

# The Role of Digital Learning Innovations in Strengthening Human Capital: A Mixed Educational and Corporate Perspective

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## Abstract

The current era is influenced by digital transformation together with Industry 4.0 and 5.0, which also significantly affects the area of human capital management and development in the form of education. The article analyzes the strategic use of information technologies, including artificial intelligence (AI) and machine learning (ML), in the process of increasing the efficiency of education and in the adaptation process of employees. The theory is devoted to human capital, potential and innovations used in the educational process with an emphasis on modern digital technologies, pedagogical models and adaptive learning. The research analyzed the results of a quantitative survey among Slovak university students (n=78). The results showed that students are very satisfied with current forms of teaching in the on-line space (video lectures, problem-solving tasks). However, universities should consider technical limitations or mandatory interaction of participants, because these two factors are perceived by students as barriers. To support the research, a case study of the Slovak branch of HPE was also analyzed, where it was confirmed that personalized education using modern technologies (cloud, educational tools based on AI and ML) makes the employee development process more efficient and improves the quality. The results of the article emphasize the necessity of cooperation between the human factor (human resources specialists) and technologies in the employee education process. This makes it possible to ensure a resilient and qualified workforce that will be able to deal with the situation and challenges of the digital economy.

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**Keywords:** Human capital, Education, Corporate learning, Information technology

## 1. INTRODUCTION

The digital economy, technologies including digitalization affect not only people, but also organizations, which should change the process of recruiting and training employees to secure competitive personnel. Since 2011, there has been talk of Industry 4.0, when technologies were at the forefront, but currently we are talking about the return of people to the first place, which is the meaning of Industry 5.0, when technologies (including artificial intelligence, machine learning, or virtual reality) and human resources should cooperate with each other and there should be no gradual substitution. Their cooperation is a key factor in competitiveness, the introduction of innovations into processes and the sustainability of the organization. Innovations in the field of machine learning systems, generative artificial intelligence and tools supporting the decision-making process are coming to the fore. All these events mean the need to change the requirements for human resources and capital, which are dissonant with them (knowledge, skills, competencies) [1].

Traditional approaches to employee education are no longer sufficient, as the speed of technological progress, together with the massive expansion of AI, is causing accelerated skills obsolescence. Organizations therefore need to develop flexible, effective and adaptive learning systems that respond to the need for continuous learning and readiness of workers for new work tasks. In this context, the concept of human capital is gaining importance, emphasizing investments in education, skills and abilities of individuals as a source of long-term economic benefits [2]. At the same time, with the growing importance of AI, human capital can no longer be understood only as a sum of knowledge or technical competencies — it also reflects the ability to adapt, think creatively, work with intelligent digital tools or cooperate with autonomous systems [3].

In response to these challenges, organizations have started to implement technologically supported forms of learning, such as e-learning platforms, hybrid learning models, personalized learning, intelligent tutoring systems or learning guided by artificial intelligence. Methods of education, their analytics and systems using artificial intelligence allow personalizing educational content to the needs of individuals, i.e. employees, but also to indicate the expected success of an employee on each educational course, or to record his/her obtained certificates, completed courses and training. The biggest advantage is that such systems are suitable for use in organizations, mainly because of their ability to recommend additional educational content, suitable courses and training. Education set up in this way leads to optimization of the organization's costs, increases the availability of educational courses and enables personalization [4]. Thanks to this, new educational approaches arise that are based on innovations, and their goal is to change the position of education within the strategic management of the entire organization.

Digitalization and the use of modern technologies in the educational process are not only implemented within the organization. Modern and innovative approaches can also be seen in universities, where modern and online approaches in education had to be introduced since the Covid-19 era. Since then, electronic educational systems, digital libraries, e-books, online testing of student knowledge, virtual classrooms, and various assessment algorithms have been used much more. A modern educational ecosystem should be based on modern technologies, including systems supported by artificial intelligence or machine learning [5]. Current trends mean that the university

environment must adapt to modern technologies and teaching must be connected to practice so that students learn to work with new technologies and become familiar with them.

