



# Exploring the conceptual basis of smart learning environment

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## ABSTRACT

This study aims at exploring the conceptual basis of smart learning environment that includes the concept in a separate framework and various perspectives of using the terms. This research is library research, which is the act of using the resources of a library, either in print or online, to find information about smart learning environments. The researcher explored national and university libraries to collect digital information and some search engines' web-based search engines to find relevant information. The results indicated that the term smart refers to self-directed, motivated, adaptive, resource-enriched, and technology-embedded, and the conceptual basis of smart learning environment was constructed. The study also indicated that the terms are used in various perspectives in the form of smart education, smart pedagogy, smart technology, and smart classroom, and the conceptual bases of those have been formulated.

**Keywords:** Smart learning environment; smart pedagogy; smart classroom; smart technology; smart education

## 1. INTRODUCTION

Studies on instructional models, media, technology, and technology-enhanced learning have attracted the attention of educational scientists today. In relation to the instructional models, several studies have been done periodically. Joyce et al. (2015: 9) succeeded in classifying instructional models from the perspective of the learning theory family, which includes the information processing, social family, personal, and behavioral systems families of theory. The study of instructional models was also carried out by Kilbane Milman (2013), who formulated nine instructional models that fit the 21st-

century instructional design. Another study was developed by Estes dan Mintz (2015) and found ten instructional models, which are divided into two inseparable parts, namely basic instructional models and advanced instructional models. However, these studies only place the instructional model as a study directly related to learning effectiveness, efficiency, and engagement.

Another study often associated with learning or in the language used by Merrill (2013) to promote learning is the use of multimedia and technology, where it is said that learning is promoted when multimedia implements prescribed instructional events. It is argued that the use of digital technologies can have a positive effect on learning in higher education. This is based on the findings showing that the Interactive Constructive Active Passive (ICAP) framework effectively encourages constructive and interactive student involvement (Wekerle et al., 2022). Virtual technology can help students' activities stay within the scope of learning, while in virtual learning, students have little say in setting goals or contributing learning content. Using technology at home for learning can present students as active inquirers who seek information and expand social networks and can use participatory learning technologies such as *Discord for Communication* (Squire, 2022). However, this study focuses only on using technology as a supportive tool to create the effectiveness of the learning process to obtain maximum learning outcomes.

The combination of models and technology to increase the effectiveness of processes and learning outcomes has also been developed and formulated. The results of this development have given rise to technology-based learning models, such as blended learning (Manna et al., 2023), online learning (Polkowski et al., 2023; Lasfeto & Ulfa, 2023), digital learning (Faridah et al., 2020), and distance education (Clark, 2020). Blended learning integrates media and resources, learning activities, the environment, and learning citizens that can be carried out in traditional face-to-face and online classrooms (Yaumi, 2021; Martin et al., 2023). This integration has been proven to increase the effectiveness of group and independent learning and trigger student self-regulation development (Wong, 2020; Turan et al., 2022).

The development of online learning also combines presentation strategies and platforms to build activities and store various learning resources, as developed by Chansanam et al. (2021). This online learning model uses a user-centric, TPACK, and V-model design. The framework uses a 5-axis to enhance the TPACK Model to support online learning, especially in pedagogy, content, and technology. However, these studies do not massively use digital technology and automation as currently being discussed in artificial intelligence in education (Haug & Drazen, 2023; Holmes et al., 2023).

Later on, new learning models were recognized, such as smart learning or smart education, in the 2010s (Chen et al., 2021). Smart learning is considered a 21st-century educational paradigm that encourages and develops all students to become global leaders by renovating the existing education system, such as content, methods, evaluation, and environment (Hwang, 2014). smart learning or Smart Learning Environment (SLE) is a smart learning space equipped with personal digital devices, wireless communication, learning platforms, and associated sensors to provide input into artificial intelligence systems (Cao et al., 2020). Artificial intelligence has been designed to make decisions about managing the physical aspects of the environment or learning systems intelligently. These requirements can be identified by analyzing learning performance, behavior, and real-world and online settings in which learners are located (Al-Shoqran & Shorman, 2021).

