CTE Workshop Proceedings, 2024, Vol. 11, pp. 411-426 https://doi.org/10.55056/cte.666

Digital twin technology for blended learning in educational institutions during COVID-19 pandemic

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Abstract. This paper addresses the challenges and opportunities of using digital twin (DT) technology to support blended learning in educational institutions during the COVID-19 pandemic. DT is a state-of-the-art technology that creates a digital replica of a physical entity, process, or system. DT has been widely applied in various domains, such as manufacturing, healthcare, smart cities, and aerospace. However, its potential for education has yet to be fully explored. This paper proposes to use DT to build a digital prototype of an educational institution, which can integrate traditional and digital resources and physical and digital spaces to ensure the continuity and quality of the educational process. The paper also discusses the benefits of DT for blended learning, such as enhancing motivation, interest, and individualisation of learning. The paper analyses existing DT practices and identifies the problems and needs of the educational sector during the COVID-19 pandemic. The paper argues that DT can be an effective solution for coping with the disruption and uncertainty caused by the pandemic and preparing for possible future education scenarios.

Keywords: digital twin, blended learning, educational institution, COVID-19 pandemic, digital prototype

The experimental process of urgent introduction of distance learning technologies [38] in 2020 became global, with the forceful involvement of educational institutions (EI) worldwide quickly entering the digital world. It is already clear that this process has launched an innovative path in developing educational systems in all countries. Soon, distance learning in various formats will be improved and gain capacity. This, in turn, will lead to changes in popular traditional teaching methods and approaches or to total reformation of educational systems in general – digital technologies continue to transform modern classrooms, teaching methods change according to expectations and learning styles and interests of students/learners.

Referring to digital technologies' potential in the field of improvement of teaching and learning, alongside increasing access to information and data management coordination, the researchers claim that rapid changes will force most EIs to either adapt or cease to exist [22].

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Analytical research shows that forced disruption of the educational process caused by COVID-19 quarantine has become a powerful stress test for educational systems around the world [15, 23]; this disruption, as a "vortex" event, also gave them the impulse to elaborate alternative long-term education development plans. After all, we realise that its participants' educational process and cooperation may differ. It is known that the COVID-19 pandemic has closed educational institutions around the world, and the UNESCO report dated March 18, 2020, stated that "more than 899 million young people were affected" [30]. It is noteworthy that as of March 24, 2020, various countries have already developed emergency plans, including the following:

- continuous provision of information and training related to virus spread and impact (France, USA, Italy);
- creation and training of working groups consisting of counsellors and teachers to support parents and pupils/students (USA);
- deployment of online classes (China, Singapore);
- training of teachers and directors (EI) for remote work (Italy, United Kingdom, China).

Some countries, as soon as in March 2020, have provided future backup plans for educational institution closure, both at the national level (e.g. China, Italy, Korea, Japan), regional level (e.g. France, Germany, Portugal, Spain) and narrow specialisation level (e.g. USA, United Kingdom). The Estonian Ministry of Education proposed cooperation with neighbouring countries and the free exchange of information resources on the Internet with the world. With the participation of three Baltic States, Latvia and Lithuania, as well as northern Denmark, Finland, Iceland, Norway and Sweden, more than 40 online learning solutions were collected. At the end of March, a webinar was held for Estonia parents on how to approach homeschooling organisations [30].

It is clarified that higher education institutions in almost all countries of the world are the most provided with Internet materials and electronic educational resources (EER), as many of them have provided distance education services using online courses in the last decade [3, 17, 35, 44]. As an example, we can cite the following resources:

- robust electronic database of educational and scientific materials of Duquesne University [28];
- resources for teaching on the Internet Institute of Food Technologists [32] (USA);
- resources for teachers and researchers (Japan) [40];
- ezines, ebooks and databases to which Osaka University attracts other universities [29], Kyoto University provides university staff with ezines (about 40,000 titles), ebooks (about 50,000 titles) and databases (about 100 types) [20] etc.

