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Methodological and curriculum development-related innovation options and challenges in education in the aftermath of the pandemic

Introduction

The digital transformation led to radical changes in our lives, including one's attitude to technology and the modification of lifestyles. In contrast, the everyday life of today's youth, known as digital natives, is determined by the Internet and the use of mobile communication devices (Prensky, 2001) Szűts, 2009). Such paradigm shift left its mark on the education sphere since digital devices are increasingly integrated into the teaching process (Molnár.et.al., 2019) (Simonics, 2016). Therefore, an evident change is discernible regarding learning habits as students tend to favour multimodality, individual learning paths, intense use of technology and demand immediate feedback. (Sass – Bodnár, 2014).

Furthermore, the identification of the self and individual goal-setting is defined by effects and impulses received online. These developments impacting the new student generation are justified since itself, along with the labour market, is continuously changing by economic and technological factors (Beetham – Sharpe, 2013). Consequently, a need arises for modified educational content and the acquisition of skills and competencies promoting lifelong learning, a shift of individual perspective and the introduction of new pedagogical practice.

Such phenomena imply increasing demands on pedagogues expected to keep up with the given changes while meeting the requirements posed by the information-based society. Effective teaching and learning require adjusting the learning process to learners' skills while fulfilling the latest professional standards enabling students to acquire relevantly and sound knowledge of long term validity, which can be adapted to the given developments (Köpeczi-Bócz, 2007). Accordingly, the role of teacher training institutions and professionals is essential as they have to prepare pedagogues to cope with the challenges of the 21st century.

Theoretical considerations

Info-communication developments have an increasingly profound and complex impact on higher education. Changes that initially seemed to be mere technical innovations now affect much more than the approaches, formats, and content of the modernization of higher education. The life of universities is being transformed by MOOCs (massive open online courses), OERs (open education resources), and e-learning applications – and not just at a methodological level; the perspectives and operations of these institutions are also changing, and the quality of teaching in higher education is undergoing a renewal (Beetham and Sharpe, 2013) (Benedek et al., 2018) (Benedek et al., 2019). Centres of learning such as the Open University (UK), FernUniversität in Hagen (Germany), and Universitat Oberta de Catalunya (Spain) have boasted successful track records for many decades. It can be said that they now consider online teaching and learning systems, which they operate at the highest levels, to be their main profiles. Internationally prominent traditional universities such as Stanford, Harvard, and MIT have also effected significant changes in recent years. They have made opting for open courses possible for many thousands of students and thus made access to higher education more flexible.

Thanks to ICT tools, modern learning methods have become generic, while network communications have made the social dimension of learning typical (Barber, Donnelly, and Rizvi, 2013) (Szűts, 2018).

Nowadays, significant initiatives – for example, the D-Transform project (Transforming Universities for the Digital Age) within the framework of the EU Erasmus+ Programme – are engaged in analyzing how activities assuming continuous interaction affect learning and the transfer of knowledge in the digital environment. At the level of learning theory, connectivism (Siemens, 2005; Downes, 2007) is playing an increasingly important role, and it is also transforming practice. Even though it has not gone undisputed (Bell, 2011) in the last decade, this theory can be said to have launched significant movements towards innovation. On the other hand, in the strategic thinking of higher education institutions in developed countries, for example, in the US (Allen, Seaman, 2014), there are marked differences in the new educational paradigms emerging in the ICT environment. Between the two extremes of absolute enthusiasm and absolute rejection, it is presumable that multitudinous institutional strategies are taking shape. In our case, we present the new teaching forms of e-learning with ICT tools integrated into educational frameworks and digital curricula in blended-learning programmes of a leading university of technology. Our institution is inherently conservative in the most positive sense (featuring predominantly full-time teaching, learning materials with restricted access, frontal lectures). Thus the new paradigm figuratively clashes with the given traditional and limited institutional profile and character.

New digital tools are appearing with increasing frequency, and they often engender new trends. This section explains how these trends can be recognized and potentially exploited.