The integration of modern digital trends into the educational process is particularly visible in countries where universities are focused exclusively on online education. This contactless method of teaching may suit some students much more for the second reason that they have greater flexibility of education, the possibility of individually setting the pace of teaching, which is optimal for the individual. These benefits also support motivation and willingness to learn, which is why such students may have better results. The disadvantages of this type of education include higher digital literacy, self-discipline, self-regulation, but also the willingness to learn with new technologies. Therefore, it is necessary to pay attention not only to the use of modern technologies, but also to the support and adaptation of students, always when adopting new technology [6].

It is also worth considering the perception of students of digital forms of teaching, which are built on new modern technologies. It is important to find out which factors can influence students in terms of their motivation, success in education and satisfaction with educational approaches. It is necessary to analyze the way in which forms of education can contribute to the development and building of students and employees, i.e. increasing their knowledge, skills and competencies. Our article combines two areas of education [7]:

- student education (university in Slovakia)
- employee education (Hewlett Packard Enterprise branch in Slovakia)

The aim of the article is to analyze how modern technologies and innovations in the educational process support motivation and development of human capital (knowledge, skills, competencies) and what factors determine their effectiveness. The connection of two areas (student education, employee education) allows for a better understanding of how modern technologies and innovations can shape human capital.

The article was created due to the need to connect these two mutually influencing environments, which are the basis of the competitiveness of not only organizations, but also entire countries. These are key topics for management practice, but also socio-economic research.

## **2. THEORETICAL BACKGROUND**

The theoretical part consists of two main chapters, namely human capital and its development through education and innovations used in the educational process of employees. Both chapters are beneficial at a time of development of human capital, which represents a set of innate and acquired knowledge, skills, and competencies used by an individual in his personal and professional life [8, 9]. Human potential, on the other hand, reflects the capacity of an individual to continue to grow, develop and acquire new competences for the future [10, 11]. Innovation in education subsequently becomes a mechanism through which this potential can be transformed into usable skills [12].

In the context of Industry 4.0 and Industry 5.0, this connection takes on fundamental importance, as digitalization, automation and new technologies change the nature of work tasks, the organization of

work and the requirements for employees. The synergy between technology and human creativity thus becomes a decisive factor in creating sustainable, knowledge-based organizations [13].

## 2.1 Human Capital and Its Development Through Education

Human capital is a fundamental component of every person – it includes everything that a person knows, controls, and contributes to the functioning of the organization [8]. According to Menzies (2003), human capital is a set of intangible inputs that an individual uses in performing work activities – in contrast to physical or financial capital, which is represented by material resources [9]. The literature shows a close relationship between human capital and human potential. Human potential represents an individual’s internal development reserve, which can significantly increase their future human capital [10]. Even under ideal working conditions, an employee’s development may not be successful if their own potential – abilities, motivation, predispositions – are not sufficiently developed. Human potential thus represents the “driving force” of the organization [11], which is reflected in people’s future ability to adapt, innovate, and grow [14].

In modern organizations, the assessment of human potential is no longer based solely on the subjective judgments of managers. Different authors present innovative methods of its diagnosis, which include [15, 16]:

- machine learning algorithms that analyze the digital footprint of applicants and employees,
- digital video interviews with the involvement of computer vision that evaluate non-verbal expressions,
- gamified assessments that simulate work situations and measure the behavior of individuals.

These tools are becoming part of the so-called people analytics, where HR data is used to predict employee motivation, performance, talent, or adaptability [17, 18].

A key aspect is also the connection of human capital and potential with digital technologies, which is especially evident in the Industry 4.0 and 5.0 environment. Today, HR systems collect data on work behavior, education, and performance, which allows organizations to plan development activities more accurately than ever before [15].

Human capital development can be seen as the foundation of long-term successful business. Human capital creates both material and intangible values. HR development represents systematic and planned activities that increase the capabilities, knowledge, and skills of employees in order to support the strategic goals of the organization [19, 20].

The most common forms of development include [21]: formal and informal education, self-study, mentoring, e-learning, rotational positions, and job shadowing.

Mentoring supports professional growth by guiding a less experienced employee to a more experienced colleague [22]. E-learning enables learning using digitized educational materials [23]. Self-study is an autonomous form of learning that develops initiative and the ability to take responsibility for one’s own growth [24].

