Application of Digital Technologies in University Education: Conceptual and Analytical Approach

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Summary
Integration of technologies into university education requires an understanding of the theories, concepts, and approaches ensuring the greatest efficiency in the process of using innovations at HEIs. This requires the investigation of practice and experience in choosing of conceptual and analytical approaches by HEIs in the process of applying technologies in various fields of higher education. The purpose of the academic paper lies in forming a set of conceptual and analytical approaches for subsequent using digital technologies in university education. Methodology. In the present research, based on the conceptual-analytical approach, an analysis of concepts, theories, approaches (system theory and systems approach, constructivism, personality theory, psychology of vocational education based on personality-oriented learning, lifelong learning, pedagogical competence, structural and functional approaches) has been carried out, underlying the application of digital technologies in university education. Results. Based on empirical verification, the main hypothesis of the research has been confirmed. HEIs combine different conceptual and analytical approaches depending on the field of application of digital technologies in university education. Constructivism is the basic theoretical basis for technology integration. Complementary components of constructivism are as follows: 1) the concept of lifelong learning, implying a constant need for participants in university education in order to update their digital skills; 2) competence-based approach, involving the formation of basic and special competences of teachers, students; 3) centralised approach for technical support for academic staff and students; 4) systemic and structural-functional approaches for the integrated use of technology in various fields of higher education; 5) the theory of personality-oriented learning based on the principle of student-centeredness as a basis for the introduction of technologies

Key words:
Digital Technologies, University Education, Conceptual and Analytical Approach, Technologies of higher educational institutions (HEIs), Application of Technologies in Higher Education.

1. Introduction

The application of digital technologies in higher education should be based on a combination of the most effective approaches to solving the problems of higher educational institutions (HEIs). The major challenges of university education are the growth of competition, dynamic scientific and technological progress, demographic crisis and reduction of the number of applicants, the transformation of the requirements and requirements of the labour market. The integration of technologies is able to partially address a number of these challenges, or reduce their negative impact on competitiveness. For instance, technologies are able to optimize the organization of the educational process, speed up communication processes, increase the level of learning efficiency. Their practical use ensures the formation of the competences of HEIs' participants: teachers, administrative staff and students. The search for the most suitable concepts for the implementation of technologies based on the analysis of the practice of integrating different approaches of universities is an extremely urgent research problem.

The purpose of the academic paper lies in forming a set of conceptual and analytical approaches for subsequent application of digital technologies in university education.

The principal hypothesis of the research is as follows: HEIs combine different conceptual and analytical approaches depending on the field of application of digital technologies in university education. Constructivism is the basic theoretical basis for the integration of technology in the context of the dynamism of scientific and technological progress, requiring teachers, administrators and students to constantly update their knowledge in the process of practice.

2. Literature Review

In the scientific literature, there are two main approaches to the application of technologies by universities: a traditional and a constructivist one [1]. The latter involves the independent acquisition of knowledge by students during educational activities in the established pedagogical conditions. In the scientific work of Vannatta & Beyerbach [1], it has been revealed that university professors consider constructivism as an effective approach for the integration of technologies; they believe that it is a learning tool that helps improve skills for subsequent application of the technologies, engaging students in meaningful learning.

Rogers [2] argues about shifting a paradigm in the integration of technology into higher education, due to the new requirements for the set of technological competences of teachers. The presence of the teacher's competences does not guarantee the effective use of technologies in training students, which requires the use of a constructivist concept

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and the transition from the paradigm of "teaching" to the paradigm of "learning", and appropriate technical support. In the pandemic period, blended learning approaches are an example of effective technical support [3], complemented by new innovative practices. The innovative blended approaches have been considered by Petronzi & Petronzi [4], which combine asynchronous (flexible, autonomous) and synchronous learning styles, collaboration between participants at HEIs. These new learning styles can be examined in the context of the constructivism concept, involving centralised technical support for teachers using a specific set of digital tools in lectures, seminars and other forms of learning activities. Such support is one of the main components of the distance learning model [5].

The theory of personality-oriented learning represented by Rogers fits well into the paradigm of constructivism as a concept of digital technology [6]. Rogers argues: "Individuals possess the resources for self-understanding and for changing their own self-concept, basic attitudes and self-directed behaviour; these resources can be used if it is possible to create a certain climate of facilitative psychological attitudes" [6]. The student-centered approach (student-centered learning) is considered as more complex one than the teacher-centered approach and is deemed essential for the successful integration of technology [7]. The investigation of Derntl & Motschnig-Pitrik [8] supports a person-centered approach to learning, arguing that Rogers' theory is acceptable as a "didactic basis for web engineering". This approach to a great extent concerns to teaching technology literacy teachers forasmuch as it enhances the personal interactivity, collaboration and academic knowledge accumulated in the professional activities and personal lives of teachers [9; 10].