However, only some of the above can be systematically and in full volume attributed to primary and secondary education. That is why an urgent need exists to address this issue as an explosive problem. We have found several new solutions to solve it, such as:

- Assistance to the Malala Foundation – it helps to shape global and national responses to the COVID-19 challenge, which in some particular countries are manifested in the following formats [11]:

  - Nigeria – Cooperation with school teachers and education authorities has been intensified to implement the radio program that broadcasts school lessons, including reading, writing and STEM. Radio program helps Nigerian children who do not have access to Internet resources to learn on the radio.
  - Lebanon – the following digital educational solutions are offered: development of digital lessons based on state programs in the scope from kindergarten to high school; these lessons are now available to everyone on the Internet. These solutions also provide training for teachers, helping them conduct interactive classes at a distance.
  - Pakistan – a digital application called Taleemabad has been developed, digitising Pakistan's national curriculum. Taleemabad broadcasts cartoons of standard lessons for all who cannot attend EI. In order to respond to the growing demand caused by the pandemic and to cover at least one million pupils/students across the country, Taleemabad is expanding its national curriculum and broadcasting lessons through the educational television program.

- Northern Macedonia – access to the new digital platform with video classes and game-based learning activities for usage by teachers of primary, vocational and higher education institutions has been made available in the shortest possible terms [6].

An analytical review of educational process organisation experience in conditions of COVID-19 spread shows that educators in many countries began to develop and implement emergency plans quite quickly [41, 42]. It is clarified that the managers of educational sectors are aware that various forms of Internet education and EER development and use should be mobilised in current conditions. In general, EERs are aimed at slowing down and limiting the spread of the disease, as well as a preparation for possible long-term disruption of EI attendance by the participants of the educational process. As UNICEF spokeswoman Patricia Di Giovanni said in spring 2020: "Our teams have been working day and night during the past two weeks to find a solution to ensure that children's right to education is not violated by a new measure to prevent the spread of coronavirus in the country" [36].

Due to the intensification of anti-epidemic measures, the pupils in Ukraine have been prohibited from attending schools from January 8 to January 24, 2021; at the same time, EI has been entitled to announce vacations for this period. It is already known that at this time, the educational process was carried out in a remote format, while in the future, training is planned to continue in a traditional full-time format. However, no one can guarantee the use of only one format (full-time or remote), even in the near future. As the experience of 2020 has shown, educational institutions must be organizationally and methodically prepared for the transition to one or another format without compromising the quality of the educational process. According to Bilousova, Gryzun and Zhytienova [1], Kovalchuk, Maslich and Movchan [18], Martyniuk et al. [21], Mintii [24, 25], Rashevska and Kiianovska [31], Vlasenko et al. [43], one of the options to be chosen for realisations of this problem can be readiness for introduction of blended learning. We believe that this format of learning organisation quite effectively combines the advantages of traditional learning with distance learning [2, 26]. As has been found, the term "blended learning (hybrid learning)" has different definitions in the literature. In general, it

combines offline and online learning in various proportions. The concept emerged in the 1990s as a counterweight to online learning [45].

Caraivan [4] grounded that blended learning involves using two or more different teaching methods, i.e. a combination of methods that meet the needs of pupils/students, regardless of the subject they are studying. It may include such combinations as:

- traditional training sessions with online learning;
- online instruction with access to the teacher;
- modelling with structured courses;
- on-the-job training with some informal classes;
- management coaching with distance learning activities.

At the beginning of the XXI century, blended learning appeared in discussions about education when the concept of distance learning began to lose its credibility. In conditions of distance learning format, students were not highly motivated and independent; they felt isolated and unsupported by teachers during their studies. Thus, it was necessary to find new conceptual approaches to avoid obligatory changes in distant learning and provide a supplement for it [4].