People in the 21st century find themselves in a new working environment, and the social and economic networks surrounding individuals are more complicated than ever. Learning theory analysis typically examines the characteristics of social learning and pinpoints where new learning methods and techniques meet, with particular attention to developments in ICT (Orosz, 2021). In such an increasingly rich learning space, understanding how to apply new learning methods consciously and effectively may prove to be an investment that produces an excellent long-term return (Pusztai et al., 2015).

Physical networks (such as the urban environment) and virtual counterparts have changed our lives concerning two critical aspects. First, we are now able to connect and communicate with far more people than previously. This is partly a result of our accelerated lifestyle and partly attributable to the sophisticated hierarchies organized around the various roles we fulfil in life.

A new, virtual dimension is now attached to learning. In this respect, we should note that our multiple connections are now considerably less restricted in terms of time and space alike. In the developed world in particular, once the technical background is available (a smartphone and a broadband Internet connection will suffice), we can now contact anybody anywhere to exchange information (Ujbanyi et al., 2017).

Knowledge has become a dynamic concept, and knowledge acquisition is a process with ever-increasing spatial and temporal dimensions. Thus, on the one hand, education has diversified and is geared to increasingly high levels; on the other hand, in the past hundred years, the time spent in education has almost doubled – from six to eight years to up to twelve or even twelve sixteen years.

Digitalisation-based methodological components in the teaching and learning process

The effectiveness of digital Web 2.0 and cloud-based solutions has been confirmed by several research results, and the relevant professional literature is continuously expanding. Below we provide an overview of the most characteristic developments facilitating open, micro-content based curriculum development efforts.

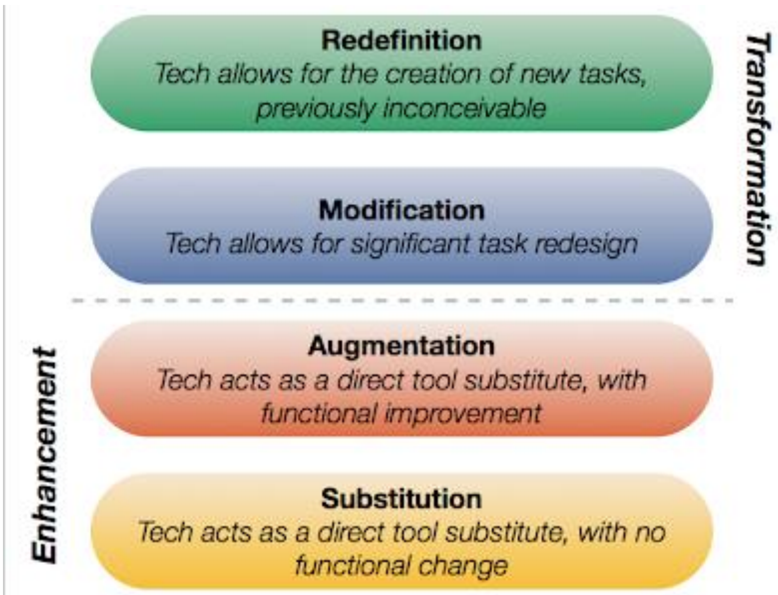
The globalization of knowledge production resulted in such a high amount of information that could not be handled or managed without digital devices and databases. The users of Web 2.0 are not merely content producers but contribute to an information system characterized by the continuous change of the respective content. Teachers and learners are both parts of this system while performing and sharing their tasks in one location. Freely editable tags help the categorization of the given content and information. Tags play an important role in providing information not only about the interests of content creators or users but promote connection building among the members of the system.

Another dominant tendency is the higher value assigned to situation-based and experiential learning and the formation of individual routes to information acquisition. These developments are brought on by the emergence of bi-directional web-based communication replacing the previous unidirectional model (Cress – Kimmerle, 2008), resulting in the propagation of writeable and readable materials. Personal Learning Environments (PLE) (Attwell, 2007) play a significant role in individualized knowledge acquisition as they enable users to meet the demands of the information-based society (Castells, 2005) along with the implementation of self-regulating personal learning strategies allowing users to become creative and productive components of the learning process instead of being passive participants (Blees – Rittberger, 2009). All these tendencies outline the three pillars of the Web 2.0 based education system: sharing, cooperation, and the formation of online communities.