However, smart learning still leaves many shortcomings; there is no clear definition of smart learning so far (Kim, Cho, & Lee, 2013), tend to be different from one another (Saini & Goel, 2019); general concepts are too focused on tools and are sometimes very technical (Dron, 2018), lack of communication touch, psychological behavior, and spiritual interaction (Kushnir, 2020), and a uniform, monotonous, and mechanical learning process (students are treated like machines). Therefore, it is necessary to sharpen, construct, or formulate the concepts smart learning environment that can provide clear directions and alternative practice options that suit user needs and the variety of application environments. Two important parts should be constructed in dealing with the term's formulation: the concept of smart learning environment and various perspectives of using the term on a conceptual bases.

## **2. METHODS**

This research is library research, which is often confronted with field research. According to Kowalsky (2019: 504-505), library research is the act of using the resources of a library, either in print or online, to find information that satisfies a need or answers a question. Library research is a literature search more than just serving the functions mentioned to obtain research data. This means that library research limits its activities to library collection materials without the need for doing field research (Sari & Asmendri, 2020: 42). The process of library research involves step-by-step way to gather information to write research papers, essays, presentations, or complete research projects (liemsa, 2023: 1-2).

In this study, the researcher explored the UINAM and STKIP YPUP library using the institutional repository to find sources related to theses, dissertations, and lecturers' research reports related to the smart learning environment. In addition, the researcher also searched and collected sources through the national library, especially in e-

resources and other search engines such as Google Scholar, ERIC Database, DOAJ, Garuda, and Research Gate to collect eBooks, articles, magazines, journals, and newspapers. The researcher also used web-based search engines such as Yahoo and Google to find relevant information. In tracing the source through tracking engines, she used two approaches. The first approach involved three general descriptors for the topics "Smart Learning," "Smart Learning Environment," and "Smart Education." Smart learning descriptors in Indonesia did not generate much information. Combining the two terms, "smart learning" and "smart education" produce many results. The second approach involves combining descriptor subtopics: "concepts and definitions of smart learning," "principles of smart learning and artificial intelligence," "models of smart learning and smart education," "theory of smart education and artificial intelligence," "smart learning and smart classroom," "implementation of smart learning in an educational setting," "characteristics of smart learning and smart education," and "smart learning in learning mathematics.

Various documents such as books, articles, papers, theses, and dissertations, as well as other website-based sources that have been collected, were then analyzed using qualitative data analysis, as suggested by Miles, Huberman, & Saldana (2014), includes data condensation, data presentation, verification drawing conclusions and verification. Data condensation (not data reduction) refers to selecting, focusing, simplifying, abstracting, and transforming data that appears in documents and other empirical materials. Condensation of data in this study occurred continuously during this study. Before the data were collected, anticipatory data condensation had already been carried out. After collecting the data, the researcher summarized, encoded, developed themes, created categories, and wrote the analytical memo.

The following analytical activity is data presentation, which refers to an organized and compressed information collection that allows conclusions and action to be drawn. This study presents data display through matrices, graphs, charts, or networks. All are designed to gather organized information into a concise and immediately accessible form so that the readers can see what is happening and illustrated in the illustrations. Data analysis ended with a conclusion and verification. Drawing conclusions refers to the interpretation of meaning by paying attention to patterns, explanations, series of events, and postulates or propositions while maintaining openness and skepticism. The goal is to draw conclusions gradually, starting with a slightly vague conclusion, then gradually improving, and finally becoming a final conclusion. As for verification, is tracing back data sources' field notes, including how to collect data to test plausibility, sturdiness, and confirmability, or what is called validity (Sgier, 2012).

