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SMART E-LEARNING – FROM THE CONCEPT TO PRACTICE

Annotation. This work revealed that implementing Smart E-learning as one of the components of Smart Campus increases the efficiency of the educational process and provides an interactive and personalized learning environment. It was established that the key technologies that support this concept are cloud computing, IoT, artificial intelligence, and augmented reality. It was found that using these technologies contributes to improving the collection, analysis and use of data for making management decisions in the educational process. The impact of integrating modern technologies on the interaction between students and teachers was assessed, which allows optimization of the management of educational resources and increases students' motivation for learning. It was confirmed that the implementation of Smart E-learning contributes to the development of independent and research skills in students. It was confirmed that the implementation of Smart E-learning contributes to achieving sustainable development goals and increasing the overall efficiency of educational institutions.

Keywords: Smart Campus, Smart E-learning, IoT, WorkSection, LMS Moodle, Google Workspace, Sustainability, sustainable universities.

Introduction. Research is being conducted on the implementation of the Smart Campus concept in domestic and foreign universities. We can assume that the Smart Campus idea should be implemented through application technologies, such as cloud computing, IoT, artificial reality (AR), and artificial intelligence (AI), to improve the comfort of the educational process and consider sustainable development goals [1].

Nowadays, universities represent the ideal place to create a smart environment. So, the Smart Campus is intended to perform multipurpose uses such as integrated green learning and living environment supported by IoT technologies.

The aim of the research is to offer a model for the digital transformation process of the UNFU as a 6-year leader among sustainable universities in Ukraine in the UI GreenMetric World University Rankings.

According to sustainable development policy and mentioned ranking (Fig.1), the main categories of Smart Campus elements are infrastructure, energy, waste, water, transportation, and education.

Elements of Smart Campus model are respectively IoT-Based Infrastructure Management, Smart Campus Energy Management, Smart Campus Waste Management, Smart Campus Water Management, Smart Campus Transportation Management, Smart Campus Education/Science Management as Smart E-learning model.

The introduction of smart technologies into the educational environment has been identified as a key factor in improving the quality of education and streamlining the management of academic processes. Table 1 reflects the functioning of the smart campus components from the moment of collecting the necessary information to the stage of forming a decision and obtaining the expected effects.

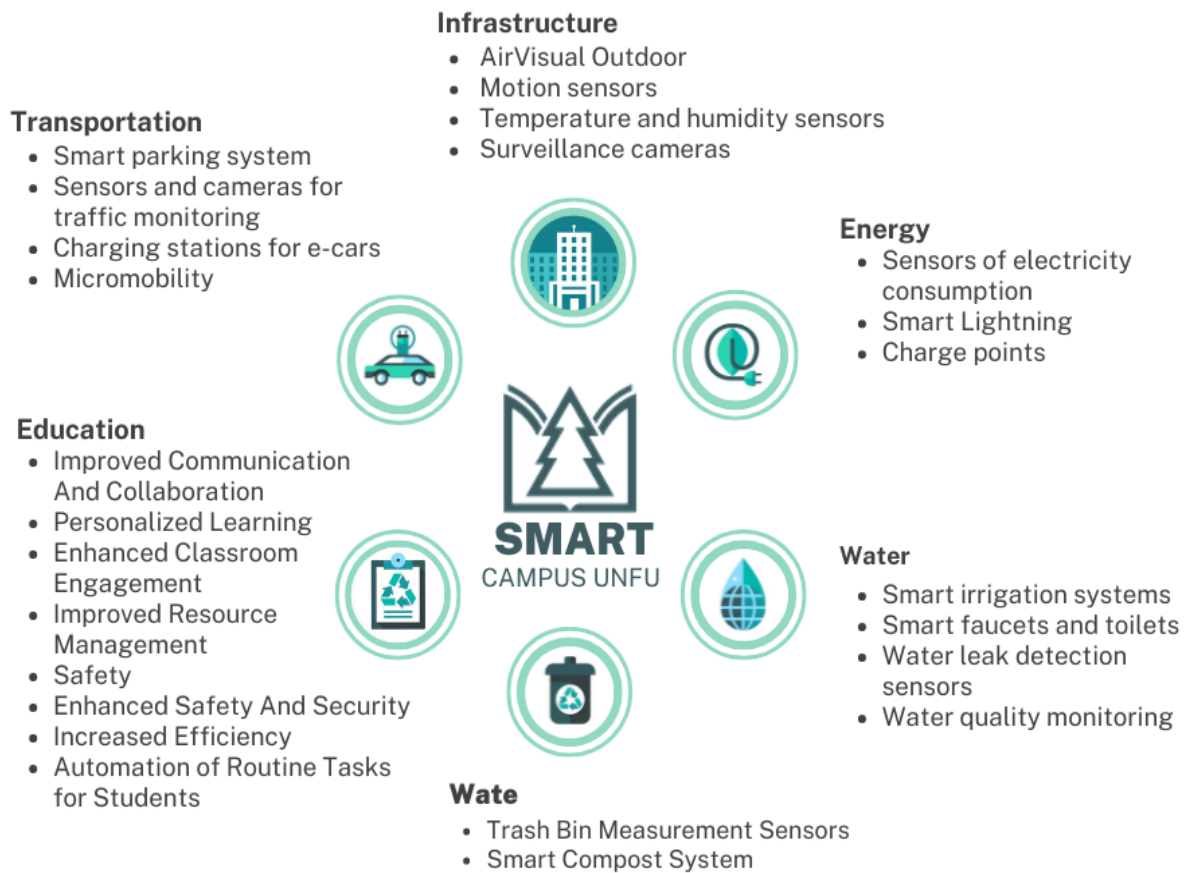


Figure 1. Components of Smart Campus UNFU [1]