Within the framework of the constructivism concept, new approaches to teaching using technologies at HEIs are emerging. The Technological, Pedagogical, and Content Knowledge (TPACK) framework is distinguished among the approaches to the application of technologies by teachers in accordance with the strategies of teaching and the content of higher education [11]. TPACK provides a structure of knowledge to teachers about the use of technology in the training process [12]. The gamified approach is also the innovative one, increasing students' motivation, productivity and performance through new principles, the possibility of adapting courses to students' interests [13; 14].

In the scientific literature, approaches to the application of digital technologies in teaching and learning are also based on the concepts of using technology in education, the concepts of teaching and learning, and the perception of the technological context of learning [15; 16; 17]. Thus, the way in which teachers conceptualise the integration of technology and the role of learning with its implementation, has a significant impact on how they use technology in pedagogical practice [16; 18]. "Approaches to teaching and learning are defined as the strategies teachers adopt for their teaching practice" [7].

The consequences of implementing different approaches explain the impact of technologies that are integrated to optimize the learning process. Digital content-oriented teaching is likely to have a manifestation in the use of technology to represent information. For comparison, the use of learning-oriented technologies will make it possible for students to demonstrate their own understanding of the topic, to form new knowledge [16]. Therefore, it is important for teachers to perceive the use of technology as a component of student-centered learning in order to achieve better learning outcomes [15; 19; 20; 21].

Thus, various conceptual approaches to the application of technologies in higher education are closely intertwined, and basic learning concepts serve as the basis for understanding the role of technology in HEIs.

3. Methodology

The methodology proposed by Mukan & Istomina [22] has been used in the present research; it considers the conceptual and analytical approach as an element of the scientific and research model. This component involves the analysis of different concepts that are combined in order to ensure the effectiveness of a particular system. In the present research, the system has identified the university education at HEIs as a separate object and the integration of technologies in HEIs as a subsystem. The subsystem for using digital technologies can be defined as a technological component of the HEI that requires a combination of different concepts for continuous development. Therefore, based on the conceptual and analytical approach, the concepts, theories, approaches (system theory and systems approach, constructivism, personality theory, psychology of vocational education on the basis of personality-oriented learning, lifelong learning, pedagogical competence, structural and functional approaches) have been analysed in the research, underlying the application of digital technologies in university education. In particular, the practice of implementing concepts in the application of innovative technologies in HEIs has been considered.

System theory and structural-functional approach assume that the use of digital technologies in education is a system including interconnected structural-functional elements, namely: structure and subsystems, purpose, goals, challenges, principles, main tasks, functions, stakeholders (interest parties) or subjects, content and methods of educational activities, system dynamics, essence and features, factors and conditions, etc.

The constructivism concept implies that the use of digital technologies in education is an active process of forming, supplementing, and deepening knowledge of all participants in the educational process, taking into account

previous experience. The concept of lifelong learning and the competence-based approach are closely linked, forasmuch as they provide the development, deepening, constant updating, and supplementation of basic, special competences of participants in the learning process.

In order to conduct the empirical verification of using these conceptual approaches by HEIs in practice when integrating digital technologies, the internal documentation of the Taras Shevchenko National University of Kyiv has been used, in particular: Regulations on the quality assurance system of education and the educational process; Regulations on the organization of the educational process; Strategic development plan of the University for the period 2018-2025. The documents specified define the purpose, functions, objectives, principles, concepts, and approaches to the activities of the university.

4. Results

4.1. System theory and structural-functional approach in the process of using digital technologies

In university education in Ukraine, strategic development plans, provisions for the development of a quality assurance system, the organization of the educational process with the definition of goals, objectives, principles, levels of educational activity, features of the formation of educational programs, their implementation and scientific and methodological support, evaluation of learning outcomes and qualifications, ensuring the quality of the educational process, the rights and responsibilities of participants in the educational process are actively developed and implemented.

4.2. The concept of lifelong learning and competence-based approach in the process of using digital technologies

In Ukraine, a professional standard for the group of professions “Teachers of higher educational institutions” has been approved. The document contains a description of the general competences that professors, associate professors, senior teachers, teachers and assistants should possess. Along with this, the established standard contains a list and description of professional competences and job functions of teachers and a description of professional qualifications. The general competences of teachers at the state level are determined as follows:

1. Knowledge and understanding of the subject area, professional activity.
2. Possession of critical thinking skills.
3. Possession of communication skills, ability to show empathy.
4. The ability to use information and communication technologies.
5. The ability of searching, processing and analysing information from various sources.
6. The ability of personal and professional development.
7. The ability to generate new ideas, creativity.
8. The ability to apply best practices in professional activities.
9. The ability to motivate people and move towards a common goal.
10. The ability to act on the basis of ethical considerations, motives.
11. The ability to show tolerance and respect towards cultural diversity.
12. The ability to conduct socially responsible and conscious actions.