The researcher triangulated data to track the accuracy of various sources, data collection times, places, and people who participated in this study to determine the

credibility of the data (Li & Zhang, 2022). The researcher also paid attention to video activities in smart learning environments so that data about the actual usage of smart learning could be determined (Jenkins, Monaghan, & Smith, 2023). Resources were also checked and checked, as well as various handwritten, digital resources and field sights in replicated form to achieve data reliability. After checking all processes and results, the researcher audited the correctness of all data sources and activities to get data confirmation.

### **3. RESULTS AND DISCUSSION**

#### **The Concept of Smart Learning Environment**

There needs to be more accurate information in various academic references about the time when the term smart learning environment was first used. However, there are many claims that the term can be traced to its development. Spector (2016) believes that the emergence of this concept stems from the development of artificial intelligence, which emerged as the academic mainstream in the 1950s. Hwang (2014) claims that researchers in computer science and education developed intelligent learning systems by incorporating artificial intelligence techniques in educational applications in the early 1980s. Meanwhile, Mikulecký (2012) indicated that the use of the learning environment was triggered by the results of intensive research in the field of Ambient Intelligence (Aml), which refers to electronic environments that are sensitive and responsive to the presence of people—originally developed in the late 1990s by Eli Zekha and his team for the period 2010–2020 (Gunnarsdóttir & Arribas-Ayllon, 2011). Apart from the difficulty of determining the starting point for using the term smart learning environment, what is certain is progress in the field of information and communication technology, as well as various innovations in technology-enhanced learning such as blended learning, online learning, digital learning, e-learning, or sort of eventually evolved into a smart learning environment.

The use of the term smart learning environment must be distinct from the many common terminologies that are often used in academic references. There are three terms whose meanings refer to the word smart or intelligent, namely "Smart," "Intelligent," and "Wisdom." "Smart" means being able to make adjustments similar to human abilities and decisions or being able to operate electronic sensors and computer technology (Huang et al., 2012). "Intelligent" shows the ability to learn or understand something easily in dealing with new situations (Yaumi et al., 2018). "Wisdom" relates to knowing what is appropriate or reasonable or with good judgment (Liu et al., 2017).

Korean Ministry of Education (2011:2) defines the word smart by making an acronym for the word S.M.A.R.T: self-directed, motivated, adaptive, resource-enriched, and technology-embedded. The description of this acronym is illustrated as follows:

- S: Self-directed means that the education system is developing towards an independent learning system more than before. The transition of the role of students from adopters of knowledge to creators of knowledge. In addition, the teacher becomes a learning facilitator (Neo et al., 2022).
- M: Motivated means education is centered on experience and involves learning by doing (learning by doing), creative problem-solving, and applying individual judgment (Singh, 2022).
- A: Adaptive means strengthening the flexibility of the education system and adapting learning to individual preferences and future careers (Spector, 2014).
- R: Resource-enriched, meaning Smart Learning leverages rich content based on the open market cloud education services from the public and private sectors. In other words, expanding the range of learning resources to include collective intelligence social learning (Neo et al., 2022).
- Q: Technology-embedded, meaning that in a smart learning education environment, students can learn anywhere, anytime through advanced technology (Singh, 2022).

The term smart learning is a new concept in educational technology studies. Noh (2011) claims that the concept of smart learning emerged as a response to the limitations of e-learning and a result of changes in the educational paradigm caused by advances in smart devices and technologies. Practices and research on smart learning began to develop in the 2010s, although long-term projects have been started since the beginning of the twenty-first century by several countries in the world. In 1997, the Malaysian government initiated a smart education project called the Smart School Policy (SSP) to improve the education system and prepare a workforce that responds to the challenges of the 21st century, then systematically arranged in the form of a smart school roadmap for the period 2005 – 2020 (Corridor, 2005; Mirzajani et al., 2016).

The Singapore government created the Intelligent Nation Master Plan 2015 (iN2015), which began in 2006. In that plan, eight Future Schools focused on creating a diverse learning environment (Yeung, 2015). In 2011, the Ministry of Education of South Korea and the Presidential Council for Informatization Strategy jointly formed 'A Road to the Power of Talented Individuals: SMART Education,' and since then, smart education has become one of the main strategies of ICT-based education in the country, where the main task is to reform the education system and improve infrastructure (Lim & Kye, 2019). In 2012, the Australian government collaborated with International Business

Machines (IBM) to design a smart multidisciplinary, learner-centered education system that links schools, colleges, and workforce training (Phoong et al., 2019).