Digital technology-based models

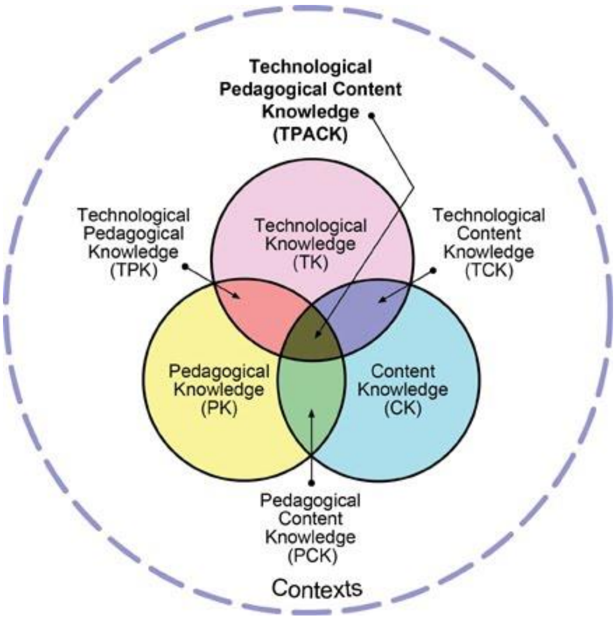
In SAMR (Substitution & Augmentation, Modification & Redefinition) technology, we can think of enriching the learning process through digital technology. The key to using the model is not to think of it as a structural process that must be followed in a restricted way. The aim here is to rethink and redesign traditional ways of learning to provide a richer learning experience that would otherwise be impossible without advanced technology. One can think, for example, of a shared document that is available online 24 hours a day, offering a shared writing and learning experience that would otherwise be impossible. The following figure shows the SAMR model.

Figure 1. SAMR-model, Source: Design for Learning - SAMR & TPACK



The TPACK model provides a so-called framework for productively integrating the appropriate level of teacher knowledge required to use technology in a complex teaching process. Technological knowledge is most effective when it is combined with deep content knowledge and rich pedagogical knowledge.

Figure 2. TPACK-model, Source: Design for Learning - SAMR & TPACK



Research background and conditions

In order to find out about the experiences of our students studying in the digital learning workflow in higher education, we conducted a quantitative online survey in March-April 2021. The online form was sent to the respondents using a snowball sampling procedure, and the contact details of the questionnaire were sent to our active students at the launch of the survey. The online questionnaire was compiled using Google forms and could be completed at https://forms.gle/ViHjHhDvJR6nZqtb9. A total of N=141 respondents completed the survey and provided answers suitable for evaluation. The questionnaire contained a total of 14 items, with nine open and five closed questions. The main focus of our survey was on digital teaching and learning, within which we would like to receive detailed information to help us understand the rapid tasks required by the digital switchover. Of course, despite our simple random sampling, the survey cannot be considered representative, but the results may highlight some significant trends.

The main features of the sample

Of the 141 respondents who could be assessed, 35% (49) were boys, and 65% (92) were girls, all enrolled full-time or part-time at our university. In terms of age, respondents ranged from 19 to 65 years old. In terms of majors, students enrolled in business studies and teacher training responded to our survey.

Research results

Below we briefly summarise the more discursive results obtained from the self-administered questionnaire, illustrated by simple distribution charts, supplemented by cross-tabulation and correlation analysis using multivariate analysis. A brief textual analysis of each set of questions is also presented without claiming completeness.

The first chart shows the distribution of respondents, with 65% of respondents being female and 35% male.

