



Current Analysis of Education in the Context of Technological Innovation



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Table of Contents

List of Figures.....	ii
List of Tables	ii
List of Boxes	iii
List of Abbreviations and Acronyms.....	iii
Change and Learning.....	1
Introduction.....	2
Methodology.....	5
1. Education Influenced by COVID-19: What Happened, Briefly?	9
Reflections of Pandemic Practices on the Main Stakeholders of Education.....	10
<i>Students</i>	10
<i>Teachers</i>	12
<i>Parents</i>	15
<i>Educational Institutions</i>	16
2. What is Learning and How Does It Change?	21
Learning	21
3. Technology Aspect.....	33
Investments in Education Technology	40
Remarks	45
Conclusion	49
References.....	51
Study Team.....	55

List of Figures

Figure 1: A Hypothetical Lifelong Education Process in the Context of Our Country	5
Figure 2: Number of instruction days (excluding school holidays, public holidays and weekends) where schools were fully closed in 2020 (OECD, 2021)	9
Figure 3: The News Published in Dixon Evening Telegraph on October 9, 1937	19
Figure 4: What is Learning?	21
Figure 5: Factors of Learning	22
Figure 6: Learning Cycle	24
Figure 7: Study Areas of EdTech Unicorns	42
Figure 8: A Generic Education Process	47

List of Tables

Table 1: Potential of Leading Technologies for Education	38
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List of Boxes

Framework: Needs	3
Information Note 1: Skills of Future	4
Information Note 2: Education Technologists	17
Information Note 3: Massive Open Online Courses (MOOC)	25
Information Note 4: Measurement and Evaluation	30
Information Note 5: Increasing Importance and Changing Role of Teacher	31
Information Note 6: Minimum requirements for technology-supported distance education	34
Information Note 7: Educational Technologies Initiatives and Investments in Our Country	41
Information Note 8: EdTech Unicorns (As of the end of 2021)	42
Case Study 1: Distance Education via Chicago Radio Following the Polio Pandemic in 1937	18
Case Study 2: An Example of Active Learning Practice at Undergraduate Level	29

List of Abbreviations and Aconyms

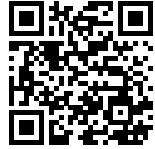
U.S.A.	United States of America
R&D	Research and Development
CEIT	Computer Education and Instructional Technologies
CEO	Chief Executive Officer
EBA	Education Information Network
EDTECH	Educational Technology
IPO	Initial Public Offering
HR	Human Resources
ENG	English
LAT	Latin
MEB	Ministry of National Education
MOOCs	Massive Online Open Courses
OECD	Organization for Economic Co-operation and Development
NGO	Non-Governmental Organisation
STOK	Strategic Focus Commission
TTGV	Technology Development Foundation of Turkey
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations International Children's Emergency Fund
VUCA	Volatility, Uncertainty, Complexity, Ambiguity



Change and Learning

**Suat Baysan**

Member of the Board of Directors, TTGV
Founder/CEO, ACMENA



Amid the soaring progress of global change, experts seek to find solutions on how we can learn more effectively and efficiently. The pandemic period made us realize that there were different options to lead our lives, even though we cannot meet in real environments. With the easy implementation of innovative systems, our capabilities of work, fun, learning, production and research have kept evolving continually.

Although virtual and real environments are perceived to be positioned to substitute each other, continuity of the course of action will be questioned in the long run. Over time, it will be more evident that virtual environments will be indispensable as an option, for their efficiency. Mentioning that the purpose is to learn and design the innovations, face-to-face meetings will maintain their inevitable priority and continuity. The basis of contemporary fiction will be reshaped with the balanced use of the mixture of both mediums.

Accordingly, we must use the digital abilities that we have developed in the course of the pandemic, as a key to transformation, to open new doors. Contrary to the view that virtual environments slow down the pace of scientific research, it is accepted that different learning methods improve our skills.

The primary inference from the experiences will be to identify the factors that simplify and facilitate learning. Yet another point under discussion in addition to the subjects already addressed is the redefinition of the conceptual design of the teacher. Bearing in mind that learning in virtual environments will no longer be sufficient with the traditional approaches, student-oriented methodologies that encourage sharing, peer learning and trigger the use of technology have begun to emerge.

We should be aware of the fact that we should follow up, care and mind the process attentively. Therefore, it is when we comprehend and analyse the change that we can make inventions, develop new products and services and enhance our competitiveness.

Introduction

Technology Development Foundation of Turkey aims; to identify and develop new areas of opportunities and actions, to conduct studies on strategic issues with high-level participation, to report, disseminate and discuss the results and to boost awareness within the ecosystem in the light of the vision of #TechnologyDevelopingTurkey. Human Resources Strategic Focus Commission was established with a view to addressing the fact of high-quality human resources from the perspective of our country's technological innovation ecosystem, and therefore, **Human Resources Research in the Technological Innovation Ecosystem** was shared with the ecosystem in November 2020 in an effort to comprehend the global trends and predictions related to the changing labor markets.

The findings of the mentioned research suggest that the changes within the scope of technological transformation were significant (71%) as per the participants' estimations about the possible radical changes that might affect the workforce in the mid and long term. As this finding indicates, the transformations experienced and anticipated in the field of technology have accelerated due to the COVID-19 pandemic, which affected the entire world as from March 2020. One of the sectors insufficiently penetrated by the technology prior to the pandemic, education faced a serious transformation process with the pandemic and almost the entire world had to turn into a global laboratory.

In this context, as a strategic issue, **Current Analysis of Education in the Context of Technological Innovation** was intended to bring the findings up for discussion by discussing the subjects such as comprehending the relationship between education and technology, and how to use the technology in the field of education, by also taking into account what has happened during the pandemic.

The most important input for production today is the qualified human resource. There is an increasing talent shortage in the real sector in our country. In addition, the changes in the scope of digital and sustainability globally have the potential to push the education system further qualitatively and quantitatively. A brief assessment of the subject is given in the Framework.

Needs

It is on the brink of turning into a growing, unsolvable chronic problem for our country to train qualified human resources, see them produce value and retain this human resource. According to the 2019 Talent Shortage Survey conducted by Manpower Turkey, there is a talent shortage by 52% in Turkey. Apart from the need to close the current gap, it is also necessary for the human resources to acquire new skills. According to the European Union's New Industrial Strategy on the Green Deal, published in March 2021, European companies postpone their investments because they cannot find the qualified human resources they need. The same report states that 120 million employees in Europe need upskilling or gain new skills in the next five years. With the figures from a simple calculation compared to the population, it can be deduced that our country will need to increase the skills of 20 million employees or make them gain new skills within a similar timeframe, if it desires to catch up with the change in the EU, which is the biggest economic partner of our country. All of the foregoing points to a radical change in the education system in a way that will focus not only on quantity but also on quality.

Source:

Manpower, <https://www.manpower.com.tr/arastirmalar/2019-yetenek-acigi-arastirmasi>

European Commission. (2020). A new industrial strategy for Europe. COM (2020) 102 final.

To put it briefly, our country will need to both train a large number of new persons and retrain the existing human resources to enable them to gain new skills, sooner rather than later. The only problem here is not about the quantitative enormity of how those subjects can be taught to a large number of people in a very short period of time using the current methods. The subject also has a qualitative aspect. In addition to the technical skills, human resources should also be given the abstract, social and soft skills called the skills of the future (discussed concisely in Information Note-1), which are hard to measure. The ways to develop these skills, the methods used to deliver such skills and the ways to use the technology in education of these skills are the major areas of change that will affect the education system and systematics radically.



Information Note 1

Skills of Future

The world of COVID-19 has shown us that uncertainty and volatility are part of the life and the crises have the potential to spread very quickly, impact and change our lives deeply and radically in a highly interconnected world. The world in which we live is defined as the world of VUCA (Volatility, Uncertainty, Complexity and Ambiguity). Brand new skill sets are needed not only for crisis preparation but for ordinary situations also. To give an example, the transition to career is becoming more problematic day by day because even people with high academic success, who study at distinguished schools, do not hold the skills required by the world of businesses. So, what type of new knowledge and skills should we possess? Various skill sets named differently e.g. future skills, 21st century skills, etc. are studied and published by various organizations. Some of these skills are defined as soft skills, as well. STOK-HR study places a serious emphasis on the soft skills, among other skills needed by our real sector. Examples of the soft skills sought after:

- Endurance and persistence
- Quick adaptability to uncertainty, and resilience
- Emotional intelligence and emotional self-awareness
- Critical thinking, questioning, ability to establish correct cause-effect relationship
- Researching
- Analytical thinking
- Synthesis
- Active learning
- Complex problem solving
- Creativity and innovation
- Self-confidence and taking initiative
- Ability to play team games, working with people
- Communication skills and self-expression
- Negotiation and conflict resolution
- Time management

In addition to the soft skills, some basic literacy such as digital competencies, financial literacy, environmental/sustainability literacy, food/nutritional literacy and ethics, etc. should clearly be acquired before proceeding to the vocational training.

Resources:

WEF, <https://www.weforum.org/agenda/2020/10/top-10-work-skills-of-tomorrow-how-long-it-takes-to-learn-them/>

TTGV, <https://www.ttgvtur.org.tr/tur/images/publications/600b0d16c762d.pdf>

All requirements make it necessary to increase the impact and efficiency of the education system (possibly with the contribution of technology). The research study started with questions such as how technology-supported distance education took place during the pandemic, what were the problems encountered in education and how to find solutions to these problems through the technology. Apart from the answers, the study also intends to ensure asking strong questions that will shed light on the future of the relationship between technology and education in order to support a proper discussion. To this end, the research examined the developments and practices in the ongoing pandemic period, recalled the basics of learning, aimed to discuss how technology can provide effective, efficient and low-cost benefits to education together with the inferences derived.

