Management of digital transformation of educational technology: key elements

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Abstract

The aim of this paper is to provide insight into the key elements of management of digital transformation of educational technology and to suggest avenues for future study. This paper offers an overview and classification of education technology and its links with the phenomena of digital organization and digital ecosystem, shows current digital trends in education technologies. Using technology to dramatically enhance universities' efficiency or scope is popular topic among academic society. But, the managerial issues of digital transformation of education technologies are still under question because most of the papers cover didactics and pedagogy issues of the digital education technology introduction. In this paper, we tried to summarize what are the keys to achieve digital transformation of education technology successfully. The findings suggest that digital transformation of education technologies need changes in content management and experience management strategies and practices, organizational and academic culture, decentralized model of operation, new financial and operative models, data-driven decisions and control tools. This results in necessity to manage digital transformation of education technology using tools of change and project management. Although the Digital Transformation has grown to include all sectors of education and business, there are some areas with more opportunities for future growth. This research was funded by RFBR, project number 20-010-00571 The Impact of Digital Transformation on Improving the Quality and Innovation of Services".

Keywords: Digital Transformation; Education Technology; e-learning.

1 Introduction

This study is intended to provide a more in-depth definition of digital transformation as key terms related to the development and use of electronic resources for a better electronic education system. Digital transformation is integrating digital technology into all areas of a business, fundamentally changing the way it is operated and providing customers with value. It is also a cultural shift that requires organizations to constantly challenge the status quo, experiment, and failure comfort. The digital transformation is the first in the company strategy's list of tasks, but in reality, several companies fail in their assessment of digital transformation levels, the Digital Maturity Test DES2018 results. Therefore, the goals are not being achieved and a lot of work remains to be done. The main keys to getting ahead and achieving a successful digital transformation in the field of electronic education will be explored in this paper.

That target customer is often students in education, though it could also be faculty, staff, alumni and others. For example, a digital transformation to transform the students' experience could include items such as: digitally recruiting students, using social media and text messaging as part of a data-driven decision-making process; Providing a variety of online learning options for students to choose from key points in their academic career; working with faculty and programs to convert courses into flipped and blended models; working in partnership with industry to provide digital badges and certificates to enhance career opportunities (Allan, 2010).

Combining these items into a wide-ranging digital transformation would bring together groups across the entire institution to put the student experience first. In addition, the institution could combine data from the new digital processes to determine its next transformation and power it.

All this can be the difference between a University of the 20th century and one of the 21st century. Over time, the most desirable students are expected to be attracted to those universities which embrace the digital age

on their terms rather than being overwhelmed by them. This implies that being mindful of unused patterns in rising innovations and having the capacity to quickly tackle their potential to drive progressed results will be a key differentiator inside Higher Instruction.

1.1 The nature of educational technology

Educational technology can mean different things to different people. Those who practice as a technical career in this area have struggled to agree on exactly what the word would entail. Educational technology is a dynamic, interconnected process involving individuals, processes, concepts, tools and organization engaged in the analysis of problems and the identification, implementation, assessment and management of solutions to these problems in all areas of learning. Computers, television/radio, printed materials, and operating systems also represent a range of diversity in types of technology (Nel, Dreyer & Carstens, 2010).

For understanding the nature of educational technology, we need to know the development of the term. The earliest form of instructional technology was related to the use of audio-visual aids such as charts, models, maps, experiments, and concrete materials (AETC, 2008).

With the emergence of physical science and the subsequent technological revolution, an era of sophisticated hardware and software such as projectors, tape recorders, radio and television came into being, educational technology meant sophisticated devices and equipment used to display instructional content (AECT, 2007). Then came the age of the mass media, which for educational purposes contributed to the major communications revolution. There is a synergistic relationship between the domain as it is digitally represented by a wheel-like-virtual, with each domain on the periphery linked to a centre of theory and practice.