Jarman [16] give several reasons why blended learning should be used:

1. *Obtaining qualitative results of learning.* As confirmation, we use the results of the study conducted at Iowa University: 95 % – best performance rate of students who studied in blended courses section; respectively 82 % – in sections of lecture halls and 81 % – learning on the Internet only.
2. *Encouragement and growth of pupils/students independence.* Using distance learning, students learn to set and manage personal learning tasks. In addition, blended learning contributes to their academic responsibility while maintaining the control needed for support. As blended learning uses online programs, students can learn at their own pace and according to their understanding and perception of information, thus building an individual learning trajectory.
3. *Preparation of pupils/students for functioning in conditions of society focused on ICT.* Thanks to the integration of teachers, they have the opportunity to ensure better preparation of students for future professional careers and civic life.
4. *Reduction of training costs.* From an administrative point of view, blended learning is a good investment because it maximises the savings of costs obtained from online learning. Blended learning can reduce the need for EI facilities, repairs, and maintenance. The reduced workload of teachers may result in a higher ratio of teacher-to-student communication and more efficient use of time.
5. *Improving the effectiveness of cooperation.* pupils/students can meet with teachers and other pupils/students whenever and wherever. At the same time, educators can find better ways to cooperate. Teaching in a team mode is much more accessible online, where everyone can work on their schedule.
6. *Formation of interest and motivation to study.* Nowadays some students find online programs and software more interesting than standard full-time sessions. Blended learning can break the monotony of the traditional classroom by introducing information and

concepts into different contexts. Of course, ICTs can be a distraction, but they can also present information in new and exciting ways, including interactive software, 3D animations, and video games.

It is necessary to add that blended learning can take first place among other formats and become popular and necessary shortly.

Given the prospects of blended learning as an innovative model of education, which is relevant not only in quarantine restrictions, we emphasise the specific features of educational process management during its implementation.

In blended learning conditions, the organisational accuracy of the educational process, provided in management through a change of educational process schedule, acquires an exceptional value. In conditions of stable functioning, EI can determine the periods of distance and full-time training, as well as their sequence and duration. Under quarantine restrictions, periods of distance and full-time training may be held not under schedule but spontaneously, depending on the epidemiological situation. Therefore, one of the first managerial tasks is to establish an accurate schedule of the educational process and provide recommendations to its participants on actions in case of unplanned changes.

In the management of blended learning, communication between managers, teachers and students is changing. It can be different at full-time training, as the possibilities of direct contact are limited. This necessitates the definition of methods and resources for communication to solve a set of tasks of various levels and orientations. In particular, during periods of distance learning, the main focus is placed on communication between teachers and students in the educational process and the format of individual work, tutoring, counselling, mentoring and more. Communication between managers and teachers and between teachers can occur both in face-to-face and remote mode at all stages of the educational process.

The next factor influencing the management in conditions of blended learning is the necessity to change the scientific and methodological support of the educational process. Educational content is being updated because of the peculiarities of full-time and distance learning; the programs, training materials, learning evaluation criteria for students, etc., require consequent adaptation. At the present stage of blended learning introduction, the problems of scientific and methodological support are becoming relevant (definition and structuring of content, teaching methods, assessment).

Thus, blended learning leads to changes in the management of the educational institution-digital twin in three main areas: educational process organisation, its scientific and methodological support and communication between its participants.

The blended learning format introduced in EI digital twin should open the possibility for the unimpeded transition from traditional to distance learning and vice versa. This is explained by the fact that to prevent EI closure, and it is natural to suggest that teachers use digital tools to complement the traditional teaching format. After all, according to experts, "every week of EI closures leads to considerable losses in the development of global human capital with significant long-term economic and social consequences. Accordingly, the governments and Education Ministries of many countries have already developed plans that summarise the following items [7]:

- *Use of existing online distance learning platforms – learning management systems (LMS).*

It is important that at present online platforms can incorporate training courses and resources in digital formats (text, video lectures, etc.), usually with a bank of relevant EER. Typically, teachers can select lectures and exercises, assigning them to students for usage through synchronous lessons. In educational institutions where such platforms do not exist, open EER can similarly be used.