Methodology

Relying on qualitative research method, a good many experts were interviewed in this study. The interviews were mostly conducted via videoconferencing method and mainly in the second and third quarters of 2021. The collected data were analyzed qualitatively through the interviews with educational technologists, teachers, educational consultants, academics/researchers, educational institution administrators, NGO administrators and technological solution providers, which allowed the collection of valuable opinions that made it possible to, reflect the perspective of these stakeholders that can be associated with the education ecosystem. In addition to all these, publication reviews and supplementary readings were conducted.

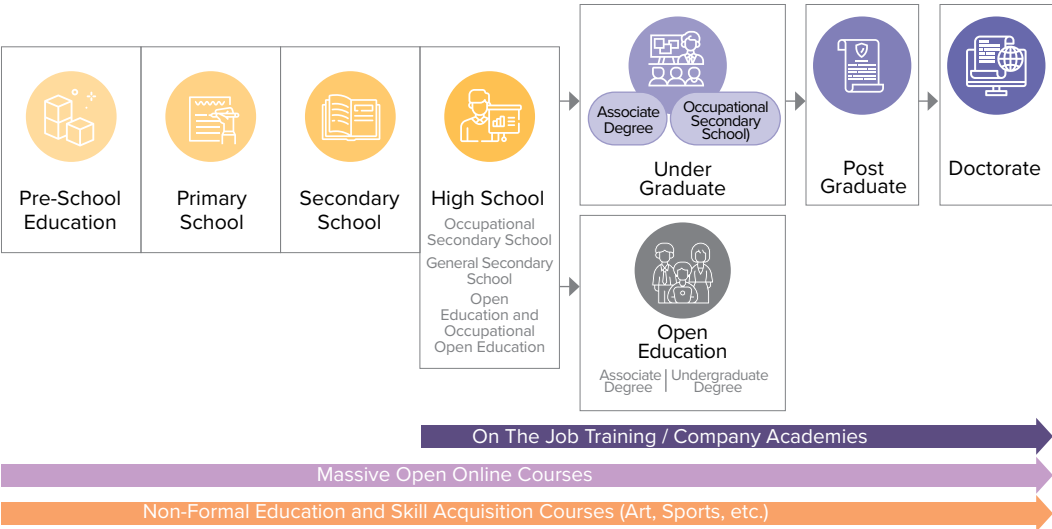


Figure 1: A Hypothetical Lifelong Education Process in the Context of Our Country

While education is usually included in the review, this study concentrates mainly on formal education. Figure-1 indicates a hypothetical lifelong learning process experienced by individuals in the context of our country, as a reference to the study.

As an important note, although it is in the focus of the research study, it should not be ignored when assessing the education that, learning is not limited to formal education, but rather it continues throughout the life; the factors outside the school (family-environment-society) including biological factors in addition to the school and training programs, are more than effective on learning and what's learned.

This study includes of four parts. The first part of the report, “Education Influenced By Covid-19: What Happened, Briefly?”, addresses the analysis of technological education during the pandemic period in our country and the effects of the pandemic on the main stakeholders of education; the second part, “What is Learning, How Does it Change?”, discusses the insight of the fact of learning and learning methods in order to interpret what has been experienced; the third part, the “Technology Aspect”, focuses on the technologies and their areas of use in education, while the last part involves the remarks in line with the findings obtained.

This study outlines the relationship between education and technology.¹ It will be good practice to address and investigate each field separately, and conduct focused research concerning the subjects such as adult education, on the job training, company academies, etc. assess their position in the continuity of education.

1. The term “technology” is mainly used in the education sector to express informatics, information technologies and digital technologies.

*We would like to thank all
of our participants who
devoted their valuable time in
making this study happen and
shared their knowledge and
experiences sincerely with us.*

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Running rampant all over the world since the first quarter of 2020, COVID-19 pandemic has profoundly affected education, as well as many aspects of our lives. Several roles and processes in the education system have been redefined with the decisions taken to ensure the continuity of education. Schools were temporarily closed to face-to-face education in order to prevent the spread of the pandemic, and the students continued their education online. According to the calculations, 1.8 trillion hours of school-age children worldwide are deprived of face-to-face education, and this period keeps increasing day-by-day (UNICEF, 2021).

According to UNICEF’s Report on Accessibility in Distance Education, which was prepared using the data from 100 countries, at least one in three children (approximately 463 million children) in the world could not access education due to the closure of face-to-face education. There are countries around the world, where the schools are closed, completely or partially, to face-to-face education as of October 2021 (UNICEF, 2021). In Turkey, face-to-face education was suspended as of March 2020 for a total of 49 weeks, including 28 weeks of total closure and 21 weeks of partial closure (UNESCO, 2021). As can be seen in Figure-2, Turkey has become the 4th country in the world where the schools have been closed to face-to-face education for more than 110 days in 2020 (OECD, 2021).

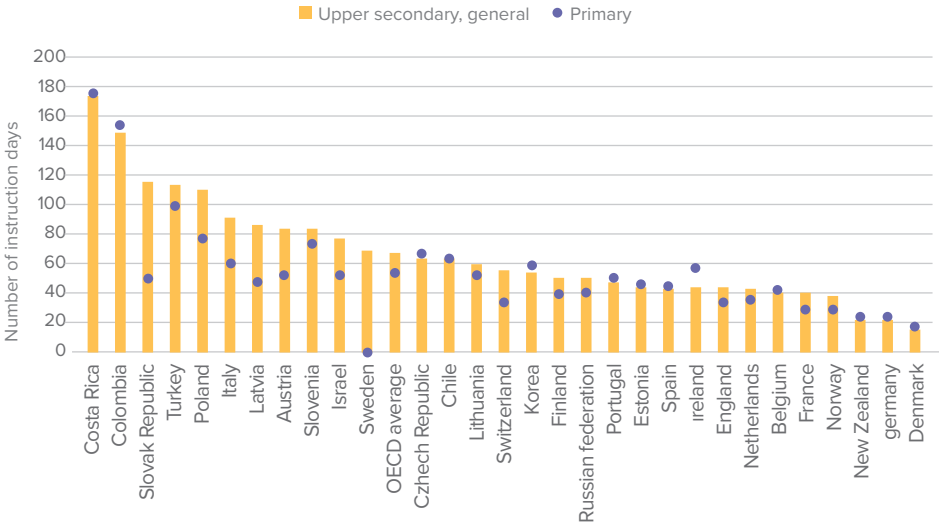


Figure 2: Number of instruction days (excluding school holidays, public holidays and weekends) where schools were fully closed in 2020 (OECD, 2021)

The measures taken against COVID-19 pandemic varied to the context and capabilities of the countries/regions. Distance education was commenced with different accessible technologies, tools, contents and methods available in different cities/regions and educational institutions in Turkey, and thus the intensive use of technology for education was sort of tested in our country, as in global scale.

Reflections of Pandemic Practices on the Main Stakeholders of Education

It is fair to claim that the COVID-19 pandemic has produced different results in terms of impact, scope and results in terms of students, teachers, parents and educational institutions, which we can call the main stakeholders of education. At the beginning of the pandemic period, with no preparations made, it was stated by the participants of our research that the state of “anxiety” is widespread over the entire education ecosystem, primarily the students, teachers and schools/ educational institutions that take an active role in the education process.

The practices used to ensure as much continuity as possible in education and to prevent possible congestions and accumulations have varied. Accessible technological tools were quickly put into use and the subjects in the curriculum were converted into video content as they would have been taught face-to-face in classroom environment; ready-made contents were used or the contents that could be prepared practically was created; lecture notes were uploaded to the electronic environment as written-visual content, and the courses were taught by using online meeting/conference programs and applications in an effort to maintain the classroom order of the pre-pandemic period.

According to 2020-2021 Academic Year statistics of the Ministry of National Education, there are 18 million 85 thousand 943 formal education students in Turkey (MEB, 2021). Not all of these students can be claimed to be able to use or benefit equally from the technology-supported (assisted) distance education opportunities. Although some schools or institutions (mostly private institutions) have been able to transform rapidly owing to their various infrastructures and capabilities, it would not be wrong to say that they are few in number.

Students

In this period, our country has also encountered some inequalities as in the rest of the world. The subjects in our research stated that the inequality of opportunity in education is much deeper for students with no or limited access to technological equipment and resources, especially those who are in an economically disadvantaged position. Some students could not have access to information, while some were just able to follow the courses through an asynchronous tool like television.

As in many developing countries, it is obvious that there are inequalities between regions, cities, districts and schools in terms of education in our country, in other saying, there are students with different conditions even if they live in the same city or even in the same neighbourhood. Apart from the problem with necessary technical equipment for distance education, external factors affecting an efficient education are also important. For instance, it is stated that factors such as whether the student has special requirements, or the level of family support for the student's education, whether there is an expectation from the student for a financial income, what type of responsibilities the student has at home, whether he/she receives support from the family members or from the accessible persons in terms of curriculum-related issues or the use of technology, whether the persons from whom he/she tries to get support are competent, have an effect on the level of student's learning and success.

On the other hand, the students with proper access to distance education opportunities during the COVID-19 period were subjected to various processes, technologies, applications and contents. It was stated that the distance education processes were described as "intensive, hard to focus, demanding" for students. For example, EBA² which was meant to be used in distance education with the pandemic period was integrated into television and started broadcasting for different education levels via the channels bearing its own name (for example, EBA TV) as it was foreseen that students who did not have the necessary infrastructure and basic technological equipment such as the Internet and computers, could not access this service. Despite all these measures introduced quickly in an effort to achieve a continuous learning, there were some deficiencies encountered in hardware and infrastructure (e.g. insufficient Internet speed/bandwidth, unavailability of more than one television or smart device at home, etc.), caused by financial difficulties or existence of more than one student in the household and at various education levels. It is stated by our research participants that the students experienced problems that can be exemplified by factors such as the fact that the students can remain passive listeners in the face of the published content, the home environment is not suitable, or other family members at home can affect the student's concentration on the lesson.