Figure 1. Gender distribution of respondents

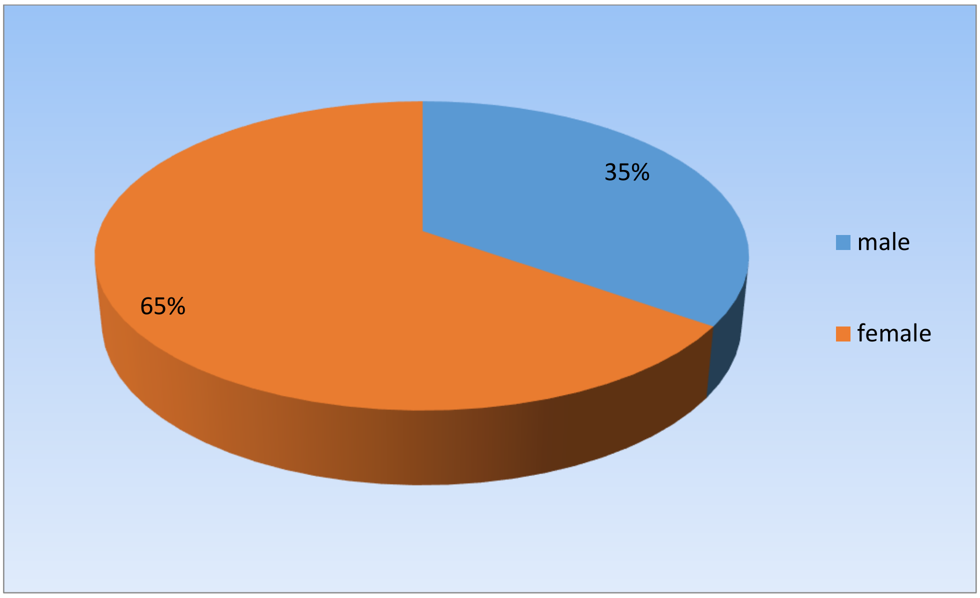
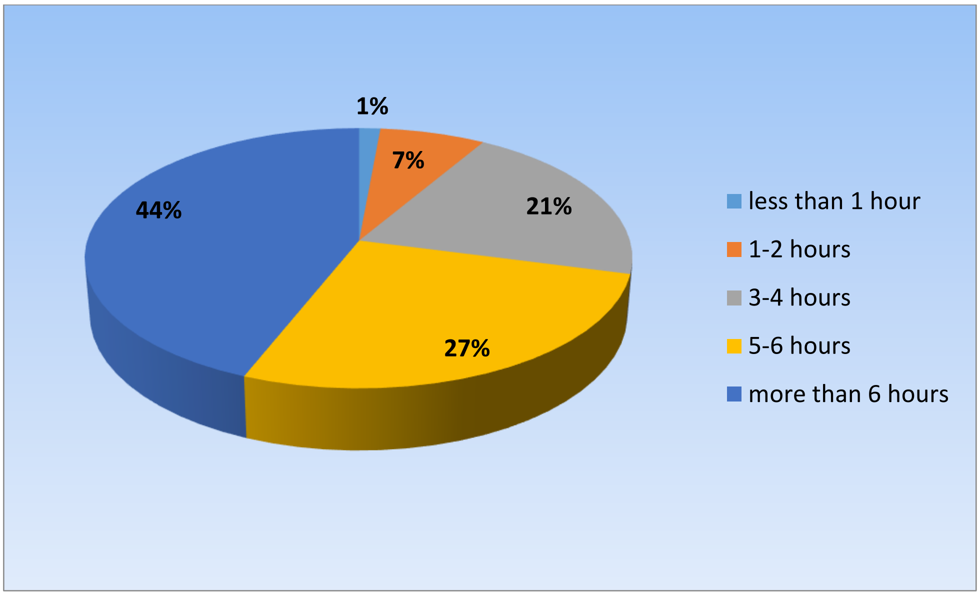


Chart 2 shows the average distribution of respondents' time spent in front of the computer. This shows that 44% of respondents spend more than 6 hours on their computer, 27% spend between 5 and 6 hours, while 21% spend between 3 and 4 hours on their computer. Only 7% of respondents spend 1-2 hours a day on the computer.

Figure 2. Distribution of average time spent in front of the computer



The following chart 3 shows the distribution of the time spent studying per day, with 43% of respondents devoting 1-2 hours to studying in front of the computer, 25% 3-4 hours and 20% less than 1 hour. 9% of respondents said they spend 5-6 hours studying and only 3% said they spend more than 6 hours.