- *Development of new open online educational platforms (virtual classrooms)* – teachers can remotely teach their pupils/students at home, using various platforms. Some "virtual audience" services exist within countries, and they have been located in China and Singapore, regardless of ownership type.
- *Partnership with private educational platforms* – one identified difficulty in using existing EERs is that their mass simultaneous use is only sometimes possible. In order to empower educational institutions, some platforms belonging to the private sector have already opened their EERs with free access just at the beginning of global quarantine (for example, in China and Japan [34]).
- *Cooperation at the international level for consolidation of existing online EERs* – although educational institutions in different countries, and sometimes some regions (states) within the same country, have different curricula, they usually teach similar disciplines, and that is why it is possible to consider the potential for the organisation of distant learning which consists in translation and use of foreign EER and digital resources, respectively, coordinating them with authentic curricula.
- *Use of all necessary electronic means* – return to the usage of some obsolete electronic means, such as television or radio broadcast lessons, for regions where the infrastructure is low.
- *Providing teachers with digital learning opportunities* – educational policies should provide continuous assistance to teachers in mastering online teaching methods (for example, as has been done in Italy). Such activities can be carried out through open web platforms designed for sharing with the possibility of exchange of author's developments – EER.

At the same time, in forming responses to the possible necessity of EI closure, educational policymakers should consider ways to:

- care for the emotional health of pupils/students;
- making necessary technological decisions to ensure continuous relationships between all participants of the educational process, their interaction and support of teachers in the teaching process;
- providing access to devices – pupils/students should have access to technical equipment; respectively, it is necessary to start projects to provide devices or provide alternative resources (printed workbooks) (for example, as it is done in the UK [9, 10]);
- IT infrastructure access management – simultaneous connection of all pupils/students can be problematic in some regions of their residence, so access to IT infrastructure should also be controlled to ensure the quality of education for all, perhaps even be regulated by way of setting certain time limitations;
- balancing traditional and digital approaches used in educational process replacement of traditional forms of learning by digital format is likely to affect both the health of students

and the quality of learning outcomes; it is logical to reduce the duration and number of lessons/classes and their combination with digital educational formats;
- security of web systems used in exams – exams often require strict identification of pupils/students; Appropriate technological and software solutions already exist for face recognition; introduction and use of these aids must be extended.

Thus, the explosive wave of urgent EI closures offered educators the opportunity to experiment, develop and implement new models of educational systems and approaches to the distribution and use of learning time. Educational institutions must be prepared to provide quality educational services. They have already faced a difficult choice of how to prepare for blended learning.

From now on, and because of present circumstances, education managers worldwide must create an updated educational environment model. They should answer the question: How can educators prepare for the execution of quality professional activities and the provision of quality educational services in an updated educational environment?

The digital twin of EI is an updated educational environment. The process of digital twin functioning must be based on the same managerial principles as actual EI, but because of specific features of the virtual environment and digital technologies. The functioning of a digital twin cannot be seen, but it is possible to take part in it and perform the same functions, act, achieve tasks, and get real results. To exercise the management of digital twin, EI uses a modelling method that allows the presentation of the main subsystems and processes of real EI in the form of schemes and models; it is done in order to select digital resources for appropriate support in cyberspace, and on this basis – to involve the participants of educational process in these activities. Thus, EI will exist and function in real and virtual dimensions. Thus, the task of management is to model a virtual reality of an educational institution. When creating a digital twin of an educational institution, the management should focus on a common strategy. In the virtual dimension, the educational institution must function the same as in real life, which ensures full implementation of all functions and has a clear structure.

The EI digital twin management process includes components similar to real EI: strategic, organisational, financial management, personnel management, infrastructure management, marketing of educational services, and operational management. These components are described below:

- strategic management – determining the strategy for the development of EI digital twin, blended learning, as well as criteria for achieving planned results;
- organisational management – ensuring the activities of EI digital twin, medium-term planning, coordination of structural units activities, monitoring the condition of subsystems, analysis of their activities;
- financial management – EI cash flow control, cash flow directing to achieve specific goals, minimising risks;
- personnel management – selection of personnel, personnel preparation for implementation of tasks related to blended learning, personnel professional activity in conditions of EI digital twin functioning;

- infrastructure management – a creation of material and technical base to ensure the functioning of EI digital twin, creation of comfortable working and learning conditions, accessibility for all participants of the educational process;
- marketing of educational services and PR – promotion of blended learning in the market of educational services, meeting the educational needs of consumers, communication with the general public in order to create a positive perception of distance and blended learning, quality assurance of educational services;
- operational management – short-term planning and solution to EI functioning problems.