Implementing Smart E-learning in the educational process provides an adaptive and individualized approach to education and creates a flexible, interactive, and accessible learning environment that adapts to the needs of each student. This contributes to increasing motivation, improving learning outcomes, and also helps ensure the continuity of education in the conditions of a pandemic, military aggression or the transition to distance learning [2].

Smart E-learning combines innovative IT technologies and pedagogy. The concept of “SMART” in the learning environment is described in detail in the article [3]. In particular, three areas are analyzed: epistemology, psychology, and technology based on which modern Smart E-learning systems are created.

A more detailed description of the technologies used for its implementation can be found in the research of other researchers [4], according to whom smart learning is related to learning in interactive, intelligent, and personalized learning environments, including, for example, augmented reality, cloud computing, and social networking services.

The Smart E-learning model is an innovative solution for the creation of a sustainable modern educational environment that includes means of collecting, processing, and presenting data. The architecture of the Smart E-learning is shown in Figure 2 and describes three components.

Table 1: Smart campus decision-making processes, collected data, tools and impact of decision-making

Process	Collected data	Data collection tools	Making decisions	Decision effect
Management of the educational process	- Class schedule info; - Occupancy of classrooms and laboratories; - Level of student activity	- Schedule management systems; - Attendance monitoring systems; - Interactive learning platforms	- Automatic schedule adjustment; - Selection of spaces for classes; - Personalized educational trajectories	- Increasing the effectiveness of training; - Uniform use of auditoriums; - Increasing student engagement
Management of student life and services	- Data on reservation and use of services; - User satisfaction ratings; - Demographic and behavioral data	- Resource booking platforms; - Questionnaires, feedback forms; - CRM systems for processing requests	- Dynamic management of services; - Planning of events and activities; - Personalized recommendations	- Increasing student satisfaction; - Optimization of resource allocation; - Improvement of service efficiency



Figure 2: Smart E-learning model

1. Information collection devices (sensors) that collect data, such as student's educational preferences, activity, traffic, etc. Data sources:

- Educational platforms, such as Moodle and Google Classroom, providing access to educational materials, tests, and video lessons;
- Interactive content (multimedia resources, quizzes, and simulations), created using authoring tools such as H5P or Articulate;
- Smart devices (tablets, smartphones, laptops), which are used to access the university network;
- IoT (Internet of Things) such as sensors and devices that collect data about user activity (eg, tracking usage time, student activity, etc.).

2. A data processing device (master controller) that receives data from sensors, collects it in Cloud storage, which is usually Google Cloud services and processes them to ensure efficient campus management. AI for data processing and Cloud technologies for storage:

- Performance analysis: AI algorithms analyze test results, grades, and completed assignments to predict student performance;
- Personalization of learning: based on the collected data, AI adjusts learning trajectories according to the individual needs of students;
- Behavioral analytics: AI helps track user progress and interaction with content, identifying difficulties or gaps in knowledge;
- Automation of surveys: AI creates or revises tests and assignments, making it easier for teachers;
- Centralization of data: cloud services (for example, Google Cloud, Amazon Web Services) store all educational materials, test results, progress reports, personal data of students, etc. This allows you to access data from any device at any time;
- Collaborative work: Thanks to cloud technology, students and teachers can work on projects and documents simultaneously in real time.

3. Data presentation tools (monitors) that display the information collected and processed by the controller. This info is usually shared all over through the main channels. Universities can use stationary LCD displays all over the campus to manage crowd behavior, to manage student flows, to help them make efficient decisions about their Individual educational path.

- Dashboards: Visualize data on dashboards that allow students and teachers to track progress and results in real time;
- Real-time analytics: monitors or interactive screens to display test results, grades, student activity;
- Smart screens: interactive whiteboards or monitors in classrooms for displaying multimedia content and interactive tasks.

This system makes it possible to improve the interaction between students and teachers, as well as to increase the efficiency of the educational process with the help of modern technologies and artificial intelligence. All these components interact with each other and cooperate to ensure optimal e-learning conditions and comfort for students and teachers, especially in times of war or pandemics.

Conclusion. The use of Smart E-Learning to organize independent, individual work of students intensifies the educational process and improves feedback between the teacher and the student. Smart E-Learning not only improves the organization of students' independent and individual work but also creates organizational and methodical principles for the development of students' motivation to study, forms skills for practical, independent research work. Smart E-Learning combines innovative IT technologies and pedagogy and is an interactive, innovative, personalized learning environment. It is an important step toward transforming education. Also it is a new concept that is actively being studied and implemented all over the world that's why our mission is the development and implementation of the most efficient version of it despite the financial, technical issues and challenges of innovations.

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