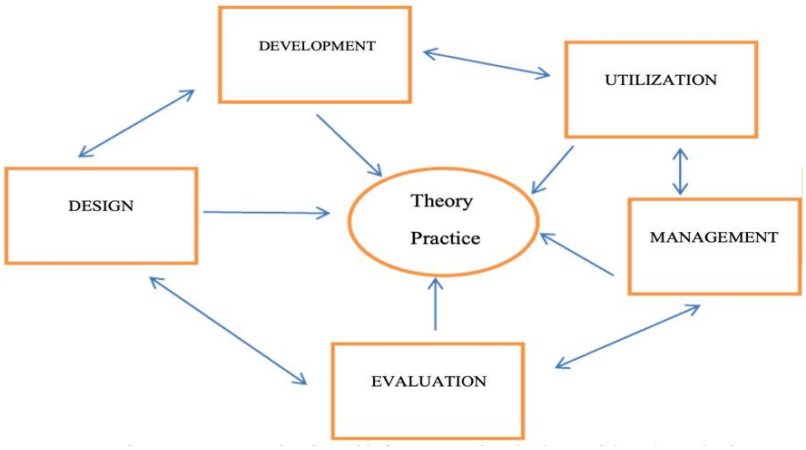

Figure 1. The Domains within the Field of Instructional Technology and the Relationship between Domains (Seels, & Richey, 1994).

This representation scheme was designed to avoid erroneous conclusion from readers that these domains are linearly related (Seels, & Richey, 1994).

The emphasis on systems approach gave rise to other aspects of education like: The educational planning or organization; The psychology of learning & The curriculum development and course design; The production of teaching-learning material; Audio-visual method of presentation and dissemination of information, storage and retrieval; The allocation and management of human and non-human resources; The cost effectiveness of medial in education; Innovation & Evaluations; partnerships in education (Vatolkina & Fedotkina, 2018).

Thus the nature of Educational Technology may be viewed from the entire teaching-learning processes like: Specification of goals and behavioral objectives; Analysis of the characteristics of the learner; Selection and organization of the content or subject matter to be learned; Methods and strategies of the presentation of the content; Use of aid-material, software and hardware, mass media and communication techniques; Effective arrangement of learning situations and learning environment; Effective classroom control and management,

and; Continuous feedback and evaluation of the results. After defining educational technology, the main obstacles to implement such technologies start to appear.

1.2 Digital transformation trends in education

The digital transformation is not a new concept or process in education, as it has been already described in the section above, the transformation has been happening worldwide, and in some cases, it has been showing excellent progress and results (World Economic Forum, 2016). To evidence the purpose of this article, this section will list six trends, in what does digital transformation look like in practice (Agarwa, 2003, Aleksandrov et al, 2018).

1) Augmented Reality(AR) / Virtual Reality(VR) / Mixed Reality(MR)
2) Classroom Set of Devices
3) Redesigned Learning Spaces
4) Artificial Intelligence(AI)
5) Personalized Learning
6) Gamification

An observation at examples of digital innovations in education builds a closer relationship and empowers educators across the whole educational industry. In the classroom, educators in all grades begin to know the advantages of technology.

For distance learning, which integrates with the virtual learning environment the following components are crucial: content management system; on-line editor for the creation of materials for distance courses; training management system; virtual learning environment; other additional modules designed to provide a comprehensive solution for organizing distance learning at the university (Berman, & Bell, 2011). There is a large number of distance learning platforms, the most well-known of which are Blackboard, Moodle, eLearning Server 3000, Web Course Tools, ATutor, Claroline, Dokeos, LAMS, OLAT, Open ACS, Sakai, Acollab, Colloquia, COSE, DodeboLMS, ELEDGE (Cloete, 2000).

2 Methodology

2.1 Maturity level

This study namely the management of digital transformation of educational technology, with the purpose to identify key elements of digital transformation was developed in a qualitative way aiming to provide enough information to locate and help to manage different institutions in the process of adopting digital technologies as support for the new era of learning and teaching.