Based on the above, it can be concluded that the development of human capital is closely linked to the educational process, which shapes the adaptability, talent and readiness of employees for a changing organizational environment.

## **2.2 Innovation in Employee's Education**

Employee training is a continuous process during which individuals develop their knowledge, competencies and ability to perform work tasks [25]. The basis of effective training is the systematic identification of training needs, which allows determining the difference between the current level of competencies and the requirements of specific job positions [26]. Quality training increases productivity supports employee satisfaction and contributes to building a company's competitive advantage [27–29].

## **2.3 Digitalization as a Driver of Innovation**

Modern education is inextricably linked to information technology (IT), including solutions based on artificial intelligence (AI) and machine learning (ML). IT is no longer just a work tool, but fundamentally influences the organization of work, forms of education and the content of educational activities. Its importance has been growing steadily since the Second World War, when the main impetus was the need for rapid and accurate dissemination of scientific information [30, 31]. Today, IT and AI affect all sectors of the economy and support process modernization, innovation, research and human resource development. Proper integration of AI and ML enables personalized learning, employee performance prediction, adaptive content recommendations and automated assessment, significantly increasing the efficiency of educational processes [32, 33].

However, excessive use of digitalization can cause cognitive overload and reduced ability to concentrate [34]. The effectiveness of digital education therefore depends not only on technological tools, but also on the quality of didactic processing, the competence of lecturers and the active engagement of participants [35]. Many organizations today use LMS, virtual training environments, simulation applications and AI/ML adaptive learning systems [36], which enable flexible and personalized acquisition of new competencies, rapid feedback and optimization of the learning process based on data-driven user behavior.

## **2.4 Online Education Management and Quality Assurance**

Quality education is not possible without systematic management. Organizations often use TQM and ISO 9001 to standardize processes, control quality, and continuously improve educational activities. TQM is based on four pillars: meeting the needs of internal and external stakeholders, quality management of processes with an emphasis on learning, qualitative leadership and management approaches, and continuous improvement through innovative tools [37].

The transformation of education consists of the integration of modern technologies, interactive teaching materials, online systems that support teamwork, creativity and autonomy [37, 38]. This

form of transformation crucial for the development of competencies needed in the digital economy – critical thinking, flexibility, digital literacy, and the ability to solve complex problems.

### 3. METHODOLOGY

The article processes secondary data (theoretical background, research at a university in Slovakia) that support the findings from primary research at HPE.

**The primary research** was conducted in the form of qualitative interviews with HPE managers from different departments and at different management levels. These were male managers aged 30 to 55. Managers at higher management levels had worked at HPE for longer (on average 15 years) than those at lower levels (on average 7 years). Younger managers held lower management positions. The interviews were conducted between February and June 2025. The interviews collected data on the learning environment, human capital development opportunities, and employees' experiences with innovative forms of learning. The interviews were semi-structured, i.e., they included both closed and open-ended questions to capture differences in respondents' attitudes and experiences. The aim was to identify relationships between learning conditions, the level of human potential, and the extent of use of innovative learning tools in organizations.

The data obtained from the interviews were processed in Excel software (because there were only 10 interviews, with some questions having a yes, no, or Likert scale answer (from 1 to 5, with 1 meaning not at all/unimportant/no interest). The information obtained from the primary research was of a qualitative nature, i.e., no special evaluation methods were used. The managers' responses were formulated into a coherent text within the article, which was supported by the analysis of secondary research and other sources.

The semi-structured interview method was deliberately chosen because there are only a few managers in the HPE organization in Slovakia who are more comfortable conducting an interview than filling out a questionnaire. Therefore, from a capacity, time and financial perspective, interviews were chosen as the best method to obtain the necessary data.

**Secondary research** that supported our findings from HPE was conducted by authors [39], who analyzed innovations in online education at one of the universities in Slovakia that provides its entire studies in the form of online teaching. A secondary questionnaire at the university was completed by 78 students. The demographic distribution of students at the university is shown in TABLE 1. In it, the data from the secondary questionnaire survey are descriptively analyzed (percentages, integer values), which is sufficient given the fact that this is only supporting research and not the main one.