Figure 3. Distribution of time spent studying per day

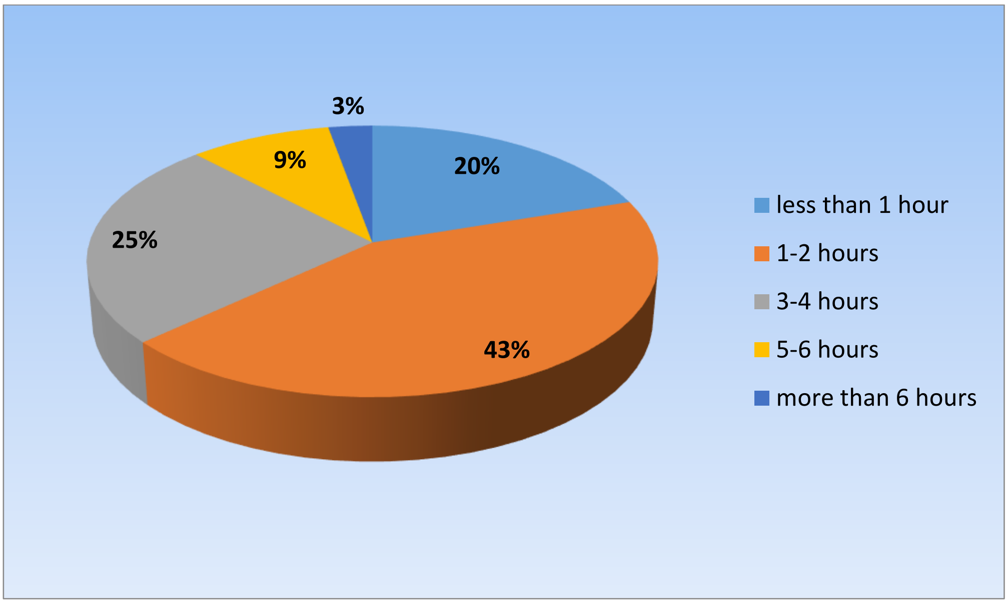


Chart 4 below shows the distribution of preferences for learning from digital devices, with 58% of respondents (82) preferring learning from computers and digital devices. Within this, 16% of respondents (23) were strongly in favour, and only 3% (5) were against.