The study is based on the concept of maturity level created after a qualitative analysis of several universities strategies from European Union (including the United Kingdom), Russia, Australia and South-Asia. The key parameters observed in these universities strategies were the way they have been developed to assist institutions in their practice of delivering a quality technology enhanced learning experience for their students, teachers and staff.

The concept of maturity levels is currently quite popular and in its most general form characterizes the development of the ability of a system, process or technology to perform a certain activity and achieve certain goals in accordance with the established requirements or criteria for achieving success. Typically, successive levels of maturity reflect the progressive build-up of capacity and improvement in the performance of the activity or function performed. It allow to assess a set of heterogeneous qualitative and quantitative parameters of systems, processes or technologies, such as predictability, controllability, focus on stakeholders, completeness and effectiveness of the activities performed, and others. Maturity level models have been developed for a wide range of objects, including the organization's management system (ISO 9004), portfolio

program and project management (P3M3), organizational processes (CMMI, ISO/IEC 15504), technology (ISO/IEC 15504) R 58048-2017), project management (OPM3, PMMM) (Rudenko & Subbotina, 2019).

Attempts to theoretically comprehend the logic of digital transformation have become a new stage in the development of models of maturity levels. So, at present, researchers have proposed general models of the level of maturity of digital transformation of an enterprise (an overview of the models is presented in (Aniruddha, 2020), production technology of industry 4.0 (MTMM (Gracel & Łebkowski, 2018), specific digital technologies such as artificial intelligence, data analysis, data management, and also for individual consumer properties of digital technologies (UMM is the level of maturity of the ease of use of a technology or service (Carvajal & Moreno, 2017). But there is still lack of comprehensive maturity level of digital implementation in higher education that can be used as a reference model for the digital transformation in higher education.

To build such model we decided to use the model that was proposed in ERASMUS+ CBHE project (# 586060-EPP-1-2017-1-RO-EPPKA2-CBHE-JP "Excellence in Engineering Education through Teacher Training and New Pedagogic Approaches in Russia and Tajikistan". (Smirnova, Lazarou, Vatolkina & Dascalu, 2019). This model is based on ISO 9004 logic and include nine key elements divided into five distinct levels for the success of digital transformation in higher institution. The adaptation comes with the goal to help institutions to locate their stage in implementing changes for adopting digital ways of teaching and learning, aiming to keep them in the market for the next decades, see table 1.

2.2 The use of the suggested model

The suggested maturity model was created for use at the enterprise level, or by the organizational areas in charge of providing leadership in technology enhanced learning and related services. The suggested maturity model was created for use at the enterprise level, or by the organizational areas in charge of providing leadership in technology enhanced learning and related services.

Performance Indicators are statements in a matrix that display the progress toward achieving best practices. The scale is a five-point rating system for self-evaluation and contrast. After a rating has been assigned, the reasoning for that rating on a scale of 1 to 5 should be given, as evidence to support the decision. The reasoning outlines key reasons for the ranking, which is then validated by proof. A URL leading to a planning document, paper, guidelines, service platform, or a written statement containing extracts or describing the source of the facts, or artefact, may be used as evidence. If necessary, this proof will be used to defend or support the ranking.

3 Results

To build maturity level for implementing a digital strategy at the university we explored approaches to digital transformation (Zaitseva, 2017), in higher education which include the following pillars: academic culture, customer focus, decentralization, measurement and control, clear objectives, conscious team, talent management, data and analysis. On the other hand we looked into the components of e-learning (MacDonald, 2005; Hammad, 2018; Usoro, 2008). "Diverse higher education institutions used information technologies as a key strategic to reducing costs and at the same time to support initiatives in advancing student centred flexible learning, and improving the quality of teaching" (Lip-Sam, 2015).