In Indonesia, smart learning programs follow the idea of developing smart cities initiated by each region, the basic idea of which was initiated by the Mayor of Yogyakarta, Herry Zudianto, in 2001, followed by a number of other cities in Indonesia, such as the City of Surabaya in 2011; Bandung city in 2015; DKI Jakarta in 2016, and the City of Makassar in 2020 (Diskominfo Kota Makassar, 2023; Binus University, 2023). Smart cities are a new concept for promoting urban planning, construction, management, and service policies using the Internet and other new-generation information technologies (National Development and Reform Commission dalam Liu et al., 2017). The services in question refer to people and various infrastructures, including learning services in education (Atmawidjaja dkk., 2015: 6). Therefore, smart learning is a learning activity that allows learning experiences, content suitability, and high learning efficiency (Singh, 2022: 6). Smart learning is also seen as context-aware ubiquitous learning. Context includes the interaction between learners and the environment, and therefore, intelligent learning environments can be considered as technology-enabled learning environments that apply adaptations and provide the right support at the right place and at the right time based on the individual needs of learners (Ossiannilsson, 2017). Thus, smart learning is a context-aware learning activity that provides media and technology support, as well as a variety of the right learning resources in the right place and at the right time based on students' individual needs. Context includes the interaction between learners and the environment.

Furthermore, smart learning environment can be considered as a technology-enabled learning environment that implements adaptation and provides appropriate support at the right place and at the right time based on the individual needs of learners. This need can be determined by examining learning behavior, performance, and the online and real-world contexts in which students find themselves.

The term learning environment can refer to a broad scope, such as the various physical locations, contexts, and cultures in which students learn, such as classrooms, workplaces, laboratories, museums, natural sites, means of transportation, and at home.

Smart learning environment refers to a broad concept including students, instructors, or instructional systems, settings in which learning takes place, support staff, including designers and technical specialists, and the culture of the class, course, institution, and community (Spector, 2016). On the other hand, the learning environment can also be used in a limited form, namely as an abbreviation for a digital or virtual learning environment (Koper, 2014). It means that the learning environment refers to formal and informal spaces, physical places, or virtual environments. If

associated with the word smart, as explained earlier, a smart learning environment includes study rooms at school, study rooms at home, community study rooms, workplaces, learning stadiums, and other virtual learning spaces. In smart learning environment, students can learn anytime, anywhere, in any way, and at any speed. A learning environment like this can also support students with learning experiences that are easy, interesting, and effective (Liu et al., 2017). In other words, an intelligent learning environment engages and integrates formal and informal learning spaces to create an autonomous adaptive learning environment, supporting individual learners with real-time, seamless, and accessible learning experiences anywhere.

In addition, smart learning environment is perceived as a physical environment enriched with digital, context-aware, and adaptive tools to promote better and faster learning (Koper, 2014). Chin Liu et al. (2017) argued that an intelligent learning environment is a learner-centered environment based on the application of information and communication technology, with characteristics (1) adapting to different learning styles and students' learning abilities; (1) providing lifelong learning support for students; (3) provide support for the development of learners. Thus, the concept of smart in relation to the learning environment describes an independent learning system, learning by direct experience, adapting to individual needs, utilizing multiple learning sources, and using advanced technology.

## **Various Perspectives on Using Smart Learning Environment**

The use of smart learning environment as a conceptual basis in scientific references is often associated with several other concepts, such as smart education, smart pedagogy, smart technology, and smart classroom. The combination of the word smart with several other words has formed a term currently widely studied in education.