Figure 4. Distribution of preference for learning from digital devices

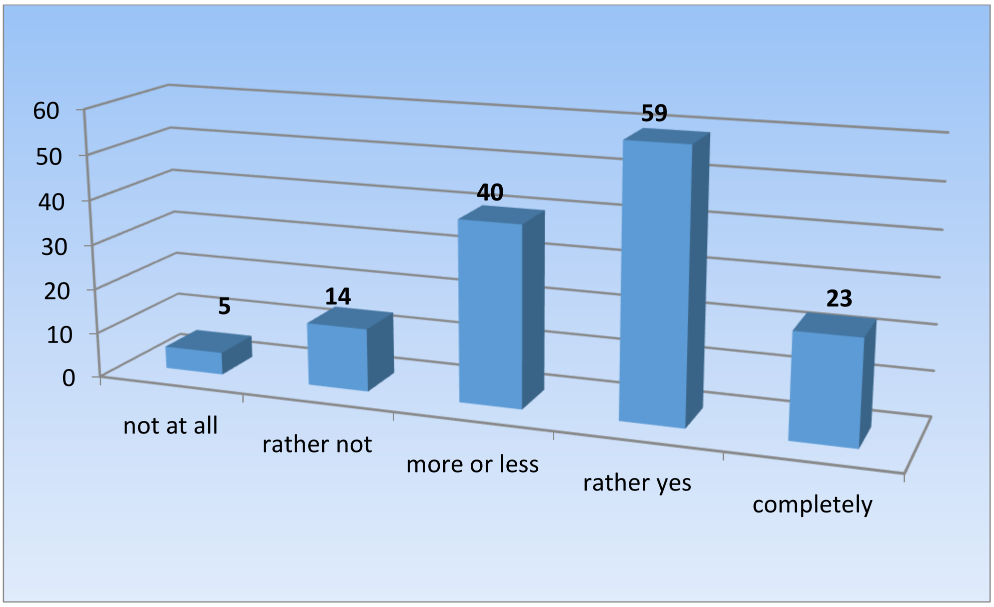
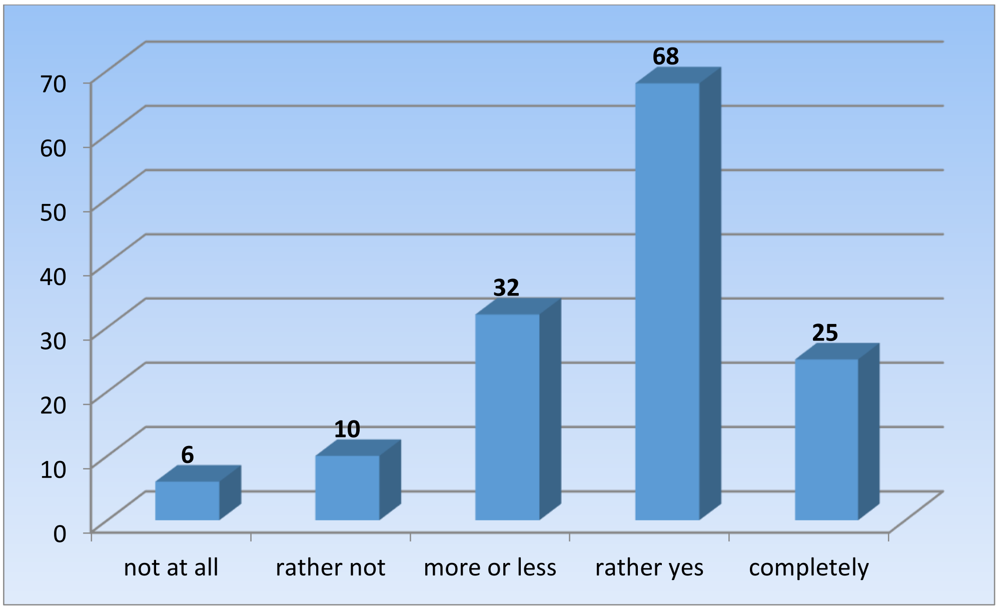


Chart 5 below shows the distribution of the effectiveness of learning from digital devices among respondents. The responses show that 65% of respondents (93) can learn effectively using a computer or digital device. Within this, 17.7% of respondents (25 people) feel that it is fully effective, and only 4% (6 people) were negative about it.

Figure 5. Distribution of effectiveness of learning from digital devices



Students responding to the survey spend 4, 05 hours a day on average in front of the computer or on the mobile phone, and the time spent for learning is 2,32 hours. The respondents included 49 males and 92 females. On a scale of 1 to 5 concerning learning with digital devices, the average value of positive answers was 3,57, while the score allotted to effectiveness was 3,68.

We used the Mann-Whitney probe to discern significant differences among the abovementioned variables. A significant difference can only be discerned in the case of one variable, the preference of learning with digital devices (p=0,005, U= 1632,500), in favour of males. (MR= 83,68, while for females it is MR=64,24).

Figure 6. Statistical tables

Ranks

	Gender	N	Mean Rank	Sum of Ranks
On a scale of 1 to 5 (1 is a dislike, 5 is a preference), how much do you like learning from a digital device?	Male	49	83,68	4100,50
	Female	92	64,24	5910,50
	Total	141		

Test Statistics[a]

	On a scale of 1 to 5 (1 is a dislike, 5 is a preference), how much do you like learning from a digital device?
Mann-Whitney U	1632,500
Wilcoxon W	5910,500
Z	-2,839
Asymp. Sig. (2-tailed)	,005

a. Grouping Variable: Gender

Men spend more time with PC, laptop, or telephone (MR=76,22 and MR=68,22), but the difference is not significant (9=0,239, U=1998). Women, however, allocate more time for learning (MR=74,89 as compared to MR=63,70), but in the case of this variable, the difference is not significant either (p=0,102 and U=1896,500).