While inability to access education is itself a serious problem, below are listed some other findings about the students who can access technology-supported education, as mentioned by some of our subjects in the research:

- Students with access to technological equipment and infrastructure and relatively higher digital literacy can adapt to this new process more readily,

2. A network of content developed by the Ministry of National Education within the scope of the FATİH Project, allowing the essential course materials to be offered online.

“ Upon the outbreak of the pandemic, the well-being of the students is affected entirely, in other words, being physically away from school poses a risk to affect the social, cognitive and physical development of students. ”

- There are some students who prefer not to attend the classes due to unsatisfactory course content and set-up problems even though they could afford to attend the sessions, or those who deal with other stuff in front of the computer/Internet during the live lesson,
- Some students establish communication and sharing networks with each other in the background by using different technological applications and programs, and they interact on extracurricular issues in addition to the lessons (sometimes during the lesson),
- It is physiologically demanding for students to have to stare at a fixed screen for long periods of time,
- It is not always easy to focus on the lesson in home environment,
- Students who are physically distanced from their social environment during the pandemic, stay away from peer interaction, which is critical for both learning and socialization, and may experience problems in interacting with outside world following the lockdown periods,
- Upon the outbreak of the pandemic, the well-being of the students is affected entirely, in other words, being physically away from school poses a risk to affect the social, cognitive and physical development of students.

Teachers

It is assessed that teachers (including faculty members), the most basic stakeholders of the education process, along with students, are affected by unfamiliar new practices and technologies introduced with the COVID-19 pandemic. Active use of technological especially in the first year of this extraordinary period, pushing the process forward, caused the teachers in general, like almost every stakeholder, to be caught unprepared for digital transformation. It is assessed that some teachers having problems in accommodating themselves to technology, resisting the change or failing to get enough technical support struggled a lot.

It is observed that teachers not only strived to learn about the technological tools that had to be introduced quickly in this period and to teach the lessons using these tools, but they also went the extra mile on motivating the students and reducing the anxiety of students struggling emotionally.

The lack of a pedagogical approach to technology-supported distance education was a major problem in directing the efforts of teachers and the quality of learning. Teachers tended to use technology like other traditional methods at all

levels of education, as if they teach in a classroom; it is reviewed that they failed to satisfy the requirement for making their contents and materials or course designs suitable for online education.

The fact that the course designs are made as if they are for classroom environment (the board and desks replaced by the screen) in technology-supported distance education turned out to be a practice with controversial outcomes. It is appraised that teachers have struggled considerably in attracting students' attention in this new online environment.

It is interpreted that teachers have had difficulties every now and then in maintaining their motivation regarding the process. In this context, it is suggested that not only did they need to be provided with equipment support via Internet access of the educational institutions they work for, but they also needed some support in terms of increasing their digital competencies. As a result of all those challenges, it was stated that teachers were willing to return to the pre-pandemic period in terms of the classroom setting and for social aspects. Besides, it was reviewed in this period that:

- There were highly qualified teachers who are open to development, in the center of the education system,
- Despite the increasing need for self-learning skills, the perception that technology (at least in its current form) can replace the teacher was an illusion (especially for teachers working with students at young age groups),
- The digitalization of the conventional education or, in other words, the educational setup that involves one-way information flow for the pre-determined curriculum from teacher to student was insufficient for an effective learning and teaching,
- The use of technological tools “within a proper process” has the potential to facilitate the work of teachers and enhance the quality of education (e.g. rich content for multiple senses, real-time feedback, increased number of repetitions, etc.),
- It should be noted that each teacher has some differences just like the students (learning new competencies, adaptation and predisposition to teaching styles, etc.),
- It is required to focus on the quality of relationship between teacher and student, a quality relationship and communication makes a difference and the competencies of the teachers should be emphasized in this respect,

- The teachers should be more accessible by students and they should take more time for students,
- Within the framework of active learning methods, it is expected that the teacher will move away from being the only authority that dictates, with the increasing age of the class (closer to vocational education, especially after high school and later) and turn into a stakeholder who increasingly persuades/motivates, guides, mentors, experience designers, facilitating the learning (change in the role of the teacher),
- The competence and development of teachers is critical for online education that will ensure the attention and active participation of the student,
- It is critical that not only students but also teachers should have access to technological equipment, infrastructures, Internet access, application software and “relevant and rich” content,
- The ability of teachers to make their courses effective and efficient is directly associated with their literacy of technology, their ability and motivation to adapt to technology, and their capacity to use the technological tools effectively,
- There is a need for processes that will provide feedback by observing teachers, and even offer coaching/mentoring support to teachers in case of need,
- There is a need for environments and tools where teachers can learn from each other and share their experiences,
- Teachers’ feeling of self-worth and high motivation are highly important for their own development and teaching performance,
- Development of teachers should continue on the use of technological tools and effective distance education systematics, once they start working at the educational institution they are employed,
- Within the framework of the changing roles of the teachers, it was considered that it would be a good practice to add experimental design, creative drama, coaching/mentoring, knowledge of foreign language, informatics, creative and critical thinking, teamwork, etc. to their training.

In summary, the importance of teacher training, quality, motivation and competencies has emerged once again during the COVID-19 pandemic. It is observed that one of the most important components in education system is teachers who love their job, are motivated and open to development. It is evaluated that schools and institutions that invest not only in technological tools but also in teachers “do a good work” during this extraordinary pandemic period.

Parents

It is worth to touch on the parents, which is another group of stakeholders that have been more involved in education than ever before, due to the pandemic, especially during the full lockdown periods. In this process, the parents had the opportunity to experience and observe the education system closely. It is observed that:

- Parents, who acted as the assisting persons who criticize and supervise prior to the pandemic period, started to play an active role in the education process, as the students needed family support during the transformation and lockdown period as required by the pandemic,
- Also the parents, like all other stakeholders involved in the education process, needed various competencies, especially technological literacy,
- Parents, some of whom have to work from home/remote due to the pandemic, have had difficulties in supporting the education of students who should be in the class at the same time, controlling their attendance to the classes and creating a minimum learning environment at home,
- Parents, who work intensely even during the lockdown period to ensure the flow of life, especially health workers who struggled with the pandemic, could not provide the support their children needed in education-related issues, most of the time,
- Even if there happened to be a need for supporting the education, the level of knowledge of the parents affected the quality of the support given to the students, and the contributions differed considerably at different levels,
- Even if the education level of many parents was sufficient, they attempted to give support without any natural knowledge of pedagogical formation (i.e. sufficient competence on how to transfer a lesson subject to their children in the schooling age),

- It is assessed that the parents have had different difficulties in providing the equipment and conditions needed, (e.g. Internet connection with sufficient bandwidth, smart devices, etc.) due to their income levels, so that the students could continue their distance education.

Educational Institutions

- The digital transformation, which was widely thought to take place in between 5 - 10 years on average at schools and educational institutions under normal conditions, had to be implemented within a few months,
- Educational institutions, which performed various digitalization experiments or integrated various digital equipment, applications and contents into the education process before the pandemic, can accommodate themselves to the transition process more quickly,
- Many schools go through a painful transition period and educational institutions struggle to guide students and teachers and offer the necessary motivation for the process during the pandemic,
- The uncertainty and confusion in the early stages of the pandemic have been replaced with more planned changes over time,
- In this crisis period, the first priority of several educational institutions was to bring the content and the student together, and therefore, the content was digitized in different formats and made available to the students, or the teachers were asked to give live lessons on the screen, in a similar way to the classroom layout,
- Research participants that institutions and organizations with a technical background in the past, which have taken actions or experimented with digitalization, and created the capacity to support the students and teachers in this process, could switch to distance and hybrid education more quickly and effectively express it.

It stands out as a general opinion that both the world and Turkey had to go swiftly much further from the point they were in digital transformation, especially considering the field of education and experiences of key stakeholders. Increasing level of digitalization and use of technological tools in educational institutions increase will lead to increase in the need for educational technologists (given in the Information Note-2) who will take part in determining which technology will be used, where it will be used and at what rate it will be used, in an attempt to support both students and teachers.



Information Note 2

Education Technologists

It is stated by our research participants that during the course of transition to technology, the students and teachers had difficulties in adapting to technical tools and infrastructure, the need for specialists to support both groups separately at this point became more evident, and the institutions and organizations that could afford this requirement could transfer the students and teachers to distance education more quickly and effectively in this period.

The fact that the professionals engaged in educational technology supported students and teachers during the use of tools and contributed to the optimization on what content to be transferred and what means and technologies to be used have the potential to increase the effectiveness and efficiency of the use of technology in the field of education. Because, educational technologists also work to carry out the learning process in the most efficient way, to provide the learning environment needed for this, and to prepare the relevant contents and materials.

It is not due to COVID-19 that distance education is experienced for the first time. Different applications of distance education have been encountered both in the world and in our country throughout recent history. When we look at the experiences in the world, the Boston newspaper's "Steno lessons" in 1728; Swedish university's "composition lessons via correspondence" for women in 1833; the opening of the first department of correspondence education at the University of Chicago in 1892; establishment of first radio station for education in the USA in 1919; university, the increase in the number of educational radio stations to 176 within a year; and the start of educational television broadcasts in the USA in the 1930s, are some examples, to name but a few.

