptation strategies of higher education institutions in facing the era of Education 5.0-based learning.

C. *Benefits of Research*

1) Theoretical Benefits

- This study contributes to the development of theoretical studies related to 21st century learning, particularly in strengthening the Education 5.0 paradigm that integrates technology and humanistic approaches. The results of this study can enrich the literature on personalised digital learning innovation and emotional well-being.

2) Practical Benefits

- **For Educational Institutions:** Providing strategic input in designing and implementing user-friendly, state-of-the-art technology-based learning systems for students.
- **For Lecturers and Teachers:** A guide to designing more interactive, personalised, and adaptive learning experiences using technology.
- **For Students:** Encouraging active participation, increasing motivation, and strengthening learning skills relevant to the future world of work.

D. *Theoretical Framework*

- The Concept of Education 5.0

Education 5.0 is a learning paradigm developed in response to Society 5.0, with an emphasis on the synergy between technology and human values. According to [1], Education 5.0 requires a personalised, adaptive, and inclusive learning approach that supports the emotional well-being of learners.

- Artificial Intelligence (AI) in Learning

AI is used to identify student learning patterns and automatically present relevant content. The theory underlying this approach is Adaptive Learning Theory [2], which states that personalized instruction improves learning effectiveness.

- Blockchain in the Education System

Blockchain technology provides a secure and transparent digital recording system for certification, credentials, and learning outcome evaluation. This concept is in line with the Decentralized Trust System theory, which emphasizes trust based on open technology [3].

- Extended Reality (XR)

XR combines virtual reality (VR) and augmented reality (AR) to create an immersive and exploratory learning experience. The theory behind it is Experiential Learning Theory [4], which states that effective learning occurs when learners experience the learning context firsthand.

- The Internet of Things (IoT) in Education

IoT supports smart classrooms that enable real-time interaction between devices and students. The relevant theory is Connectivism [5], which emphasises the importance of network connections in modern learning.

2. LITERATURE REVIEW

A. Basic Concepts of Education 5.0

Education 5.0 is a new paradigm in the global education system that has emerged in response to the transformation of society towards Society 5.0. This concept combines advances in digital technology with humanistic values to create a personalized, adaptive, and collaborative learning system. According to Sakurai [6], Education 5.0 is not merely an evolution of Education 4.0, which focused on technology, but also a revolution in educational values that places humans at the center and technology as a supporting tool.

In Education 4.0, the learning approach focuses on content digitization Education 4.0, the learning approach focuses on content digitization, Learning Management Systems (LMS), and open access to knowledge. However, Education 5.0 goes beyond this approach by introducing a learning system that integrates Artificial Intelligence (AI), Blockchain, Extended Reality (XR), and the Internet of Things (IoT) to create a more immersive, connected, and personalized learning experience. Tion, Learning Management Systems (LMS), and open access to knowledge. However, Education 5.0 goes beyond this approach by introducing a learning system that integrates Artificial Intelligence (AI), Blockchain, Extended Reality (XR), and the Internet of Things (IoT) to create a more immersive, connected, and personalized learning experience.

B. Artificial Intelligence (AI) in Personalized Learning

Artificial Intelligence (AI) is a key pillar in supporting personalised learning within the Education 5.0 framework. AI enables learning systems to analyse student learning preferences, evaluate academic progress, and recommend materials tailored to individual needs. According to Holmes et al. [7], AI in education can detect learning gaps and automatically adjust the content presented to students.

AI is also used to create intelligent tutoring systems (ITS), educational chatbots, and machine learning-based automatic evaluation systems. In line with the adaptive learning approach, students no longer receive uniform material, but rather dynamic content tailored to each individual's learning pace and style.

In the context of emotional well-being, AI is capable of monitoring users' facial expressions, voices, and behaviour through camera- and microphone-based systems to detect stress or boredom, and suggest appropriate learning interventions. [8][9]

C. Blockchain in Education Security and Transparency

Blockchain is widely known in the financial sector, but is now being adopted in higher education to improve security, accountability, and transparency in academic record-keeping. Blockchain-based systems enable digital certification, student achievement records, and evaluation results to be stored in a decentralised, immutable network.

According to Sharples and Domingue [3], blockchain has the potential to replace traditional systems such as diplomas and academic transcripts with blockchain-based credentials that are more secure and globally verifiable without intermediaries. This increases trust in academic data and reduces the risk of educational document fraud.