Figure 7. Statistical tables

Ranks

	Gender	N	Mean Rank	Sum of Ranks
How much of this can be attributed to the time spent studying each day?	Male	49	63,70	3121,50
	Female	92	74,89	6889,50
	Total	141		

Test Statistics[a]

	How much of this can be attributed to the time spent studying each day?
Mann-Whitney U	1896,500
Wilcoxon W	3121,500
Z	-1,636
Asymp. Sig. (2-tailed)	,102

a. Grouping Variable: Gender

Males consider learning with digital devices more effective (MR=77,70 as to MR=67,43), but again the difference is not significant (p=0,127 compared to U=1925,500).

Figure 8. Statistical tables

Ranks

	Gender	N	Mean Rank	Sum of Ranks
On a scale of 1 to 5 (1 is a dislike, 5 is a preference), how much do you like learning from a digital device?	Male	49	77,70	3807,50
	Female	92	67,43	6203,50
	Total	141		

Test Statistics[a]

	On a scale of 1 to 5 (1 is a dislike, 5 is a preference), how much do you like learning from a digital device?
Mann-Whitney U	1925,500
Wilcoxon W	6203,500
Z	-1,525
Asymp. Sig. (2-tailed)	,127

a. Grouping Variable: Gender

We relied on the Pearson-correlation coefficient to establish correlation among the given variables. First, we examined a potential correlation between the time spent in front of the computer and the respective time allocated for learning. We identified significance (p<0,000) and received the same results and Chi value regarding time spent in front of a computer and preference of learning with digital devices, and the correlation between time spent in front of a computer and the efficiency of learning with digital devices. The respective results confirm that in the case of the students under inquiry, the use of ICT devices has even a direct effect on learning motivation and the outcomes, and a positive correlation can be discerned among the given variables.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	55,326[a]	16	,000
Likelihood Ratio	58,276	16	,000
Linear-by-Linear Association	27,154	1	,000
N of Valid Cases	141		

a. 15 cells (60,0%) have expected count less than 5. The minimum expected count is ,06.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	,440	,059	5,783	,000[c]
Ordinal by Ordinal	Spearman Correlation	,415	,072	5,378	,000[c]
N of Valid Cases		141			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

Figure 9. Statistical tables

Summary and outlook

Based on our many years of experience and the research we have conducted, we believe that the effectiveness - and goodness if you can call it that - of teaching also depends on teachers knowing when to use digital technology and when to stick to traditional methods. And this knowledge will apply not only to the present but, we argue, to the entire 21st century. The recent pandemic, and the second and third waves of the Syndrome phenomenon, have posed many challenges for all social actors and for those in the education system in particular. Pedagogical and then methodological challenges have replaced the initially technological challenges. All this also required the long-term preservation of crucial competencies, highlighting understanding, patience, resilience, collaborative thinking, working together online, and maintaining a cooperative perspective. At the same time, the learning world of digital education has strengthened and valorized our previous decades of experience in distance learning technologies and methodologies, which we have been able to put to good use during this period.

Furthermore, as many circumstances and phenomena have changed since then, significant improvements have been necessary. The respective developments include interactive exercises, the availability of open and accessible professional learning materials, the emphasis on collaborative activity-based working methods, and interactive e-learning systems and technologies that support complex functions. The large sample of empirical studies briefly presented in this paper has also clearly confirmed the prominent role and importance of digital tools, platforms (Teams, Mentimeter, Redmenta, Discord) and IT equipment (PC and peripherals) and the shift towards the digital world. Our research also showed that there was a significant shift in device and system usage preference towards digital, ICT-based systems, which were used for an average of 4.05 hours per day for some purpose during the period under study, with a clear emphasis on the time spent on learning, which was 2.32 hours per day. From this point of view, innovative, professional initiatives focusing on the development of digital curricula that progressively follow the theoretical framework of e-learning and the expectations of programmed education may be of particular importance. An excellent example of this was the MTA-BME Open Curriculum Development Research Group's developmental effort over several years, which primarily supported students and teachers in vocational education (Benedek et al.,2019) and training, but its recommendations can be taken forward, its basic pillars and tried and tested methods can be adapted for the future.

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