In our country, it was in 1956 that the bank employees were trained via correspondence education for the first time, under the leadership of Banking and Commercial Law Research Institute, Faculty of Law, Ankara University; and it was in 1960 that this method was introduced as part of "Correspondence Education" within the Ministry of National Education. Correspondence Education Center was established in 1974 by further expanding the scope of applications so that it can be available at all levels. Vocational and Technical Education Correspondence Education School was opened in 1974 and 50 thousand students were enrolled in different programs during the current academic year. Towards the end of 1975, Common Public Higher Education

Institution (YAYKUR), to which the Correspondence Education Center was also affiliated, was established, aiming to offer education opportunities to students who graduated from high schools or equivalent, but could not manage to enter a university or higher education, by using the available resources of educational technology in the areas needed by the society. Anadolu University assumed the task of delivering distance education in 1982, and more than 3 million students graduated from different programs thanks to the education carried out with printed materials, television broadcasts and Internet content since 1986. These are the examples to distance education practices in our country.

As addressed within the scope of the study, technology-supported distance education, resulting from a crisis, has also been experienced in the world before. As can be seen in the Case Study-1 experienced in the past, all available technological tools were used in order not to interrupt education during the pandemic, trying not to disrupt the education.



Case Study 1

Distance Education via Chicago Radio Following the Polio Pandemic in 1937

It was not upon the outbreak of COVID-19 pandemic that technology was first used for distance education of large masses in emergencies. During the polio pandemic that widely affected the United States of America (USA), the schools were closed in Chicago in 1937 and distance education was started via Chicago Radio. In the 1930s, availability of radio in 80% of the households in the USA made it possible to deliver widespread education. Although it was a very innovative idea to receive education over the radio at that time, it was assumed that around 315,000 children watched the lessons during the 3 weeks when the schools were closed. Additional “compensatory” trainings were also planned for students who did not have a radio at home, who had a poor reception even if they did have radio, or those who were out of Chicago during that period. The lessons were designed to be informative but entertaining. Lessons were designed in 15-minute programs, and when the schools reopened, the students took the exams and submitted their homework for the semester. During this period, the parents naturally became a part of the education process and they were heavily involved in the questions that came to the minds of the students during the classes, especially since the radio provided a one-way communication. In addition, a telephone help line consisting of 16 teachers (then the number was increased to 21 due to high demand) was set up to answer the questions.

After the opening of the schools, the lessons learned from this “experimental study” were discussed, the initiative that was introduced during the closure of the schools with the cooperation of local schools and radios turned into the Chicago Radio Council, as a result of which new educational and academic contents and programs broadcast on the radio for many years were developed. It is ensured that more radios were used at schools and in the education process with the quality contents developed.

Main lessons learned from this historical case study are as follows:

- It is always a top priority to maintain the Continuing.
- The technologies that were available, reliable, having a widespread infrastructure and quickly accessible were used in an emergency.
- Compensatory trainings were planned to ensure that the students learned what they were supposed to.
- Homework and exams were maintained.
- The lessons were planned in an interesting, entertaining way, allowing the least distraction of student.
- When education is delivered at home, the parents inevitably become a stakeholder in the education process.
- Since one-way information is not sufficient, adequate communication channels enabling the students to ask questions at least were established.
- New opportunities and facilities were created by strengthening the collaborations formed in the study conducted.

Resources:

The Washington Post, <https://www.washingtonpost.com/education/2020/04/03/chicago-schools-closed-during-1937-polio-epidemic-kids-learned-home-over-radio/>

The Conversation, <https://theconversation.com/remote-learning-isnt-new-radio-instruction-in-the-1937-polio-epidemic-143797>

Newspapers.com <https://www.newspapers.com/clip/59888554/children-to-be-taught-by-radio-dixon/#>



Figure 3: The News Published in Dixon Evening Telegraph on October 9, 1937

“

“If We Teach Today as We Taught Yesterday, We Rob Our Children of Tomorrow”

John Dewey



2. What is Learning And How Does It Change?

The lessons learned about education practices and about the use of technology during the COVID-19 pandemic make us think that it is necessary to reconsider the concept of “learning”. This section focuses on the basic principles that lead learning to occur and the question of how the teaching environments should be designed effectively, with a quick emphasis on the fundamentals of the nature of learning.

The panic and confusion that occurred in the early days of the pandemic was replaced with more planned changes over time, a number of educational institutions thought that the priority was to bring the content and the student together in this crisis period. For this reason, the contents were digitized in different formats and made available to the students, or the teachers were asked to give live lectures on the screen. Basically, the purpose of these efforts is to protect the student's connection with the educational institution, but due to the nature of learning, these efforts were not sufficient for a quality learning. Although this approach actually covers the cognitive dimension of learning, its affective and social dimensions were not included in the process adequately.

Learning

Learning may have several definitions. That's because learning is both complicated and explored by various disciplines of science. For example, educational sciences usually define learning as **“the change and progress in the knowledge, skills and attitudes of the individual within a certain time interval and based on experiences”**.

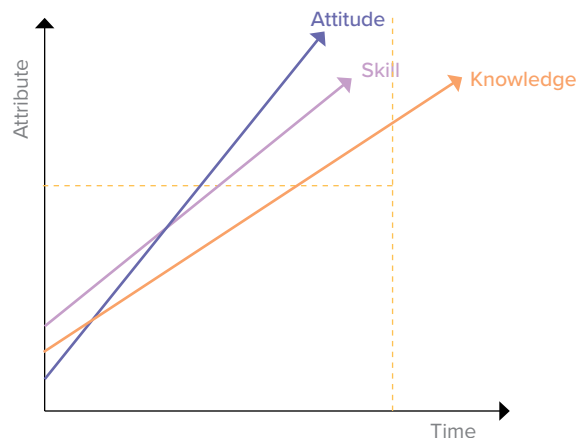


Figure 4: What is Learning?

From the neuroscience perspective, learning is a function of 80-100 billion nerve cells in our brain and their interactions. Learning is the result of chemical transmitters and protein synthesis that occur in specialized regions called synaptic cleft which exists 1,000-10,000 in each neuron. According to cognitive

“The concept of “zoom fatigue” has also entered the literature during compulsory distance education.”

sciences, learning is the storage of information in the long-term memory once processed in the mind and the ability to retrieve when needed.

In order to get an inclusive definition of learning, it should be understood that learning is affected by several factors (Senemoglu, 2020). Learning is the most important ability determined by both cognitive, affective and social factors as well as psychomotor, genetic and biological factors, which distinguishes modern humans from other living things.

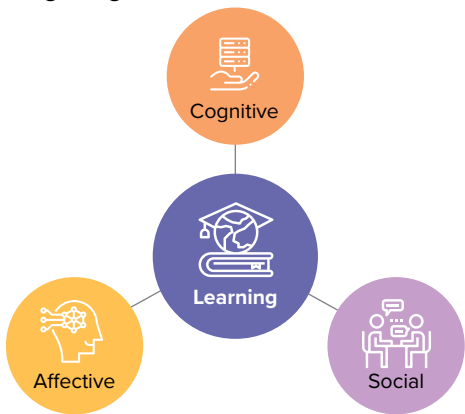


Figure 5: Dimensions of Learning

- Learning occurs when 3 dimensions, cognitive, affective and social, are considered and supported in a balanced way. Distance education, which started with the pandemic period, mainly focused on the cognitive dimension. However, it is well known that unless cognitive learning efforts are fostered by emotions, it is very difficult to learn and memorize, and retrieve it when needed. Because, the brain uses emotion hormones to tag what should be cared for, and things tagged with a good emotion are easily learned and recalled better. For example, even a small amount of increase in dopamine secretion, which stimulates motivation, is important for an efficient learning process. On the other hand, there is a situation where the knowledge tagged with stress or fear is interpreted as “something that shouldn’t be stored or retrieved” for the rest of life.
- It is during the learning that the brain needs energy the most, and the source of energy in the human body is mostly glucose molecules. In order for these molecules to be converted into energy in the cell, they must be oxygenated. Therefore, the required amount of oxygenation of the blood in our body is also a critical condition for learning. The most effective way of oxygenation is physical activity. It is considered that leaving students inactive in front of the screen for long hours in distance education does not make a positive contribution to learning. Even the concept of “zoom fatigue”³ has also

3. It is defined as video calling applications such as Zoom, etc. causes more fatigue on people, compared to physical meetings.

entered the literature during compulsory distance education.

- Spaced and multiple repetitions are important in learning. Experiments on forgetting show that if the information learned is not repeated mentally at regular intervals, it will be forgotten (Lemov, 2017). Assignments, question-answer activities and feedback quizzes are effective strategies to support learning.
- It is known that our brains learn if it focuses on a subject matter and unless it is involved in multitasking. When the brain is exposed to numerous unnecessary stimulus in the learning environment, it increases learners' cognitive load, which negatively affects focusing and learning. Unnecessary and improper use of technology in distance education, the length of consecutive online course hours did not contribute to the learning of students, on the contrary, they caused them to be distracted from the subject and the course.
- People make sense of visual messages thousands of times faster than other messages (Larkin & Simon, 1987). This is because most of the data (90%) that the human brain processes evolutionarily is visual data. For this reason, the use of visual materials will make learning much easier for each student.
- The social dimension of learning is at least as important and effective as the cognitive and affective dimensions. Observation and imitation are also one of the most basic learning styles of people. For this reason, peer learning is one of the activities that contribute to learning the most. Simplifying the learning in distance education simply to individual effort has ruled out the social dimension of learning.
- One of the basic principles of learning is that prior knowledge also determines what to learn and how to learn. In other words, preliminary information determines how new information will be processed in the mind.
- Self-efficacy in learning is one of the factors that support and stimulate intrinsic motivation. If students are not motivated to learn, they will not engage with learning environment either mentally or physically, in other words, learners are quite frustrated when they are not able to acquire new content . Figure 6 shows the cyclical relationship between self-efficacy and learning. One of the most effective methods to promote the learners' of self-efficacy is to explain the relationship between prior knowledge and new knowledge, so make new subjects meaningful for the student. Especially infographics and mind maps are the applications that can be used effectively in linking prior knowledge with the new knowledge.