### **a. Smart Education**

The term smart education was first introduced by Tikhomirov (2011), a professor of economics from Moscow State University, in his article entitled "The World Towards Smart Education: New Opportunities for Development"(translated from the original Russian language). He said that smart education requires emerging technologies such as smart boards, smart screens, and Internet access from anywhere. Each of these technologies makes it possible to build content development, updating, and delivery processes in new ways. Smart education is a comprehensive composition of learning delivery methods, formative and summative assessments, teamwork, or learning game-based applications (Ongoro & Mwangoka, 2019: 28; Díaz-Parra et al., 2022). They also stated that smart education optimizes human, economic, and technological resources from educational institutions and research centers. Similarly, smart education provides



the right application of the latest intelligent technologies in conjunction with advanced pedagogical tools, practices, and techniques for effectively delivering educational services (Kiryakova et al., 2018).

### **b. Smart Pedagogy**

In general, the concept of pedagogy is often associated with science, art, or the teaching profession. Pedagogy studies how knowledge and skills are imparted in an educational context and considers the interactions during learning. In some references, pedagogy is the art and science of teaching (Ahamer, 2016: 21), involving a learning philosophy that underlies strategies (Collis & Moonen, 2009: 8) or a style in which educators carry out learning, including presenting content to construct new knowledge (Gonzalez & Balderas, 2019), as well as improve performance and learning outcomes (Momanyi, 2016). Therefore, pedagogy is about what educators do and how learning occurs in a technological space, environment, and learning resources. What educators do can influence learning events, especially changes in mentality, attitude, and behavior, including general and specific skills. owned by students.

In further development, the concept of smart pedagogy emerged, which was constructed from three main foundations, including regularity in developing human knowledge, the educational process, and technological advances (Q. Zhang & Long, 2021; Daniela, 2018). The regularity of human intellectual development refers to conditions for the development of cognitive processes, conditions for sensory development, and conditions for socio-emotional development. The educational process includes the goals to be achieved and the regularity of the learning process needed to achieve these goals. Technological advances demand changes in teacher pedagogic competence, where one of the most important components of this competency is predictive analytical competence. Predictive Analytics is an approach used in data analysis that uses historical data to predict future events, creating a mathematical model, which is then applied to current data. Automated machine-based learning is often associated with predictive analysis, including student competence.

### **c. Smart Technology**

This study's concept of smart technology is only directed at the education sector, not the economics sector to market products, the medical sector to deal with medical problems, engineering and physics technology, or others. Technology is the practical application of knowledge for purposes that are of value to a group of people (Spector, 2016). In relation to smart technology, he proposes to use the term smart learning technology instead of just using the term smart technology. This is based on the view that not all smart technology is categorized as smart learning technology, depending on

whether smart technology supports learning and learning or is only directed to the needs of communication between the general community currently interacting. Technology in smart learning is used to empower students, educators, or learning designers by adjusting their needs and situations to be considered as smart learning technology. However, in this section, the author uses the term smart technology, which is meant for smart learning technology.

In addition, intelligent technology uses extensive data analysis, machine learning, and artificial intelligence to provide cognitive awareness to previously thought powerless objects (Thakur, 2022). Intelligent technology is also understood as a new generation of technology that enhances the interaction between humans and machines and machines with machines via an Internet connection (Ercan, 2022). Smart technology must be directed at a deliberate effort to support, facilitate, and improve learning processes and outcomes; that is called smart learning technology. This is also based on Merrill's view that the instruction should be effective, efficient, and engaging as the focus of using smart technology (Merrill, 2013).

#### ***d. Smart Classroom***

Smart classroom is often also called intelligent classroom (Chiou & Tseng, 2015; Hsu et al., 2012), future classrooms (Chang et al., 2015), or technology-enhanced classrooms (Prieto et al., 2015), all of which refer to the environment technology-assisted learning to enhance teaching and learning experiences. Smart classrooms are equipped with computers and audiovisual equipment that enable teachers to use various media (Phoong dkk., 2019). Another definition is also given by (Zhang et al., 2019; and Kaur dkk., 2022) whose characteristics are as follows:

- Smart classrooms are fully integrated interactive systems that allow users to seamlessly access media from a central point;
- Smart classrooms can be classified as classrooms with computers, projectors, multimedia devices (video and DVD), network access, loudspeakers, or the like, and are able to adjust lighting and control video streams;
- The smart classroom is a fully self-service learning environment where teachers use resources in a simple and easy-to-use way; and
- Smart classrooms allow users to interact with them as naturally as possible.