First of all, a digital environment (web environment) of each separate EI; the conditions of this digital environment should provide for implementing the educational process in a mixed format based on the integrated use of traditional tools and Internet resources. In turn, the pedagogical community must develop innovative organisational and methodological approaches to provide educational services in the web environment. The conditions of above mentioned EI web environment should be formed in view of equal access to knowledge for all participants, in accordance with personal needs and qualities. After all, according to Caraivan [4], "The environment is a mixture formed by mass media and various methods leading to interactions. The educational experience is based on memorising interactions and practices exercised during interaction so that communication is, in fact, the main "ingredient" of the mixture".

Performed scientific research demonstrates the realisations of various authors, where the "Digital University" concept is the most remarkable.

The authors' understanding of the "digital university" phenomenon is based on the conceptual "matrix" consisting of four components: digital participation, information literacy, learning environment, curriculum and course design. According to the authors, none of these components can be considered new if regarded separately. However, their combination and analysis of their interrelations provide a holistic way to understand the digital university [33].

- *Digital participation* – provides for the involvement of university societies to spread the idea of universities being a public good for society.
- *Information literacy* – stands for the idea that students develop digital literacy skills to improve their academic potential and opportunities for personal development.
- *Learning environment* – means a combination of digital and physical spaces that exist within and outside the university; it is more than just a virtual learning environment of EI.
- *Curriculum and course design* – these are formed through "constructive coordination", evaluation and transition to the latest developments, such as digital analytics.

McCluskey and Winter [22] offer thesis: "Digital University is fundamentally different from traditional university". Declaring this idea, the authors put forward their thesis that education must change in response to growing demands for public accountability. Researchers claim that this goal can be achieved by using advanced ICT capacities.

There are many examples of digital universities functioning in the educational space of various countries [19, 37]. For example, universities and educational experts from Germany, Austria, Russia, Georgia and Ukraine are actively involved in international cooperation: they

have established the International Digital Network University, thus laying the basis for education to function by way of crossing the borders between the countries. According to the portal, "Network University is a virtual association of universities and higher education institutions created for long-term cooperation. Participating educational institutions provide online training courses certified by the European System ECTS, are recognised by all network partners and can be taken by students as electives". The most important task of a network university is to promote mutual comprehension. This is being achieved through structured intercultural exchange and joint development of educational proposals in the fields of education for constant development, inter- or transculturalism, conflict prevention and peace-seeking, as well as proposals for integrated subject-language learning in German CLILiG (Content and Language Integrated Learning in German) [13]. The network university includes:

- University of Bremen;
- Virtual Academy of constant Development (Germany);
- Ruhr University in Bochum (Germany);
- Viadrina European University in Frankfurt on the Oder (Germany);
- Ilia State University (Tbilisi, Georgia);
- Mariupol State University (Ukraine);
- Vienna Higher School of Agricultural and Environmental Pedagogy (Austria).

However, according to the author's concept, there is a necessity to develop not only digital IE (universities, schools, gymnasiums, lyceums, etc.) but, for the most part, digital prototypes of real educational institutions.

The analytical review of digital innovations showed that one of the 10 best strategic trends determined by the research and consulting company Gartner Inc. in 2017 is a digital technology called digital twin (DT-technology) [12, 14]. The digital twin concept is based on the convergence of physical and virtual worlds, where each object receives its dynamic digital representation (imprint). DT tools include powerful components such as big data, the Internet of Things, machine learning, and artificial intelligence, primarily used in industry. Broad access and use of these tools have made DT more cost-effective and accessible for the business world, including, in our view, the educational sphere.

According to Mussomeli et al. [27], "digital twins are multiplying as their capabilities and sophistication grow. Nevertheless, fully realising their promises may require integrating systems and data into entire organisational ecosystems".