In the case of secondary research, which was a questionnaire survey at a university among students, we see its meaning when comparing the answers with HPE managers. In this case, two worlds meet, the world of employers (HPE and expectations from future employees) and the world of potential employees (university students in Slovakia, who should reflect on the company's requirements). The university questionnaire was chosen because young people prefer online communication and thus fill out an online questionnaire faster than they would answer questions in a face-to-face interview.

Table 1: Demographic distribution of students

<b>Gender breakdown</b>		
<b>Female</b>	65.4 %	51
<b>Male</b>	34.6 %	27
<b>Age breakdown</b>		
<b>Under 24</b>	30.8 %	24
<b>From 24 to 30</b>	42.3 %	33
<b>From 31 to 45</b>	26.9 %	21
<b>Education breakdown</b>		
<b>Secondary education with high school diploma</b>	68.0 %	53
<b>Bachelor’s degree</b>	28.2 %	22
<b>Master’s degree</b>	3.8 %	3
<b>Breakdown by whether respondents work</b>		
<b>Full-time work</b>	54.0 %	42
<b>Full-time student</b>	29.5 %	23
<b>Self-employed</b>	11.5 %	9
<b>Unemployed</b>	5.0 %	4
<b>Online learning experience breakdown</b>		
<b>More than 5 online courses</b>	71.8 %	56
<b>3 to 5 online courses</b>	17.9%	14
<b>1 to 2 online courses</b>	2.6 %	2
<b>Currently studying the first online course</b>	7.7 %	6

The article uses common scientific methods such as analysis (theoretical foundations, secondary research), synthesis of knowledge gained from theory, secondary research and primary research (interviews with 10 managers), induction (based on specific results from primary research conducted through interviews and secondary results conducted at the university, specific innovations and trends in online education are pointed out), deduction (based on general knowledge from theory, primary research was conducted with managers, which was supported by secondary research at the university), comparison of the authors’ opinions within the theoretical part, the results of primary and secondary research, or sociological questioning in the form of interviews with 10 managers of HPE.

#### 4. RESULTS

The results of primary research in HPE show a significant connection between innovative approaches to education, human capital development, and the readiness of students and employees for the changing demands of the digital economy. A good practice example is the study of Hewlett Packard Enterprise (HPE), which integrates modern learning processes in a global IT environment. As a provider of hybrid cloud solutions and AI technologies, HPE combines corporate data, cloud

architecture and advanced digital tools to increase process efficiency and support the development of employee knowledge [40]. Education here is based on digital, interactive and personalized forms of learning, while adaptive AI systems adapt the content and pace of the curriculum to the individual needs, preferences and learning style of each employee [41]. This approach supports autonomy, self-assessment and responsibility for one's own development, thereby increasing the effectiveness of professional growth.

The HPE educational system consists of various modern tools such as Salesforce, PowerBI, Microsoft 365 Cloud, thanks to which they can better collaborate in the organization, visualize data necessary for decision-making processes, or for sharing files and information between individuals and departments [42]. The organization uses artificial intelligence and machine learning, especially in the process of analyzing employee performance, recommending training and courses, or in optimizing and setting up the development and education process. Courses and training are aimed not only at hard skills (working with systems, AI, ML, ICT), but also at soft skills (communication, teamwork, critical thinking, emotional intelligence) [43]. The foundation for the organization within human resources and their education is flexibility, well-being, diversity, because according to them, these are the three key pillars on which they must build the foundations of the educational system and which support engagement.

The Slovak branch of the HPE organization is harmonizing its approaches with educational approaches valid within the European Union, which brings more innovations and methods into the educational process, which should ensure a better understanding of the learning material, the fulfillment of the curriculum and the creation of new motivational procedures [40]. A similar emphasis is placed by the Ministry of Education of the Slovak Republic, which identifies six key areas of innovative approaches: from programs to inclusion to school management [44]. Research confirms that these areas are directly linked to how students and employees perceive their opportunities to learn, interact and develop in a digital environment.