Figure 6: Learning Cycle

- Regular sleep hours makes a significant contribution to the formation of memory, namely the transformation of what we just learned into a memory. Even 1 hour of extra sleep is shown to have a positive affect on cognitive performance (Mantua & Simonelli, 2019).
- Although learning and development are often perceived as the same concepts, they should be reviewed very carefully. Development is the acquisition of certain cognitive, affective and social qualities rather than learning certain academic subjects. For instance, the acquisition of attributes such as self-regulation skills, socialization and metacognition is more important than learning certain definitions in mathematics or learning the fractions. Especially the pre-school period and the first five years of primary education are critical periods for healthy development of the child. Keep in the mind that development mostly refers to quality whereas learning is commonly perceived a quantity in the educational system.

Misjudgement that distance education should be the inevitable medium of instruction because of pandemics is not necessarily true. Since World War II, human life expectancy has increased remarkably, and people's demands for education are increasing in terms of both content and duration. It is not possible to meet the learning needs of people who live longer, in terms of quality and quantity, only with formal education institutions and traditional methods. With the development and widespread use of technology, especially availability of Internet, various educational applications can be accessed whenever and wherever desired. The reviews regarding the Massive Open Online Courses, one of the examples that can be given in this regard, are given in Information Note 3. Distance education, apart from being an education model imposed by the pandemic conditions, appears as a natural outcome of current conditions and realities. In addition, the pandemic has speeded up the awareness of this reality.



Information Note 3

Massive Open Online Courses (MOOCs)

All over the world, people of all age groups have shown great interest in Massive Open Online Classes for different reasons, especially during the pandemic period. At first glance, it can be thought that being able to access the content you want, when you need it, provides a higher motivation. However, in practice, when people are alone with online education, their interaction reduces and they show a low attendance in the courses they enrol voluntarily; even dropout rates was evaluated to be over 90% (Goel and Goyal, 2020). In this context, being able to access and enrol the courses alone is not sufficient and does not help with self-motivation. It is a very controversial issue how much motivation this education method that can be considered an “adult education model” will create for the pre-vocational education stages.

The fact that especially the big technology companies have begun to focus on skills instead of diplomas in recruitment process and even these institutions have established their own certification systems at lower costs compared to university education, leads to the assessments that distance education platforms will replace the education-training system we were accustomed, and cross out the conventional universities. On the other hand, it should not be ignored that leading universities do not convert the courses taken from Massive Open Online Courses into credits.

Learning, which is a natural survival mechanism of human being, is a tedious and time-consuming process. While the certificate symbolizes a skill in its essence, the university symbolizes the campus life as well as the technical knowledge and skills obtained. Certificate programs cannot be expected to replace a good university education. In addition, it is inevitable that the ecosystem will encounter a certificate inflation, without knowing about the quality, owing to the excitement such a demand will create on the supply side. The practices increasing in number, such as “making a short video watch and giving a certificate in return”, will also harm the concept of “certificate”.

Source:

Goel, Y., Goyal, R. (2020) On the Effectiveness of Self-Training in MOOC Dropout Prediction. *Open Comput. Sci.*, 10:246–258.



Diploma



Licence



Participation
Certificate

The developments on both supply-side and demand-side have brought along the question of how distance education environments should be designed effectively. Compared to face-to-face education, the content design, interaction and feedback in distance education require the inclusion of different methods. Effective learning does not occur by only being exposed to one-way information transfer, reading from the text or watching it on the screen, or in other words, the student remaining passive. The methods applied in the traditional method and based on one-way information transfer from the teacher to the student also cause the education to be perceived as an activity that has to be undertaken by the teacher only. In an effective learning, the student must also do his/her part with active participation. In this context, it is observed that inclusion of some basic methods that can be used in education, other than traditional methods, will be beneficial.

Active Learning

Active learning involves all activities in which students are involved in the learning process, do something for the learning to occur and urge themselves to think all about these activities (Aydede & Kesercioglu, 2012). Considering the role of motivation and participation in learning, active learning activities are the activities that both motivate students and involve them in the learning process mentally and physically. It can be carried out during individual work or group work. Contrary to the traditional learning method, a successful active learning provides all students in the learning environment with the opportunity to learn while interacting with the course materials. The activities such as problem solving, discussion, drama and animation are some of the activities that can be used for active learning to occur.

Cooperative Learning

Cooperative learning is based on the idea that the students learn by doing a teamwork in small groups. It is critical that the groups be structured in such a way that all members can collaborate with each other. The leadership role in the group is shared among all members of the group, and the members also bear the responsibility of each other's learning (Yildiz, 1999). The teacher will serve as a participant when needed; in other cases, he/she acts as an observer. Cooperative learning is one of the learning approaches in which the social dimension of learning is involved in the process in the most effective way (Hertz-Lazarowitz, Kagan, Sharan, Slavin, 2013).

Peer Learning

Peer learning includes student's ability to collaborate with others and assume the responsibility for their own learning process. The teacher works as a

facilitator and guide, and the peer students learn the relevant content from each other. Effective peer learning is mutually beneficial and requires the students to share knowledge, ideas or experiences with one another. One of the positive aspects of peer learning is that the students feel more comfortable working with their peers. For this reason, they have the chance to convey and explore their ideas more deeply by interacting more than they do under the supervision of a teacher.

Students learn more readily with their peers since their cognitive structures are more similar than those who are not their peers. For the same reason, peer learning can be more efficient than the transfer performed by a teacher or educator.

Flipped Learning

Flipped learning is independent of the basic dynamics of the traditional model where the course and content transfer and operation is under total control of a teacher while the student is only a listener and passive participant (Karadeniz, 2015). According to this model, learning occurs in a student-oriented manner and classrooms become the environments where the shortages are supplemented and mistakes are corrected. The tools such as computers, Internet as well as the contents such as videos, articles, images and slides are actively used (Bolat, 2016). The basic logic in flipped learning model relies on the fact that the basic knowledge needed by the student is digested and the process of the emergence of new knowledge takes place in an environment where the students and teachers collaborate mutually.

In brief; active participation, questioning, experimentation and socialization are critical for effective learning. Considering the effect of edutainment, playing games (in physical and/or digital environment) and gamifying the learning experience at appropriate dose will contribute greatly to the learning through internalization of knowledge. Encouraging active participation of student instead of passive listening/watching requires that:

- A proper student-student, student-teacher and student-material interaction is achieved,
- Rich content such as story, animation, etc. is used,
- Experiment, observation, examination, case study discussions are included,
- They are supporting with gamification and games,
- Asking questions is encouraged,

- Feedback is given on applications, studies and games,
- Teachers and learners are allowed to create their own content,
- Peer learning is promoted with the inclusion of the practices such as cooperation, teamwork, Workshop and chatting, etc.

Various processes in which above mentioned methods are applied are given in Case Study 2.

Within the framework of changing education approaches, it is seen that the subject of measurement and evaluation should be handled carefully. Information Note-4 gives brief and general outline concerning the assessment of a number of students as well as measurement and evaluation that determines the scope and quality of entire education process.

Lastly, it is reviewed that those who will make a difference in the future as they did in the past will be the teachers open to learning, who care about their students, try to adapt to new tools and especially care about the continuity of learning. On the other hand, it is predicted that the role of the teacher, their competencies and the education they receive will also change in line with the changing education approaches. Information Note 5 includes the assessments regarding the increasing importance and changing role of teacher.



Case Study 2

An Example of Active Learning Practice at Undergraduate Level

“At the beginning of the class, I give the students a case study or a ‘what if?’ question that they will most likely be unable to answer. I give them a little time to think. Before explaining the theory for the subject I will teach here, I aim to make to students to ponder for a while. After the time is up, I give the theory to teach them how to respond better. The critical point is that the student feels curious about the subject and asks about the explanation of the theory. In other words, I make sure that the student acquires it not with the push method but pull method instead. I can make it richer, using the technology,. For example, I can turn it to a game or application, as a problem. They play for a while and/or do a teamwork. In this way, I make sure that they learn from each other and empathize with each other.

I also use flipped learning in some courses. Students come and study the lessons in advance, and we move the outdoor activities outside the classroom. For example, the student watches the videos about the lesson beforehand. In this way, instead of giving 5 hours of lectures, we can concentrate more on questions-answers and do a project-team work for 2 hours productively.

Contrary to conventional concept of education, we have seen that it was necessary to make room for mistakes and this was a natural part of learning. We work with students and try to teach them how to analyze their own mistakes with algorithmic thinking.

In order for all these practices to be effective, interesting and quality content must be produced, and students must be encouraged to study these contents prior to the classes.

Active learning changes the role of teacher while also enabling him/her to reach more students.”

Source:
Research Participant (Academician)



Information Note 4

Measurement and Evaluation

Measurement and evaluation, i.e. exams in its widely used form and especially central exams dominates the entire education value chain. The subjects to be asked in the exam and the type of exam (multiple-choice) determine the stuff to be taught and the way they are taught (test techniques, etc.). A substantial economy was formed on this demand. This should not be taken as a specific situation for our country only. In a survey conducted on social media among students aged 13-24 in 15 countries in order to get an idea about the perception, they were asked what the schools taught (human skills, reading and writing, how to pass a test, problem solving) and it was stated that the perception that the schools taught “how to pass a test” was by far the highest in almost all countries.

Consequently, if the curriculum or methodology of good schools is not aligned or inconsistent with the central examination, the parents tend to avoid them, even if they want to. Schools reserve almost the entire period of the final years of the school (Grade 8, and Year 12 in our country) so that the students can prepare for the central major exam through which they will enter the higher education. Students may choose not to attend the classes that do not directly help with the exam success (but important for life). Students cannot afford to spare time for many subjects and skills they need to acquire at that age, instead they focus mainly on multiple-choice test success.