It was found that DT is increasingly used in advanced industries to achieve various goals. According to research conducted by the Deloitte company, DT technology is spreading rapidly in industries such as aerospace, retail, healthcare and others. In industry, DTs are used to optimise the operation and to maintain physical systems and production processes, where digital twins are understood as digital copies of physical models with the possibility of observing their behaviour (both digital and physical format) simultaneously in real-time mode. Developed DTs allow the visualisation of objects or be used to evaluate technological solutions. Digital representation of objects provides for both the development of individual elements and the functioning dynamics of their physical analogue. In the industrial sector, too many digital twins (equipment, systems, separate machines, or even enterprises) were developed before the startup

of large-scale and high-speed production [5]. DTs can imitate any aspect of a physical object or process. According to the Deloitte report, the global market of DT technologies will reach the point of $ 16 billion by 2023 [27]. We have identified several definitions for the term "digital twin" [8, 14]:

- digital representation of real object or system;
- software analogue of physical device simulating internal processes, technical characteristics and behaviour of the real object under the influence of interference and environment;
- fundamental technologies evolving and covering physical and digital spheres and make it possible to obtain increasingly important digital results;
- digital copy of living or non-living physical object;
- digital replica (imprint) of potential and actual physical values, processes, people, places, systems and devices.

Researchers suggest the following classification of DT [39]:

- *Digital Twin Prototype (DTP).* The DTP duplicate contains the information needed to describe and create physical versions of natural objects, including geometric and structural models, specifications, conditions, cost models, calculations (design) and technological models of the object. A DTP duplicate can be considered as a conditionally constant virtual model of the object.
- *Digital duplicate instances (Digital Twin Instance, DTI).* DTI of an object describes a specific physical instance to which a duplicate remains associated throughout its life. DTs of this type are created based on DTP-duplicate and additionally incorporate production and operational models, including history of work production, applicability of materials and accessories, and statistics of failures, repairs, replacement of assemblies, aggregates, etc. Thus, the DTI-duplicate of the product is subject to change per changes of a physical object in operation.
- *Digital Twin Aggregates (DTA).* DTA is an information system for managing physical instances related to a family of objects; it has access to all of its DTs.

According to the classification above, each type differs in functionality, complexity and technology integration level. In summary, DTs can be divided into digital models of systems, specific lines and separate components of certain lines. Digital twins can form connections between all objects of the natural physical system, enabling cooperation in the team/teams and interaction between teams. While functioning in DT mode, one can create, assign, and track tasks meeting real facilities' business priorities and needs. We can single out the reasons for the sudden demand for digital twin technologies [14]:

1) they bring considerable value to the business and become essential for digital strategies;
2) the rapid growth of digital technologies introduction is explained, in particular, by active marketing and organisation of training performed by their suppliers.

Nowadays, given that DT technologies have relatively strong support from IT giants, including IBM and SAP, various companies have already paid close attention to digital technologies. In times of forced quarantines, it has been reported that many well-known companies have ensured the efficiency of continuous production processes in conditions of their digital twins.

An essential feature of digital twins is that their functioning as a model or as a system is possible in both online and offline modes. For presentation and improvement, the functionality of DT is constantly updated from several sources [12]. For example, in marketing activities, virtual avatars can provide tours for visitors interested in DT real estate. Accordingly, visitors can provide feedback and ask the owners questions in real-time. DT also allows to organise training for new employees to perform their professional duties and use equipment, regardless of their location in the world.

As mentioned above, DT technology is spreading rapidly in various fields and, ultimately, according to the author's vision, should affect education. Already in 2019, Gartner included the concept of Digital Twins in the TOP-10 list of technological trends and predicted that "in the near future, digital twins will exist for billions of things" [14]. Over time, the DT trend will evolve and expand – individuals, teams, services, businesses and even cities have or are forming their digital twins. So, in the coming years, DT technologies can be expected to be widely deployed in education as well. Given the specifics and qualities of DT, we can assume that their qualities, combined with the development of Internet powers, will open opportunities to monitor, control and optimise the educational process in EI both in distance and full-time traditional format, as well as to use their integration form – a mixed format.