Dynamic changes in the global labor market are fundamentally changing the skills requirements of workers. According to available data, up to 33% of the skills needed in 2019 will soon be irrelevant, which requires targeted upskilling, reskilling and cross-skilling processes (GTOG, 2024). These processes are particularly important in the field of IT and online education, where technological changes are taking place the fastest. Analytical thinking, digital literacy, flexibility, empathy, and the ability to lead others will be key [45], which corresponds to data from a study among students at the University of Management, where similar competencies were identified as the most important for a career.

The empirical part of the secondary research showed the high attractiveness of online education for working students - up to 52.6% of respondents worked full-time, while the flexibility of studies was a key factor of satisfaction. Most participants (70%) completed more than five online courses, which indicates a high level of digital competencies. Overall satisfaction with the Moodle platform was strongly positive (71.5% rated it 4 or 5 on a five-point scale).

Technological innovations – video learning, adaptive interfaces and interactive discussions – increase student engagement and satisfaction, but technology alone is not enough. Effective course organization, rapid feedback from teachers and a unified structure of subjects are key [39]. The results support global findings from the WEF, OECD, UNESCO and the European Commission, according to which the most significant innovations in education are flipped classroom, hybrid and

adaptive learning, micro-learning, gamification and the use of virtual and augmented reality [46]. Adaptive AI/ML systems allow for the personalization of these innovations to individual student needs, thereby maximizing learning effectiveness and readiness for the digital economy.

## 5. DISCUSSION

The research results point to a significant connection between technological innovations, forms of online education and human capital development in the context of digital transformation. In the discussion, we interpret the main findings in relation to the existing theory of human capital, human potential and innovative approaches in education, while highlighting their practical implications for educational institutions and organizations.

One of the most striking findings is the effectiveness of the combination of technological, pedagogical and organizational innovations in online education. Based on the conclusions of the HPE employee training, organizations must have a comprehensive educational system that will reflect the current needs of the labor market and current trends in innovation. The educational system should consist of modern technologies that are used within the framework of personalized education aimed at developing soft and hard skills. Such a form of education supports three key employee competencies that are more in demand in the labor market - adaptability, creativity, resilience.

Organizations should use technologies supported by artificial intelligence and machine learning as part of a personalized education system. Various algorithms based on these technologies allow for a more detailed and effective analysis of the behavior and performance of not only students in schools, but also employees in organizations. Technologies can design appropriate teaching materials, help optimize the pace of education, and provide immediate feedback, which also makes the work of teachers and lecturers easier. HPE uses systems based on artificial intelligence to monitor the educational progress of an employee. The systems can also reveal which skills an employee needs to improve and develop, while the courses and training that the employee should complete are automatically suggested to the employee. [41].

However, it should be borne in mind that while online education is increasingly in the spotlight, it is also important to pay attention to its negative aspects, which include the need for a certain level of digital literacy, possible technical problems, contactless teaching with mandatory communication with the teacher. However, these limitations are not yet so serious as to outweigh the advantages, which include flexibility, accessibility, interactivity, course structure, personalization. For everything to work as it should, organizations should have connected technical equipment with personnel, i.e. use modern technologies, but have correctly set teaching approaches, organizational rules and have qualified lecturers.

Among the significant findings are also the results from students who like the most video lectures, which are recorded and accessible to students, tasks for critical thinking and problem solving. On the contrary, webinars are the least attractive for students. The reason for this may be the change in learning style within the online environment, when unlimited access to teaching materials is expected, one's own pace of teaching. Discussion forums are not so positively evaluated by students because they are required to interact more with classmates or lecturers. Effectively set up modern

education should reflect the needs of students and the labor market but pay attention to the load and obligations that are required of students.

We also positively assess the findings that it is necessary to emphasize not only education in hard skills (knowledge of technologies and work with them), but also in soft skills (emotional intelligence, creativity, critical thinking), which will further support a comprehensive education system. Organizations can solve this similarly to the HPE organization, i.e. with a personalized educational plan. This could work similarly at universities, where one strict model of education should not work, but adaptive education focused on individual needs should be introduced. This can also be helped by the inclusion of technologies such as artificial intelligence or machine learning in education, both on the student's side (assistance in learning) and on the teacher's side (assistance in assessment, predicting problem areas).