The above-mentioned competences are basic and relate, inter alia, to the field of digital technology implementation, both directly through the formation of the ability to use information and communication technologies in teaching, as well as indirectly. These skills can be used indirectly by teachers as follows: for instance, in personal and professional development of digital skills; or, for instance, when motivating students and achieving the goal of developing digital skills in the learning process; or applying best practices for teaching students in technology-related classes. In addition to the defined teacher`s competences of the, the framework of digital competences in educational activities has been approved in Ukraine (Table 1).

In fact, the frameworks outlined define the areas of application and levels of teachers’ competence in the use of technologies. Thus, the main areas include as follows: training, leadership, and self-regulation, collaborative learning and cooperation, evaluation and analysis of results, feedback and planning, differentiation and personalization of learning, accessibility and inclusion, active involvement. Competence frameworks develop the skills of teachers and students in different areas of educational activity, solving a number of challenges, using different conceptual approaches. Consequently, different skill levels of teachers indicate the need for teachers’ lifelong learning.

4.3. Personality-oriented learning in the process of using digital technologies

Systems for ensuring the quality of education and the educational process of Ukrainian HEIs include student-centered learning. For instance, student-centeredness is defined as one of the main principles of the quality assurance system of education of the Taras Shevchenko National University of Kyiv. According to this principle, the purpose of educating students at the University lies in acquiring the competences necessary for personal development, career building and social life [24].

Table 1: Framework of digital competences

Competences	Level A.1. Beginner (basic)	Level A.2. Performer	Level B. Integrator	Level C. Leader
3.1. Training. Planning and implementation of digital devices and resources in the educational process in order to increase the efficiency of educational technologies. Proper management and streamlining of digital learning strategies.	Experimentation and development of new formats and pedagogical teaching methods	Basic use of available digital technologies for teaching	Comprehensive integration of available digital technologies in the process of teaching and improving pedagogical strategies	Organization, monitoring and flexible adaptation of the digital technologies in order to improve and update pedagogical strategies
3.2. Leadership. The application of digital technologies and services in order to enhance interaction with students, within and outside the learning process. The use of digital technologies for timely and focused leadership and assistance. Experimenting and developing new forms and formats of leadership and providing support.	Weak use of digital technologies for interaction	The application of basic digital strategies for interaction	The application of digital technologies in order to improve interaction	Strategic and focused use of digital technologies for management and support
3.3. Self-regulation of learning. The application of digital technology to support self-regulated learning, that is, to teach students to plan, monitor and reflect on their own learning, provide evidence of progress, share opinions and generate creative solutions.	Weak use of digital technologies for self-regulation of learning	Encouraging students to use digital technology for self-regulated learning activities	The application of digital environments to comprehensively support self-regulated learning	Critical reflection on digital strategies used for promoting self-regulated learning, development of new digital formats and / or pedagogical approaches
3.4. Collaborative learning. Promoting and improving collaboration. Supporting students in the use of digital technologies as part of common tasks, as a means of enhancing communication, cooperation and knowledge creation.	Weak use of digital technologies in joint educational activities	Development of joint educational activities	Support for joint learning activities	Joint knowledge creation, mutual evaluation and updating cooperation
3.5. Evaluation and analysis of results. Formation of current and final assessment. Improving the diversity and suitability of assessment formats and approaches. Selection, critical analysis and interpretation of digital indicators of performance, efficiency and progress.	Weak use of technology for assessing and monitoring progress	Integration of digital technologies into traditional assessment strategies. Evaluation of basic data on activity and performance	Using and modifying existing digital tools and assessment formats. Strategic use of a range of digital evaluation formats. Evaluating the range of digital data for informed teaching. Strategic use of digital tools for data generation.	Comprehensive and critical selection, creation and adaptation of digital assessment formats. Development of innovative assessment formats using digital technologies. The use of digital data to reflect on learning patterns and teaching strategies. Data generation update and assessment
3.6. Feedback and scheduling. The use of digital technology for targeted and timely feedback from students. Adapting learning strategy and providing targeted support based on indicators obtained by digital technologies. Enabling students and parents to understand digital technologies and use them to make decisions.	Weak use of digital data for feedback and scheduling	The use digital technologies to composing and providing feedback	Using digital technologies in order to improve the effectiveness of feedback and support	Using digital technology for personalized feedback and support and related assessment and improvement of teaching
3.7. Differentiation and personalization of learning. Meeting a variety of learning requirements, allowing students to advance at different levels and speeds, and adhere to distinct learning paths and objectives	Uncertainty concerning the potential of digital technologies for differentiation and personalization	Awareness of digital technologies and use of some of them for differentiation and personalization	Strategic use of a range of digital technologies for differentiation and personalization	Comprehensive and critical implementation of differentiated and personalized learning, innovative strategies for different and personal using digital technologies
3.8. Accessibility and inclusion. Ensuring the availability of educational resources and activities for all students, including those with special needs. Reflection on students' expectations, skills, uses and misconceptions, as well as contextual, physical or cognitive limitations on the use of digital technologies	Concerns about accessibility and inclusion	Awareness concerning accessibility and inclusion issues	Addressing issues and implementing accessibility and inclusion opportunities	Improving accessibility and inclusion, strategies of innovative accessibility and inclusion
3.9. Active involvement. The use of digital technologies in order to promote active and creative participation in the study of subjects. The use of digital technologies in pedagogical strategies promoting students' diverse skills, deep thinking and creative self-expression.	Weak use of digital technologies to attract students.	The use of digital technologies to attract students.	Encouraging students to actively use digital technology in order to engage in the subject of learning.	Comprehensive and critical implementation of active learning strategies, innovative digital active learning strategies.