Furthermore, blockchain enables the emergence of the concept of a learning passport—a system that records every learning process and outcome of students, both formal and informal. This supports lifelong learning and portfolio-based competency recognition.

D. Extended Reality (XR) for Immersive Learning

XR is a combination of Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR). This technology enables students to experience learning simulations in virtual environments or the real world enriched with digital elements. XR is widely used in the fields of engineering, medicine, design, and vocational training.

The use of XR encourages experiential learning approaches, such as virtual surgery practice, chemistry lab exploration, or crisis management simulations. According to Radianti et al. [11], XR can increase learning motivation, facilitate the mastery of complex concepts, and create social interaction in a collaborative digital environment.

In the context of emotional well-being, XR has also been shown to aid in virtual therapy, immersive meditation, and empathy simulations, which can reduce learning anxiety and increase engagement[12].

E. The Internet of Things (IoT) in Creating a Smart Learning Environment

IoT enables data collection from various devices and learning environments to create a smart learning ecosystem. In an IoT-based classroom, sensors can monitor light, temperature, noise levels, or even student emotions through wearable devices, and automatically adjust the learning environment accordingly.

IoT systems can be used to monitor student attendance, physical activity, and cognitive responses to learning. This enables teachers and lecturers to make data-driven teaching decisions in real time.

According to Khan et al. [13], the integration of IoT in education supports project-based, interactive, and connected learning. In the context of Education 5.0, IoT is the basis for creating student-centred, responsive learning spaces that support students' comfort and emotional well-being [14].

F. Emotional Well-being in Modern Learning

Emotional well-being is an important dimension that is often overlooked in conventional education systems. In Education 5.0, students' emotional well-being becomes an integral part of the learning process, with a pedagogical approach that focuses on empathy, motivation, and stress management.

According to Huppert [15], emotional well-being includes positive feelings, resilience, healthy social relationships, and meaning in daily activities. When students feel connected, valued, and receive appropriate support, they are more likely to succeed academically and develop as individuals.

The application of technologies such as AI and XR in Education 5.0 enables monitoring of students' emotional states and provides adaptive interventions, such as sentiment analysis, visualisation of learning behaviour data, and even VR-based immersive therapy. Technology becomes a tool for creating empathetic and humanistic learning. [15]

G. Collaboration and Interdisciplinarity in Education 5.0

Future education requires the ability to work collaboratively in multicultural and multidisciplinary environments. Education 5.0 promotes teamwork through AI-based digital platforms, XR forums, and transparent blockchain assessment systems.

Interdisciplinary collaboration is important in project-based learning, and technology supports this collaboration without the constraints of space and time. Students from different countries or study programmes can work together in a virtual space, developing solutions to complex real-world problems [16].

H. Criticism and Challenges in Implementing Education 5.0

Despite its great potential, the implementation of Education 5.0 also faces serious challenges. Some of these include:

- Inequality of access to technology in 3T (underdeveloped, frontier, and outermost) regions
- Readiness of educators and digital infrastructure.
- Data ethics and security, especially in the use of AI and IoT.
- Resistance to change in traditional learning culture.

Therefore, a gradual and inclusive approach is needed to ensure that the transformation towards Education 5.0 is not exclusive and detrimental to certain groups. [17] [18]

3. METHOD

A. Type of Research

This study uses a qualitative-descriptive approach with a case study method, aiming to explore the implementation of Education 5.0 in higher education environments and analyse its impact on personalised learning and student emotional well-being.

This type of research was chosen to gain an in-depth understanding of the integration process of AI, Blockchain, XR, and IoT technologies, as well as the perceptions of students and lecturers regarding the learning experiences generated.

B. Research Location and Subject

This research was conducted in three study programmes at a private university in Indonesia that has implemented some or all elements of Education 5.0 (e.g. the use of AI-based LMS, blockchain for digital certification, or XR for virtual laboratories)

Research subject:

- 15 students (from three different study programmes)
- 3 lecturers teaching related subjects
- 1 university Learning Management System (LMS) administrator

C. Data Collection Techniques

Data was collected using the following techniques:

- In-depth interviews

Conducted with students and lecturers to find out their experiences, perceptions, and the impact of technology use in learning.

- Participatory observation

Conducted during the learning process to observe the implementation of AI, XR, Blockchain, and IoT technologies in the classroom.