It is also important to discuss digital literacy and readiness, as the results indicate that although most respondents have completed online courses and training, online education still faces problems such as technical problems that students or employees cannot solve and often feel a sense of loneliness, which hinders the development of adaptive online learning processes. A possible solution would be to introduce socio-cultural elements into online teaching. An example is the HPE organization, which solves this using communication platforms, team activities and building virtual communities. In schools, this can be done through smaller discussion groups, forms of personal tutoring, mutual mentoring between students, or the creation of online communities. There are several possibilities for using artificial intelligence in such a case, for example, moderating discussions, designing teamwork, and devising creative tasks for students with different learning styles.

It is important to note that modern technologies alone cannot create an adaptive and creative learning environment. It also depends on the structure of the teaching, the personality of the lecturer/teacher, the different types of tasks that students have to complete, the speed of feedback that students receive, and the teaching methods used. When all these elements (technological, pedagogical, organizational) come together, there is a high probability that an organization or school will be able to create a functioning comprehensive personalized learning system.

Practical recommendations based on the results presented in the article and intended for universities and organizations include:

- Flexibility must be at the core of online learning: Students, especially working ones, need the ability to adapt the pace and scope of communication to their time options. If mandatory interaction is introduced within a discussion, it can be demotivating for participants.
- Smaller interactive groups: Discussions in the learning process should be clear, concise, and to the point. Discussions are best given in groups of 8 to 10 students.
- Technical support and intuitive use are important: The teacher/lecturer should work with applications and technologies that he/she is familiar with and that are not demanding on software equipment so that the participants can also work with them. Frequent technical problems or the difficulty of mastering technologies and applications could reduce the motivation and willingness to learn.

- Problem-based learning with recorded lectures: Research has shown that these are the two activities that respondents find most attractive in online learning. In addition, they are forms that promote autonomy and practicality.
- Focus on both hard and soft skills: Don't just focus on technology, but also support critical thinking, communication, self-reflection, and emotional intelligence.
- Personalized learning as the foundation of human capital development: Organizations and universities should use adaptive personalized learning systems that use elements of artificial intelligence or machine learning.

## 6. CONCLUSION

The article focused on connecting modern technologies, innovations in education with the learning process, whether students or employees. It was found that education should be a complex process, combining technological, pedagogical and organizational components, given current trends. Based on the results of the analysis of the case study in the HPE organization, it was concluded that if organizations want to achieve higher competitiveness, performance, or creativity and adaptability of employees, they should personalize and innovate their educational processes.

The results identified specific pros and cons of online education within universities. The strengths of this education are personalization, self-paced learning, flexibility, and accessibility. On the contrary, the problem is mainly technical problems that students often cannot solve themselves, which complicates the educational process. They also see unclear and chaotic user interfaces and the need to interact with other students as problems. However, since it has been proven that this type of education has great benefits for both students and organizations, it would be appropriate for both sectors to be interested in introducing elements of adaptive, innovative, personalized education that reflects the needs of students.

An interesting element that can enrich online learning is the introduction and use of artificial intelligence or machine learning systems. Both elements can be helpful not only for students (more interactive teaching, content personalization, faster feedback), but also for teachers (creation of creative tasks focused on solving problems, student assessment, design of additional activities and training). When technology is combined with the quality of educators and innovations, schools and organizations can create an environment in which autonomy, engagement and lifelong development of human capital come first.

The research has several limitations. First, the sample was relatively small ( $n = 78$ ) and does not allow generalization of the results to all groups of students. Second, data collection took place at only one university specializing in online education, which may affect the respondents' experiences and their digital readiness. Third, the study relied on students' self-assessment, which may be influenced by subjective feelings, current motivation, or personal experiences.

Future research should focus on several areas:

- Comparative analyses between traditional and online universities to identify differences in motivation and learning styles.

- Longitudinal studies to track how students' digital competencies and preferences change over time.
- Expanding the sample to include employers to examine how they evaluate online education graduates.
- Experimental studies testing the effectiveness of specific innovative methods (e.g. gamification, VR/AR).

Analyses of the impact of artificial intelligence and machine learning on the personalization of education, which is still an underexplored area with great potential for making learning more efficient and developing human capital.

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