On the other hand, it is not always possible to establish a strong relationship between academic achievement and success in life. When it comes to the employment market, the marks are no longer decisive. Individuals who develop other skills and manage to create a portfolio (social activities, volunteering, internship, projects, etc.) even though they do not have high marks, and those who have soft skills (apart from technical skills) are preferred more by employers and become more successful over time. In a sense, since measuring valuable things may require different systematics, things that can be measured seem to be made valuable.

When evaluated with the marks, the problems such as the failure to learn from mistakes, the tendency to measure what one remembers rather than how he/she approaches a problem or what he/she can do, the inadequacy of measuring with the exams on skill-based subjects that require a feedback, etc. disrupts the acquisition of necessary skills. At this point, it is recommended to avoid measurement and evaluation with the tests -especially multiple-choice tests- whenever possible, to evaluate the skills and approaches rather than the knowledge recalled and to use the methods based on problem-solving whenever possible, to this end.

Source:

Karma Colonialism, <https://karmacolonialism.org/what-do-schools-actually-teach-we-asked-in-15-countries/>



Information Note 5

Increasing Importance and Changing Role of Teacher

In traditional education approach that emerged in times when access to information was difficult, the teacher played a role that conveyed information to students, as the only perfect authority assumed to know everything. According to new approaches, teacher or educator acts as a facilitator of learning for the student, i.e. learner, rather than convey the information directly to the learner as a guide, a mentor.

With the outbreak of COVID-19 pandemic, it has become more evident that learning comprises academic/cognitive, social and affective skills as a whole. Considering that, information is accessible from anywhere; learning process should involve the effort based on questioning and collaboration between student and teacher. It has now become more critical to interpret the information, distinguish necessary/unnecessary, correct/incorrect/incomplete/misleading information, synthesize the information and make it useful or, in simpler terms, transform the information into a benefit, rather than acquire or memorize the information. To make that happen, it is also important that the teacher develops his/her communication skills. Because the function of the learning experience where the teacher constitutes the most important part will be to provide an appropriate learning atmosphere by urging and encouraging the student to learn.

It is expected that this role, which is described, will become even more crucial as the size of the classes grows. It is very important to select, train, motivate and develop the teachers who will take on this role, systematically on a continuous basis. In this context, there is a need to discuss the issues related to the development of teachers. It is important for teachers to feel valued, to be motivated for renewal, to systematize their development, to increase their technological literacy and to create feedback mechanisms for them. Moreover, it is important that teachers be given the trainings on the subjects including experimental design, drama, coaching, creative and critical thinking and teamwork, and that these trainings be offered by using the active learning methods, just as recommended for the students.

Taking the learning from a holistic perspective, it is emphasized that the teachers assuming the role of facilitator should create an active learning environment by both asking questions and encouraging asking questions, listen to everyone observing the principle of respect and equality for different opinions, answer the questions and provide feedback.

“

“I’m still learning”

*Michaelangelo,
at the age of 87*



3. Technology Aspect

Previous chapters examined the fact that the world and our country tested new technologies and tools in the field of education because of the COVID-19 pandemic, how the main stakeholders were affected in this context and touched on the basic principles of learning. Educational Technologies, i.e. EdTech, kept emerging for education before and during COVID-19. In this period, technology-focused main learning strategies introduced apart from traditional classroom education are: over written material (printed or digital), over TV broadcast, over web-video conferencing applications and massive open online course platforms.

As we addressed in the previous sections, It is important that an **effective** educational process addresses affective and social dimensions of learning as well as cognitive dimension, and ensures student-teacher (feedback, answering questions, etc.) and student-student (peer learning, teamwork, etc.) as well as student and material interactions. Accordingly;

- In-class education is much more advanced than other strategies in ensuring student-teacher and student-student interaction. The closest strategy to the potential of classroom education in providing multiple interaction is the education given through web-video conferencing applications. Other strategies largely prioritize material interaction with the student, enabling one-way information transfer to the student (cognitive dimension of learning) and reducing the student to a passive listener-watcher position. Affective and social dimensions of learning fall behind.
- Classroom education is inherently synchronous and has little potential to provide independence from time / space. Asynchronous education is possible in the use of electronic content and materials. Re-use of digital content in all educational strategies also makes it possible to return to points that cannot be understood well.

In making the above assessments, it is assumed that access to the relevant technological infrastructure and equipment and training materials for all methods are complete and sufficient. In fact, this is a serious problem and an investment area. It is highly important that both students and teachers do not lack infrastructure and equipment in order to make “good use” of the technology in education. “Minimum” requirements for technology-supported distance education are concisely shared in Information Note-6.



Information Note 6

Minimum requirements for technology-supported distance education:

Technological infrastructure is crucial for education. Minimum infrastructure and hardware components that every student and teacher should have for distance (and hybrid) education can be listed as follows:

- ☒ Smart device with appropriate speed and features,
- ☒ Affordable Internet access with sufficient bandwidth (WiFi signal booster at some points),
- ☒ An environment where the person can focus on learning/teaching (his/her own space and appropriate furniture),
- ☒ Access to “quality” and assorted (e.g. written, visual, video, audio.) content and course materials (content providers should have a sufficient capacity, as well),
- ☒ Video conferencing application optimized for the needs of education and integrated with school management systems,
- ☒ Application(s) for effective communication and socialization of students and teachers among themselves, with each other and with parents,
- ☒ Application(s) and tool(s) (considering with the legal infrastructure) that will enable teachers and students to develop and present/share interactive content.

Like in every crisis, it is predicted that the COVID-19 pandemic will come to an end, and distance education will be permanent in different education units in a partial or hybrid way, owing to the widespread use of technology. The following are the findings on how to include new technologies in the education system:

- Technology is a tool. Focusing on the basic principles of pedagogy, putting people at the center of the process and concentrating on the learning process and experience should become a priority. Within an appropriate process, massive benefits and opportunities other than those we have today will be possible with the effective use of the right technologies.

- To make a general assessment of digitalization, digitizing an unplanned/ problematic/outdated process or supplementing it with technology does not eliminate its problems, but rather it has the potential to enlarge it.
- In the current situation, technological tools for education are predominantly supply-side or developed with the method of “technology push”. Technological tools developed should not be considered the sole determinant of the learning process or the quality of education. Incorporating a new tool into the learning environment without knowing precisely about the process, method, systematics and its effect on learning may not always produce the intended effect.
- Highly motivated and good teachers are at the center of an effective and productive learning process. The quality of relationship between teacher and student in learning process is, in most cases, more critical than the tools used. Technology has the potential to be a facilitator and complementary for the teachers, rather than being an opponent and substitute for teachers. As in other industries, the applications of human-machine teaming or human-machine collaboration have the potential to go beyond the effect and benefit that a single human or machine can offer in education, as well. This will require readdressing the entire process, from the setup of educational process to the training of teachers.
- Quality and wide range of content is just as important as the tools. It is recommended that the contents should not limited to a single format; diverse and interactive content such as images should be provided for those who likes to watch, and audio for those who fancy to listen, and text for those who would like to read.
- Both the use and learning of some of the existing technological tools by the students and teachers are described as “complicated”. Stakeholders tend to use the simplest tool that meets the minimum requirement. Innovations require some efforts to render them easy to use and learn.
- With the proper use of technology, it has the potential to facilitate the work of teachers and educational institutions. Practices such as taking attendance, providing instant feedback, increasing the number of repetitions, and planning personalized repetitions will save teachers time and enable them to attend to the students longer.
- As the time spent “in front of the screen” gets longer in distance education, technology fatigue is observed increasingly in both students and teachers. This fatigue increases since the communication is within a

“
Another flexibility offered by technology is that the content can be accessed from anywhere and by anyone, and that the people can personalize their learning, experiences and journeys for their own purposes.
”

very limited framework, students' mobility is restricted and the duration of the lessons is longer than the time required to maintain the necessary attention for such an interaction.

- It is stated that there are many technological solutions having a dissemination problem. There is a need for innovative, accessible, affordable applications and tools that are positioned correctly in the right process, capable of providing diversity, can be used/learned easily, do not have negative effects on health.

Aside from the use of technologies and tools in the “current” education process, innovative educational processes and systematics that will be developed by gaining an insight of what the technology has to offer will enable both more effective and more efficient education. For example, the settled thoughts and habits developed in the education system over a very long period of time still make the education dependent on time and place (at school and during school hours). However, the technology has the potential to make the education independent of time and space to a great extent according to the personal needs. Another flexibility offered by technology is that the content can be accessed from anywhere and by anyone, and that the people can personalize their learning, experiences and journeys for their own purposes. Not only the system of school education, but also the field of institutional education has begun to make good use of this flexibility.

Today, the most common applications in EdTech ecosystem are electronic marketplaces and platforms (which connect the student to the material/content or teacher) and learning management systems. Table-1 is a summary of anticipated potential offered by today's prominent technologies for education.

While Table 1 points out the potential of various technologies to bring benefits to the field of education, it will not be enough to evaluate technology preferences alone in terms of performance. The effects and effective use of existing and future technologies, especially human health and privacy, should be analysed thoroughly. For example;

- * It should be taken into account that looking at something in a real, three-dimensional and multi-sensory manner with virtual reality glasses will not create the same effect.
- ** Emotion recognition; Protection of personal data should be a priority, as it may include facial, vocal and behavioural signatures.
- *** Gamification needs to be used carefully and in moderation. Otherwise, it involves a possibility of dependence on extrinsic motivation and reducing the intrinsic motivation.

**** In game-based learning, debriefing and feedback are critical in order for learning to occur.

There are different levels of technological maturity where the technologies can be used effectively, widely and affordably in education, and each one of them has the potential to create different values. The main effect will be achieved through the use of these technologies, not individually, but in different set of combinations. Some of the potential benefits of various technologies for education include:

- Creating multi-dimensional and multi-sensory learning experiences and content for effective learning,
- Reducing student's anxiety, increasing the motivation,
- Designing effective, interesting and entertaining educational environments,
- Creation of student-tailored learning experience and content,
- Allowing the students with different developmental speeds to learn at their own pace,
- The student's ability to work out his/her own learning experience,
- Allowing for the constructs taking the concentration times of the students into account, ensuring the attention, concentration and participation of the student.