Source: Digital competencies framework [23]

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Student-oriented learning, teaching and assessment involves as follows: 1) survey of students on educational programs (curricula) and educational components; 2) consideration of the complaint of the degree-seeking student on the organization of the educational process (except for assessment), on academic and non-academic support of students; 3) monitoring the transparency and objectivity of the assessment of control measures; 4) monitoring the application of the latest teaching methods; 5) students' appeals regarding changes in curricula; 6) competition on academic mobility of students (selection for study abroad); 7) formation of an individual curriculum; 8) the procedure for forming and submitting consolidated proposals of students on the content of programs, curricula and educational components; 9) the procedure for making proposals by degree-seeking students on the development of the material base, including on issues related to the life and leisure of students; 10) participation of students in the discussion and solution of issues of improving the educational process, research, scholarships, leisure, life, health; 11) providing students with information about the disciplines included in the individual curriculum, forms of control and criteria for evaluating learning outcomes prior to their teaching; 12) the procedure for conducting surveys of students on their satisfaction with educational programs, their components and the quality of educational services, procedures for analysis and consideration of survey results; 13) determining the academic difference when transferring from other educational programs.

The student support system also involves monitoring the IT support of the university, creating new information resources. The creation of electronic information resources of the University is carried out on the basis of the provisions of regulatory legal acts, departmental regulations, decisions of the University management, as well as on the initiative of structural divisions in order to provide information support for the implementation of assigned tasks. The creation of new information resources makes it possible to expand the possibilities of interaction between different categories of participants in the educational process and stakeholders.

5. Discussion

Over the last ten years (since 2011), Ukrainian HEIs have been actively implementing various concepts of digital technology, based on the theory of constructivism. The dynamism of technology excludes the use of other basic theories for integrating digital solutions in higher education, requiring the use of concepts of lifelong learning, a competence-based approach, student-centered learning. As a result, HEIs function as a unified system, placing quality at the centre of educational activities and developing quality management systems, taking into account the indicated approaches, concepts, and theories. The frameworks of teachers' competences in Ukraine determine the areas of application and levels of teachers' competences in the use of technologies. Key areas of technology integration include as follows: learning, leadership, self-regulation, coeducation and collaboration, assessment and analysis of outcomes, feedback and planning, differentiation and personalization of learning, accessibility and inclusion, active engagement. Competence frameworks develop the skills of teachers and students in different areas of educational activity, solving a number of challenges, using different conceptual approaches. Therefore, different skill levels of teachers indicate the necessity for lifelong learning of teachers.

6. Conclusion

An empirical study of the practical application of conceptual and analytical approaches to technology integration in education confirms the principal hypothesis of the present research. HEIs combine various conceptual and analytical approaches depending on the field of application of digital technologies in university education. Constructivism is the basic theoretical basis for the integration of technologies in the context of the dynamism of scientific and technological progress requiring from teachers, administration, students constant updating of knowledge in the process of practice. Complementary components of constructivism are as follows:: 1) the concept of lifelong learning, providing the constant need of participants in university education in order to update digital skills, their development in the process of using technologies based on constructivism; 2) competence-based approach, involving the formation of basic and special competences of teachers and students; 3) centralized approach to technical support of academic staff and students by creating unified standards, rules of procedures for the use of technology; 4) systemic and structural-functional approaches for the integrated use of technology in various fields of higher education; 5) theory of student-centered learning based on the principle of student-centrism as the basis for the implementation of technologies, for instance, in the quality assurance system of HEIs for assessment of students' learning outcomes, making proposals for improving the educational process.

It has been revealed that conceptual and analytical approaches outlined are closely related. Therefore, the competence-based approach as a basis for the formation of basic, special skills in the use of technology is closely linked to the concept of lifelong learning. These two theories imply

a gradual deepening of competences in the course of educational activities.

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