Due to fast interactive feedback, the EI digital twin's emergence will help develop innovative solutions to complex educational problems – in particular, to build an authentic innovative educational web environment for each EI. After all, the benefits offered by DT can provide many opportunities not available in educational institutions' physical educational space. Nowadays, when educational institutions have to learn to work virtually, digital twins can become the only opportunity to create an EI web environment with comfortable conditions for the development of all participants of the educational process and the provision of quality educational services in blended learning. We acknowledge the possibility and the necessity for building an EI digital twin, using EER and LMS as a basis, because of their capabilities to support the entire life cycle of educational institutions. After all, DT technology, taken as a digital dynamic resource, can ensure the creation of a "digital" or virtual "building" inside the educational institution and provide for the following:

- to combine previously incompatible systems, resources and formats in order to gain new insights, optimise management of educational process and remote monitoring;
- to plan and implement a sequence of production tasks and find ways to distribute them among the performers;
- to provide influence at the organisational level – for EI managers, there appear opportunities to develop planning of all production processes in advance and to manage them remotely;
- to provide control and monitoring of teachers' workplaces and conditions of the real educational environment, thereby improving the experience of EI administration staff;

- to minimise participants' presence in the EI facility's educational process and protect them from possible risks.

It is seen that in the "walls" of EI digital twin, all the traditional components of the educational process and digital resources used in teaching should be integrated. The main feature of the EI digital twin is the possibility of continuous updating following changes in its educational and technological contents, as well as in the general development of digital technologies. According to the author's vision, the EI digital twin, as an integral web resource, should include all its real components in digital format:

- means of educational process organisation;
- EI structure (classrooms, study rooms, electronic library, administration offices, teachers rooms, rooms for methodologists, psychologists, etc.);
- teams (groups) of participants in the educational process;
- total amount of workload and expected learning outcomes of students;
- list, content, duration and interconnection of subjects, disciplines, etc.;
- description and tools of the internal system of education quality assurance;
- teaching aids;
- means of technological and technical equipment;
- nomenclature and technologies used;
- system of collection and storage of educational and methodical information – web library;
- other educational components (by decision of EI administration).

The more efficient technological systems and resources are included in constructing the EI digital twin, the more functional the educational web environment becomes, forming digital streams that add opportunities for EI. It is assumed that in conditions of the web environment of EI digital twin, it is possible to exercise the following tasks:

- to implement management, organisational, and educational processes in blended learning;
- to coordinate the logistics of institution activity;
- to configure virtual training modules for educational tasks;
- to carry out remote analysis and diagnostics of processes in each classroom.

Among the main conceptual provisions of DT application in EI, we would like to accentuate the following: "digital representation and system support of EI real life cycle – ensuring quality implementation of all educational functions". Accordingly, the EI digital twin is created to facilitate the tasks for the following groups involved in the educational process:

- manager:
  - to keep in control all complexity of the educational process;
  - to provide an entire educational environment for data that has been represented in various systems and EERs;
  - to analyse operational data related to the implementation of the educational process;

  - to outline the opportunities to improve the quality of the educational process, etc.;
- teacher:
  - to carry out the educational process (including the use of such components as scheduled, assessment system, teaching materials for disciplines, home assignments, electronic communication, e-library, etc.);
  - to implement self-learning and self-improvement, etc.
- pupil/student:
  - to gain access to quality education due to the usage of quality access and quality resources.

Although the development of an operational digital model of EI digital twin can be considered a rather difficult task for practical implementation, we should not forget about its expected value, which mostly lies in the implementation of basic functions:

1. Ensuring support for organisational and managerial decisions.
2. Reproducing the educational process in real-time mode for everyone.
3. Ensuring the integrity of the educational system.

Suppose an educational institution is ready to create its authentic digital twin, which will be an innovative solution and provide comfortable and understandable conditions for the educational process to function. In that case, it can proceed to the development of a digital twin and pre-answer the following questions:

1. Which systems, processes, tools, and digital resources would be powerful and effective components for inclusion in the EI digital twin?
2. What infrastructure platforms and LMS can be used as a basis for building a digital twin?
3. How EI digital twin can reduce EI expenditures on the organisation of blended learning?

The answers will facilitate a logical approach to the formation of purpose, tasks, and ways of digital twin formation, as well as the choice of a comfortable, transparent, and accessible web toolkit for its construction. The digital twin as a holistic web resource should cover and combine physical and digital spaces of educational institutions and enable all participants of the educational process to obtain quality results under any conditions that may be dictated by modern society.

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