(Marshall & Mitchell, 2007) proposed a Benchmarking With The E- Learning Maturity Model, which provides an institution's understanding guide of their e-learning capability, and they list 13 categories which they believe to be essential to create a model for a better understanding of the obstacles that e-learning organizations face, as well as the resources that emerging technology and pedagogies provide for promoting student learning. As the result we proposed the following components of the maturity level for the development of digital strategy:

1) Development of a policy for the development of educational technologies
2) Deployment of educational technology policy
3) Exchange of knowledge, information, best practices in the field of application of educational technologies

4) Educational technology infrastructure
5) Monitoring the effectiveness of the application of educational technologies
6) Application of electronic educational technologies
7) Application of active educational technologies
8) Advanced training in the field of application of educational technologies
9) Postgraduate training

The digital transformation of education maturity model can be applied to all educational levels. Adapting existing models to match specific needs is wiser than proceeding without any plan. However, flexibility is needed to adapt a model to a given situation. Digital transformation at higher institutions can vary considerably in complexity and size. The maturity model described above is comprehensive – it covers all the options that can be included in a complex digital education development project. However, some of the elements can be simplified according to project's objectives and requirements, such as budget, expertise or organizational constraints. Future studies can complete the dynamic of this maturity model suggestion, adding an alternative strategy of how implement such technologies efficiently.

4 Conclusions

Companies have had to begin a transformation to adapt to the digital era. Digital transformation is reshaping the manner in which organizations emerge, operate, and develop (Chan & Chung, 2002). It also introduces changes in how to enter the market and deliver services. Higher Education institutions are no exception. Therefore, why university classrooms should undergo digital transformation? This question should be answered before the introduction of the main steps to a successful digital transformation in education. It is necessary to analyse the potential obstacles or roadblocks that an organization may face in order to understand how a complete and effective digital transformation will take place. By understanding those issues, they can be overcomed. Improved standards for the training specialists define the current state of education, which implies the relentless search for new approaches and resources to increase the efficiency of the educational process. Enhancing education and enhancing its efficiency is assured by the use of the management of implementation of newest technologies. This research introduces a maturity model that that portrays digital transformation as a dynamic ecosystem of capabilities. The model proposed answer the questions, from where to start and where to go, proving useful in each phase of transformation assisting in identifying gaps, determining key areas to focus on.

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Table 1. Maturity level for the development of digital strategy at universities.

Key Elements	Maturity level				
	Level 1	Level 2	Level 3	Level 4	Level 5
1) Development of a policy for the development of educational technologies	The planning process is not systematic. Policy and goals are undefined.	There are elements of a policy-making process for educational technology development. The goals in the field of development of educational technologies are included in the general development policy of the university.	The policy-making process has been further developed to include an analysis of the needs and expectations of students and teachers. The planning process involves examining changing external trends.	A structured process for setting policy and goals is in place. The policy in the field of development of educational technologies exists as an independent document. Trends and resource availability are assessed and examined before plans are approved.	The educational technology policy is defined, regularly reviewed, and it can be demonstrated that the policy has led to the achievement of education quality objectives. Effective monitoring and reporting mechanisms are in place, including the use of stakeholder information in planning.
2) Deployment of educational technology policy	Performance indicators related to the application and development of educational technologies have not been determined.	Policies are converted into indicators for faculty assessments. The performance of the indicators is not assessed systematically.	The policy is converted into indicators for the assessment of faculties, departments. The progress of work to achieve the indicators is assessed. Positive and negative deviations from the plan are analyzed and appropriate action taken.	The policy is converted into indicators for evaluating faculties, departments and teachers. The assessment of indicators is associated with the system of labor motivation and affects the bonuses for departments / teachers. The progress of work to achieve the indicators is assessed. Appropriate action is taken.	The indicators related to the application and development of educational technologies are regularly analyzed and updated in accordance with the policy. An assessment of progress towards achieving the goals indicates numerous positive trends. Policy changes are communicated to relevant stakeholders and to all levels of the organization.
3) Exchange of knowledge, information, best practices in the field of application of educational technologies	There is no process of exchange of knowledge and best practices at the university.	There is an irregular exchange practices within individual departments (faculties, departments) in the form of methodological seminars and other events.	There is a regular process of exchange between departments in the form of methodological conferences, seminars and other events. There are elements of a best practice databank.	The exchange practices are carried out not only within the educational organization, but also with partners of the university and other interested parties. The information received from partners is disseminated within the university.	Management are used to develop educational technologies at the university and this has led to the achievement of the organization's goals in improving the quality of education
4) Educational technology infrastructure	A basic infrastructure has been created for the application of modern educational technologies. Not all teachers have access to infrastructure.	Planning and management of educational technology infrastructure is carried out. Legal and regulatory requirements are taken into account. Access to infrastructure is limited.	Periodic analysis of infrastructure and related processes is carried out with a focus on the future. Most teachers have access to infrastructure.	Evaluation of the effectiveness of the use of infrastructure in the educational process for planning in future periods. All teachers have access to infrastructure. The infrastructure meets the needs of the educational process.	Infrastructure is managed and developed with policy and educational technology development goals in mind. All teachers use such infrastructure actively in the educational process. Infrastructure efficiency increases and compares favorably with other organizations.