Thus, smart classrooms take advantage of sensing technology, network technology, multimedia technology, and artificial intelligence technology as a whole, with pads, e-school bags, and other mobile devices one-to-one. It can monitor students' learning status in real-time and collect data on student diversity processes, and can

develop self-directed and cooperative learning systems, which support 21st-century skills such as communication, critical thinking, creativity, and collaboration. Smart classrooms also provide rich learning materials accompanied by skilled teaching resources and a comfortable and flexible learning environment to be anywhere and anytime. So, the concept of a smart learning environment is built from various components of the terms smart education, smart learning, smart classrooms, smart teaching, and smart technology, which can be illustrated in Table 1.

**Table 1.** The Construction of the Terms and Their Definition

<b>NO</b>	<b>Conceptual Component</b>	<b>The Definition of the Terms</b>
1	Smart Education	The process of design, implementation, presentation, and assessment of learning by optimally applying the latest technology to create quality educational services.
2	Smart Pedagogy	It is creating learning conditions that support cognitive, sensory, and socio-emotional developmental processes by implementing strategies and delivery systems based on automation and predictive analysis.
3	Smart Technology	A new generation of machine technology and artificial intelligence to facilitate learning, analyze big data, and enhance multi-directional interactions between man-machine and machines through Internet connections and telecommunication systems.
4	Smart Classroom	Physical and non-physical learning spaces utilize sensing technology, networks, multimedia devices, and artificial intelligence technology to monitor student's learning status in real-time, enabling independent and collaborative learning.
5	Smart Learning Environment	The formal and informal environments in the form of physical places or virtual that are context-aware, media and technology support, and appropriate learning resources, in the right place and at the right time based on the individual needs.

The intelligent learning environment combines the physical environment and the virtual environment. The physical environment increases when installing all technological devices according to the existing real conditions. The virtual environment is presented through network systems, multimedia devices, and artificial intelligence technology. The application of augmented reality can create a seamless integration between virtual and physical environments. Learning services in a smart learning environment emphasize students' individual characteristics, various content presentation models, assessment of reactions, learning abilities, and behavior and results. The smart

learning environment facilitates systematic instructional design, implementation, control, and measurable formative and summative evaluations to determine student performance.

Smart learning environments must support on-campus and off-campus learning, formal learning, and informal learning. Students in this situation are not only students on campus but also everyone who has learning requirements in their work.

#### **4. CONCLUSIONS**

The smart learning environment is a new concept in the tradition of academic studies. There needs to be more accurate information about when this term was precisely used. However, traces of its development can be attributed to artificial intelligence, Ambient Intelligence, information and communication technology advances, and various innovations in technology-enhanced learning. Smart learning environment is defined as a formal and informal environment, physical and virtual, that is context-aware, with media and technology support and appropriate learning resources in the right place and at the right time based on the individual needs.

The use of smart learning environment is often associated with several other terms, such as smart education, smart pedagogy, smart technology, and smart classrooms. Smart education is the design, implementation, presentation, and assessment of learning by optimally applying the latest technology to create quality education services. Smart pedagogy is the creation of learning conditions that support cognitive, sensory, and socio-emotional development processes by employing strategies and delivery systems based on automation and predictive analysis. Smart technology is a new machine and artificial intelligence generation to facilitate learning, analyze big data, and enhance multi-directional interactions between man-machine and machines through Internet connections and telecommunication systems. Smart classrooms include physical and non-physical learning spaces by utilizing sensing technology, networks, multimedia devices, and artificial intelligence technology to monitor student's learning status in real-time, enabling independent and collaborative learning.

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