Table 1 : Potential of Education Offered by Prominent Technologies

Prominent Technologies	Potential for Education
5G	fast connection infrastructure (basically critical)
Virtual reality* Mixed reality	learning that will minimize/eliminate student's accident risk settings enabling the learning, relocation and mobility within the framework of scenarios subjects that cannot be learned independently of the context (situated cognition)
Augmented/enhanced reality	consolidating the learning experience
Blockchain	building a trust architecture by creating unalterable records authentication of diplomas and certificates received (creation of indestructible and protected information)
Artificial intelligence, machine learning	development of individual learning models and roadmaps measurement, evaluation, adaptive learning planning of compensatory and additional repetitions based on the measurement results reproduction and plagiarism detection verification of whether the given content has been read or not creating a more effective learning process and experience with human-machine collaboration keeping the students away from harmful content providing decision support in students' choices of school and education
Cloud computing	accessibility to content, materials, data and information services from anywhere with Internet access ability to collaborate cost effective data storage
Internet of Things, IoT and non-invasive sensors	In-class smart assistants ID authentication for exam with biometric systems monitoring student's well-being and concentration with wearable technologies fast and effective interaction with smart screens, markers, etc. service and transport monitoring
Chatbot and smart assistants	answering the questions (frequently asked questions, etc.)
Deepfake and hologram	delivery of a more realistic distance interaction experience

Prominent Technologies	Potential for Education
Data analytics and behavioral analytics	developing personalized solutions by determining when the students are most prone to effective learning, their preferences, with which content they can learn more easily, what problems they have, where they have difficulties and what they need, by taking into account the background mobility of the students. conducting educational research
Emotion recognition**	determining the student's interest in the lesson
Interactive videos	creating interactive video content
Gamification ***:	development of problem solving ability discovery learning competing by setting goals extrinsic motivation with systematics of competition and reward-punishment
Game-based learning, simulation, serious gaming****:	grabbing the attention and ensuring concentration achieving active learning instead of passive listening learning by scenario-based problem solving reinforcing the theory vocational training (especially operator training) virtual labs
Speech-to-text	assisting in taking notes, preparing assignments and projects
Text-to-speech	making sure that the texts are listened
Smart scanning and interactive document formats	ability to scan physical documents and edit in computer environment, work on the documents and create interactive documents
Automation	management of school processes (For example: course follow-up, enrolling, attendance, etc.)
Cyber security	the protection of data, particularly personal data (and ensuring the protection of personal rights in this way)

“It is important to use the right technologies in a well-structured process, whenever required and in moderation, rather than the level of availability of the technology or how exciting it is for the technologies to be included in the education system.”

Despite the potential of technology, it is considered that the starting point in education applications will not be technology. It is important to use the right technologies in a well-structured process, whenever required and in moderation, rather than the level of availability of the technology or how exciting it is for the technologies to be included in the education system. What really matters is that learning strategy and the teaching process. There are other decisions to be made before the decisions about the integration of technology are taken. Hence, it would be appropriate firstly to put the people at the center of the process and then seek answers to the following questions respectively:

- What (topic) is intended to be taught?
- Who is it intended to be taught?
- What is the correct teaching approach to this subject?
- With which teaching and interaction approach/method (theory) can this subject be taught most effectively?
- What types of contents and apps are needed?
- What technologies are most suitable for this method and content?

Here, it is thought that scientific progress that will take place especially in the field of neuroscience, apart from the technologies, will directly affect the development of new technologies and the selection of appropriate technologies by making it possible to have more knowledge of the functioning of the brain and learning, and therefore this field should be strongly supported.

Investments in Education Technology

Initiatives and investments in educational technologies are rising so rapidly in the world. As can be seen in Information Note 8, 32 EdTech Unicorns⁴ involved in various sub fields have a total value of more than US\$ 98.5 billion. According to information published on dealroom.co, one-third of all EdTech Unicorns emerged in 2021.⁵ The world is very active in terms of EdTech investment and start-ups.

As can be viewed in Information Note 7, the investments made in educational technologies are considerably low for our country. Therefore, the ecosystem

4. A term used for private companies with a value of more than 1 billion dollars.

5. https://app.dealroom.co/curated-heatmaps/unicorns/industry/f/industries/anyof_education?endYear=2021&hss_channel=tw-980071686&interval=yearly&rows=education&showStats=line&sort=-_2021&startYear=2016&type=rounds&utm_campaign=End+of+year+2021+-+socials&utm_content=193566585&utm_medium=social&utm_source=twitter

of our country's needs to be developed in terms of start-up and investment, and even a campaign is needed for EdTech.

While the size of funding that will be needed in the first place is debatable since the educational technologies are just small ecosystem, It is considered at this stage that it will be required to plan and implement many different activities in an integrated and interrelated manner, such as strategy, orientation, fund formation [match fund]], creating an investor category that can be called “EdTech investor”, establishing angel investor network, building incubation centers, organizing hackathon⁶, bringing the technologists and the stakeholder in education system together.

It is also believed that our EdTech initiatives have high technological competencies, on the other hand more competency should be acquired in the field of education and the concept of learning. It is stated that right steps should be taken and a momentum similar to that owned by the sectors of gaming and financial technologies can be achieved in educational technologies, as well.



Information Note 7

Educational Technologies Initiatives and Investments in Our Country

According to the data from startups.watch, there are 316 start-ups operating in the field of education in our country as of the end of 2021. 44 of these initiatives seem to have received investment between 2010 and 2021. The majority of these investments, amounting to a total of US\$ 5.4 million, are seed investment. The average investment per business is \$122.456 US, with a minimum of \$20.000 US and a maximum of \$400.000 US.

Source:

startups.watch, <https://startups.watch>
(Courtesy of startups.watch)

6.An activity where the participants including computer programmers, graphic designers, interface designers and project managers intensely compete with other teams for the development of software projects.



Information Note 8

EdTech Unicorns (As of the end of 2021)

Created by HolonIQ and involving 32 companies, global EdTech Unicorn list includes the companies from the USA (15 firms), China (8 firms), India (5 firms), Canada (1 firm), Austria (1 firm), Australia (1 firm) and Israel (1 firm). On top of the list including a total value of more than \$98.5 billion US, is BYJU'S company from India, with a market value of \$18 billion US.

Examining the subjects on which these companies, nearly all, operate with the platform approach, the distribution in Figure 7 is obtained.

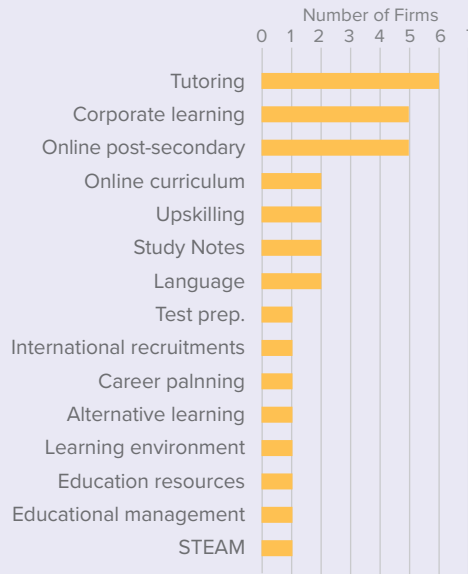


Figure 7: Study Areas of EdTech Unicorns

The list of 32 companies does not include Coursera (\$5.9 billion US market value), Zhangmen (\$2 billion US market value), Duolingo (\$5 billion US market value) and Udemy (\$3.7 billion US market value) that were funded as a result of IPO that took place in 2021..

Source: HolonIQ, <https://www.holoniq.com/edtech-unicorns/>.

“

Let the main object... to seek and to find a method of instruction, by which teachers may teach less, but learners learn more....”

Johann Comenius, first illustrated textbook “Visible World in Pictures”- 1630



Remarks

It is vital for Turkey to educate a good many highly qualified people, create value, continuously develop and retain these people if it wishes to catch up with the future. There is also an ever-increasing talent shortage in the real sector in our country. It is important to increase the impact and efficiency of the education system (with the contribution of technology) and to take into account the lessons learned from the technologies and strategies used for education during the pandemic period.

The Current Analysis of Education in the Context of Technological Innovation research was initiated with the questions of how technology-supported distance education was carried out during the pandemic period and what problems were encountered in education. In addition to answering the questions intended for, it was also aimed to ask new and strong questions that will shed light on the future of relationship between technology and education. In this context, the basics of learning were recalled, the relationship between education and technology was examined and the subjects how the technologies of future could be used in the field of education were reviewed.

Technology occupies more and more space in our lives and the resistance to technology is gradually decreasing. Education, which was one of the sectors that technology did not penetrate until before the pandemic, has inevitably faced a serious technological transformation process, like many other sectors, and almost the entire world has turned into a laboratory. Distance or hybrid technology was used extensively in education as well as in working life during the pandemic period. In this period, different applications were introduced, expecting that they could be alternative or complementary to the classroom education. Some of the methods used: over written material (printed or digital), over TV broadcasting, web - video conferencing applications and Massive Open Online Course platforms, to name but a few.

The main actors of education tried to create various solutions in order not to interrupt the education, in the fastest way with the use of the technologies and resources they could access. It is considered that transferring traditional/conventional education systematics from the classroom to the screen with the support of technology (by conveying information one-way only, reading from the text, listening, watching from the screen or in other words, by keeping the student passive) does not produce an effective learning. While being unable to access various distance education opportunities created by modifying the traditional methods with the use of technology during the pandemic period was a big problem that increased inequalities, it was also unclear what the students who could afford to access and use these facilities learned, how much they learned and what kind of skills they acquired. Although various success stories were written in terms of the speed in introducing the technological tools and various processes that contained them, all tools were an input to the education process. Appropriate configuration of future educational systematics, either distance, technology-supported or a combination thereof and proper positioning of the technologies require investigating the issue of “who learns, what is learned, what skills are acquired and what educational strategy is used?”