- Documentation

Collection of documents related to curriculum, learning materials, digital certification, and evaluation systems using blockchain technology.

- Literature study

Collection of secondary data through journals, books, and relevant research reports related to the concept of Education 5.0.

D. Research Instruments

The main instruments used in this study were:

- Structured and semi-structured interview guides
- Observation sheets
- Data documentation templates
- Field notes

E. Methods of Data Analysis

The collected data were analyzed using an interactive analysis model from [19], which consists of three main stages:

- Data Reduction

The process of filtering and grouping data according to theme: technology implementation, personalized learning, collaboration, and emotional well-being.

- Data Presentation

The data is presented in the form of matrices, narratives, and diagrams to facilitate interpretation of the research results.

- Conclusion and Verification

Reflection was conducted on the patterns that emerged and verified with data triangulation to ensure the validity of the findings.

F. Data Validity

To maintain data validity and reliability, several techniques were used:

- Source triangulation: comparing data from students, lecturers, and LMS administrators.
- Member check: confirming interview results with respondents.
- Audit trail: systematic documentation of the research process.

G. Research Limitations

This study is limited to the implementation of Education 5.0 in the context of private higher education in Indonesia.

The focus of the research is on the integration of AI, Blockchain, XR, and IoT without discussing the technical development of the technology. The emotional well-being of students is measured qualitatively based on the perceptions and narratives of respondents, not through formal psychometric measurements. (1)

Below is the compiled examples of interview and observation instruments for research on the theme of Education 5.0, which focuses on the integration of AI, Blockchain, XR, and IoT in creating personalized, collaborative learning that is oriented toward students' emotional well-being:

- **Interview Instrument (For Students and Lecturers)**

Part I. General Information on Respondents

Name:

Status: Lecturer / Student

Study Program:

Experience using digital learning systems (in years):

Part II. List of Interview Questions

1. Technology Implementation

Have you ever used a learning system that implements AI, Blockchain, XR, or IoT on campus?

What learning technologies do you use most often in class?

What is your opinion on the use of technologies such as XR (virtual labs, AR) in the learning process?

Does the learning system you use tailor the material to your needs? If so, how does the process work?

2. Personalized Learning

Do you feel that the learning materials or methods used in class are tailored to your personal needs?

When using AI-based systems, do you receive automatic recommendations for learning materials?

Do you feel that the existing learning system helps you learn more independently?

3. Collaboration and Interaction

How does the use of digital technology (online forums, virtual reality, or other) affect your collaboration with classmates?

Do you feel that communication between students and lecturers is easier with this technology?

4. Impact on Emotional Well-being

Does the use of technology-based learning systems help you feel more comfortable, motivated, or burdened?

Have you ever felt depressed, anxious, or stressed because of the digital systems used in learning?

Do you feel more noticed as an individual in the learning process that uses technology?

5. Challenges and Expectations

What are the main obstacles you encounter when using this learning technology?

In your opinion, what needs to be improved in the current digital learning system?

What are your expectations for the learning system in the future?

- Observation Instruments

Observation Sheet Format

No	Observed Aspect	Observation Indicators	Description / Notes
1	Use of AI	The learning system displays material recommendations/automatic personalization.	
2	Use of Blockchain	Blockchain-based certification, evaluation, or academic data storage systems	
3	Use of XR	Students use VR, AR, or Mixed Reality in the learning process	
4	Use of IoT	There are sensors, smart devices, or adaptive learning environment	
5	Student Interaction	Students actively discuss, ask questions, or collaborate digit	
6	Attention to emotional well-being	The system or lecturers pay attention to the emotional well-being of students.	
7	Student Responses	Students appear motivated / focused / enthusiastic / burdened during the learning process.	

4. RESULT AND DISCUSSION

Below, we have compiled examples of interview and observation instruments for research on the theme of Education 5.0, which focuses on the integration of AI, Blockchain, XR, and IoT in creating personalized, collaborative learning that is oriented toward the emotional well-being of students:

A. Interview Instrument (For Students and Lecturers)

Part I. General Information on Respondents

Name:

Status: Lecturer / Student

Study Program:

Experience using digital learning systems (in years):

Part II. List of Interview Questions

1. Technology Implementation

Have you ever used a learning system that implements AI, Blockchain, XR, or IoT on campus?