5) Monitoring the effectiveness of the application of educational technologies	Monitoring is not carried out.	Monitoring is carried out on a case-by-case basis, and there are no corresponding processes.	Periodic analysis of infrastructure and related processes is carried out with a focus on the future. Most teachers have access to infrastructure. Changes in legal and regulatory requirements are systematically tracked.	The monitoring process is carried out regularly. Monitoring is focused on the needs and expectations of teachers and students. Tracking procedures for legal and regulatory requirements are effective and efficient.	The monitoring process is systematic and planned. The collection of information from employees of the organization and students is carried out through professionally conducted surveys and through the use of other mechanisms such as groups for thematic sky poll.
6) Application of electronic educational technologies	Electronic educational technologies in the educational process are used unsystematically by individual teachers.	The university has created a subdivision of electronic (distance) education. There are distance learning programs.	The university has created elements of a digital educational environment. There are additional and basic educational programs implemented in a distance form.	The university has created a digital educational environment. Electronic courses have been introduced into some full-time / part-time educational programs of higher education. There are elements of a local regulatory framework.	The digital educational environment functions effectively at the university. Electronic educational technologies are widely used at all levels of education. A corresponding local regulatory framework has been created. MOOCs are created.
7) Application of active educational technologies	Active educational technologies in the educational process are applied unsystematically by individual teachers.	Active educational technologies in the educational process are used regularly within the framework of individual educational programs.	Active educational technologies in the educational process are used regularly throughout the university.	There are elements of a local regulatory framework. The educational technologies used are adequate and correspond to the goals and content of educational materials.	The university effectively uses active educational technologies at all levels of education. A corresponding local regulatory framework has been created. The effectiveness of the technology is regularly evaluated and improved.
8) Advanced training in the field of application of educational technologies	Professional development is not carried out systematically. Competence testing in the field of educational technology is not carried out.	Continuing education in educational technology is part of an overall development plan that is linked to university policies.	A system of advanced training in the field of educational technologies has been developed. At least half of the teaching staff are covered by this system.	An effective system of advanced training has been developed. Most of the teaching staff are covered by this system. There is a program for assessing the competence of teachers.	The effectiveness of the professional development system is assessed by regulation in order to improve the system. Most of the teaching staff are covered by this system.
9) Postgraduate training	Preparation of graduate students for the use of educational technologies in future teaching activities is not carried out.	Within the framework of postgraduate programs, a course in Pedagogy and Psychology is conducted.	A course in Pedagogy and Psychology is conducted, as well as other courses that allow to study the main modern educational technologies.	Beyond a course in Pedagogy and Psychology, other courses that allow to study modern educational technologies to a specific subject area are conducted.	Beyond a course in Pedagogy and Psychology, and other courses about modern educational technologies to a specific subject area, regular pedagogical practice of graduate students is organized.