“It would not be wrong to claim that those who make the difference in this unusual period are the teachers who care about their students, are open to innovations and learning and strive to accommodate themselves to technology.”

Various benefits offered by technology-supported distance learning even in its current form should also be taken into consideration. It is thought that distance/technological education systems have the potential to deliver permanent benefits for some students physically unable to make it to the school, with some disadvantages, special conditions or requirements. Moreover, the fact that the content can be used multiple times due to the asynchronous nature of digital content is also an important advantage for independence from time and space. However, it is clear that putting technology at the center without ever focusing on the learning process and learning experience will not make the learning more effective. Furthermore, it should be noted that not every subject may suit technology-supported distance education.

Why? Learning is an activity with cognitive dimension as well as affective and social dimensions. An important evaluation of the practices carried out is that the main factor that makes the school a school is not the cognitive learning only; School is what accelerates the social and affective dimensions of learning. The close attention of the teacher in education, especially at pre-school and primary school levels, the increasing importance of peer learning for the subsequent grades has stood out once again. Students can learn from the questions asked by their mates, from what they hear in the hallway, or even from the games they play. Although it is very beneficial to strive to create systematics and tools that individuals can learn by themselves to the greatest extent, the students are known to learn from their peers most effectively. These two approaches should be deemed as complementary, rather than alternative. Triggering peer learning by creating face-to-face or online learning communities is critical for the increase in quality of learning and internalizing the subject learned.

“Technology assumes auxiliary and complementary functions in favour of teacher, rather than replacing the teacher and the work of teachers are facilitated in many ways (giving immediate feedback, regulating the number of repetitions, etc.) will enable the teachers to devote more time and energy to affective learning and learning experience.”

Although technology is intensely included in the education process upon the outbreak of COVID-19 pandemic, it would not be wrong to claim that those who make the difference in this unusual period are the teachers who care about their students, are open to innovations and learning and strive to accommodate themselves to technology. It has been witnessed in this period that the quality of communication and the relationship between student and teacher can have a greater impact, than the technology in most cases. Contrary to various opinions, it is believed that the fact that technology assumes auxiliary and complementary functions in favour of teacher, rather than replacing the teacher and the work of teachers are facilitated in many ways (giving immediate feedback, regulating the number of repetitions, etc.) will enable the teachers to devote more time and energy to affective learning and learning experience.

It is reviewed that the form of education in which the teacher injects the content into the student (in other saying, from the one who knows to the one who does not know) has begun to fall short and turned into a disadvantageous method in continuously changing global competitive environment, as is the case with old school methods from the times when the accessible information and content

was much more scarce, than it is today. Today, information can be accessed from anywhere. In fact, from time to time, the students can access information as quickly as their teachers can. Success now lies largely in the ability to associate and synthesize the knowledge.

Regardless of the tools used, what is critical for effective learning is primarily to develop the student's (and teacher's) sense of self-efficacy; motivate learning; attract attention; keep student and teacher concentrated and attentive on the learning experience; ensure active student participation by urging them to grow out of passive listening/watching; enable socialization, peer learning and interaction; take personal learning differences and specific needs into account and observe close and distant transfer with the real-life equivalent of the subject or content taught.

Although it is not difficult to foresee that technology will be integrated more widely into education by gaining even greater momentum in the future, it is highly likely that the stakeholders who fail to spend the education process carried out in the course of the pandemic, effectively and efficiently, want to return to the traditional face-to-face education model which is their comfort zone. On the other hand, the stakeholders who see the potential of technology and the opportunities it offers will not want to see their achievements go down the drain. Given this situation, it can be expected that a hybrid learning model, which includes both the benefits of interaction provided by face-to-face education and the opportunities offered by online education, will gain some ground in the midterm. With proper process designing and the use of technology, it is possible to achieve a certain degree of independence from space.

For example, the introduction and explanation at the beginning of the learning process (a generic education process is given in Figure-8.) and the summary sections at the end of the process can be easily given asynchronously.

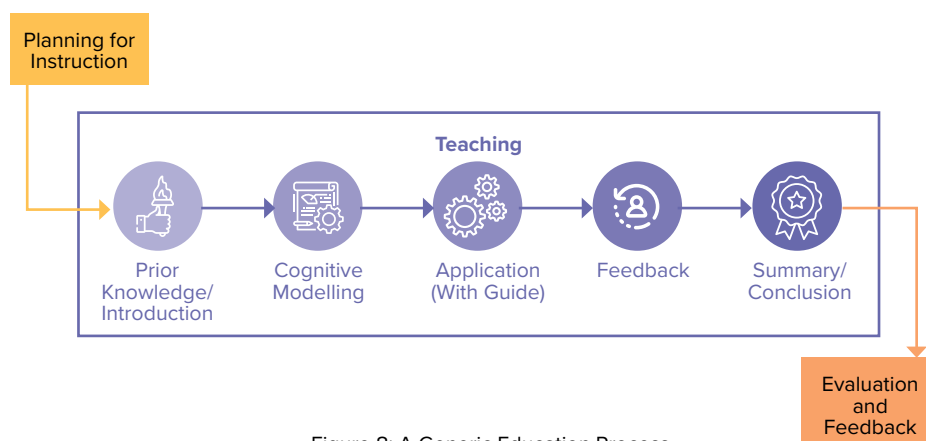


Figure 8: A Generic Education Process

“In order to make education an effective and entertaining process, it is important to use technology and learning tools accurately and effectively, and to establish a good process-tool balance, considering that technology is a tool.”

Before delivering the lesson, students should be provided with preliminary organizing information, infographics, etc., enabling them to think about the subjects, directing them to research with open-ended questions, having projects done, etc., in order to achieve more effective learning. It would be more appropriate when other stages are synchronous. It is important that the students are present at school/campus for observation, experimentation, questioning, discussion and socialization, rather than listening to the content.

It is considered that the real big transformation will actually be possible by designing the learning experience and taking into account the social and affective dimensions of learning as well as cognitive dimensions while this is carried out. This is not an approach that excludes technology. Technology should be at an “adequate” level in education, just as it is in life. In order to make education an effective and entertaining process, it is important to use technology and learning tools accurately and effectively, and to establish a good process-tool balance, considering that technology is a tool. Some other findings regarding the integration of technology into education systems are as follows:

- It will not be enough to add the technology only as a hardware, application or content, so both pedagogy and methodology of the process should be handled in the first place and designed in detail, and also the technology and content to be used should be planned in accordance with this system,
- It is required that “adequate” use of the right technology and tools should be planned when designing the learning process and experience, by focusing on people (student and teacher), rather than technology,
- In addition to the potential of technologies to add benefit to the field of education, the effects that they can create on students, especially human health, psychology and privacy, should be analysed thoroughly before they are introduced.

“It should be ensured that the entrepreneurship and investment ecosystem in Education Technologies especially in our country be improved, directed and supported systematically, and also the technological base be mobilized in this direction.”

All assessments point out that there will be a need to redesign and define the education, along with the potential of technology. Implementation of a more effective and efficient education system will improve the learning approaches, culture and systematics as well as the role of teachers, their set of competencies, and therefore the teacher education and even the physical designs of schools.

Finally, it should be ensured that the entrepreneurship and investment ecosystem in Education Technologies especially in our country be improved, directed and supported systematically, and also the technological base be mobilized in this direction.

Conclusion

The history of humanity is a befitting summary of people's struggle for existence of people. Human beings, unlike other living things, have established everything on their ability of learning, including their 'domination' over the planet. Human life has become more and more complicated over time with development, and made the corporate education compulsory. It is only by virtue of the education that production methods, collective living and the culture shaped by human beings can be transferred to future generations.

Important events in the history of humanity caused significant transformations also in education systems. The most important one of these milestones is the industrial revolution. James Watt probably had not thought that his studies would have completely changed the education system when he started to develop the steam engine in 1764. With the industrial revolution, the production tools and processes of people were re-defined all over; so were the role, function, process and output of education. With more focus on the production of goods and services, this period became both the primary function and output of educational institutions.

With the introduction of the Internet into daily life in 1990s, the history of humanity witnessed a new milestone. There was a need to redefine and restructure the production of goods and services; and now the focus was on knowledge production and sharing. New meaning and new 'mission's have started to be attributed to the concepts of learning, teaching and education. This change has inevitably caused the concept of school to be re-questioned and redesigned.

Unlike the milestone in the industrial revolution, the focus of the change was on human in this new era of Internet and digital technologies. Average life expectancy of human beings was increased from 40-45 years during the industrial revolution due to famine, diseases and wars to more than 90 years today being largely free of the threat of hunger, and increased quality of life thanks to technology.

That is, the humankind has entered an era in which people can focus on themselves and discover themselves-for the first time throughout his history. No matter how much technology penetrates our lives, speeded up with the pandemic, this era of change will be a "human-oriented" one. This is also because people now have the power and luxury to do that. As I mentioned above, different from the industrial revolution, the technological and social developments and change in this period have to be "for people" and "relevant to the people". It would not be wrong to foresee a restructuring in educational systems and institutions in this regard. Compared to the change rate of technology and tools, the change of human biology and psychology so far is negligible. That is, biologically and psychologically a human being is still the same human being, whatever the means are.

“No matter how much technology penetrates our lives, speeded up with the pandemic, this era of change will be a “human-oriented” one.”

“We do not learn for school, but for life”¹

Seneca

l. Lat: Non scholae sed vitae discimus



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