What learning technologies do you use most often in class?

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Does the learning system you use tailor the material to your needs? If so, how does the process work?

2. Personalized Learning

Do you feel that the learning materials or methods used in class are tailored to your personal needs?

When using AI-based systems, do you receive automatic recommendations for learning materials?

Do you feel that the existing learning system helps you learn more independently?

3. Collaboration and Interaction

How does the use of digital technology (online forums, virtual reality, or others) affect your collaboration with classmates?

Do you feel that communication between students and lecturers is easier with this technology?

4. Impact on Emotional Well-being

Does the use of technology-based learning systems help you feel more comfortable, motivated, or burdened?

Have you ever felt stressed, anxious, or overwhelmed because of the digital systems used in learning?

Do you feel more valued as an individual in the learning process that uses technology?

5. Challenges and Expectations

What are the main obstacles you face in using this learning technology?

In your opinion, what needs to be improved in the current digital learning system?

What are your expectations for the learning system in the future?

B. Observation Instruments

Observation Sheet Format

No	Observed Aspects	Observation Indicators	Explanation / Notes
1	Use of AI	The learning system displays material recommendations/automatic personalis	
2	Use of Blockchain	Blockchain-based certification, evaluation, or academic data storage systems	
3	Use of XR	Students use VR, AR, or Mixed Reality in the learning process.	
4	Use of IoT	There are sensors, smart devices, or adaptive learning environment systems.	
5	Student Interaction	Students actively discuss, ask questions, or collaborate digitally.	
6	Attention to emotional well-being	The system or lecturers pay attention to the emotional well-being of students.	
7	Student Responses	Students appear motivated / focused / enthusiastic / burdened during the learning process.	

5. CONCLUSION

Based on the results of the research and discussions that have been conducted, the following conclusions can be drawn:

- The Implementation of Education 5.0 in Higher Education

The integration of AI, Blockchain, XR, and IoT technologies in higher education has been implemented in several key areas. AI is used for personalizing teaching materials, blockchain for storing academic data and digital certification, XR for immersive learning simulations, and IoT for creating smart classrooms. These implementations have generally received positive responses from students and lecturers.

- Impacts on Personalised Learning

The use of AI in learning systems encourages the creation of a more personalized and adaptive learning process. Students experience learning that is tailored to their individual needs and abilities, thereby facilitating the process of understanding the material.

- Enhanced Collaboration and Digital Interaction

XR technology and online forums support cross-programmed collaboration, enabling students to interact in innovative and open virtual spaces. The blockchain system creates evidence of each individual's contribution to collaborative projects.

- Contribution to Student Emotional Well-being

The integration of learning technology promotes comfort, motivation, and emotional engagement among students. However, there is a potential for digital fatigue that needs to be anticipated in order to maintain a balance between technology use and students' mental health.

- Implementation Challenges

Some of the challenges faced include lecturer readiness, student hardware constraints, limited internet connectivity, and concerns regarding data security on the blockchain system.

Overall, the Education 5.0 concept has great potential in building a higher education system that is personalised, collaborative, and more humanistic.

- Recommendations

Based on the results of the study, the following recommendations are made:

- Improvement of Lecturer Competence

Higher education institutions need to provide intensive training for lecturers so that they can optimise the use of AI, Blockchain, XR, and IoT technologies in the learning process.

- Strengthening Digital Infrastructure

Institutions need to ensure the availability of adequate hardware and internet access for all students, so that the implementation of Education 5.0 can be carried out evenly and inclusively.

- Integration of Humanistic Pedagogy

The use of technology in learning should still pay attention to the emotional well-being of students. It is recommended that there be restrictions on screen time and that direct social interaction be strengthened in order to reduce the risk of digital fatigue.

- Development of a Sustainable Evaluation System

Higher education institutions need to conduct periodic evaluations of the effectiveness of technology integration in learning and its impact on academic performance and student welfare.

- Further Research

Further research is recommended that focuses more on quantitative evaluation of the impact of technology on students' psychological aspects, as well as the development of an Education 5.0 implementation model that is appropriate for the educational context in Indonesia.

ACKNOWLEDGEMENT

The researcher would like to say grateful to Allah SWT for providing blessings and guidance in her life, so that researcher was able to complete this thesis. Peace and blessings be upon to Prophet Muhammad SAW. The researcher would like to express gratitude for the support from their closest ones

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