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Academic's Views on Industry 4.0 within the Scope of Open and Distance Education

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Abstract: The main purpose of this study is to explore the effects of Industry 4.0 on resources (specialization, rationalization, preparatory work, and capital-intensive techniques) in the field of open and distance learning. Industry 4.0 is a period in which a great and rapid change is experienced, has a wide and deep impact that can affect business lines all over the world, and changes in production, management and control systems. For this purpose, within the framework of Otto Peters' theory of Industrialization, the study is a case study based on the opinions of experts in the field of industry-related effects of open and distance learning. The study group consisted of 10 academicians working at Anadolu University Open Education Faculty as experts. For the determination of participants, purposive sampling was used. The purposes of selecting the Anadolu University in research are presenting open and distance learning services since 1982, having the only Distance Education master's and doctoral programs in Turkey and having lecturers who give a lecture about digital transformation and Industrialization. The research was a qualitative case study and the data were collected by a semi-structured interview form consisting of 6 questions by face-to-face interviews with experts. As a result of the analysis, industry 4.0 effects on resources, instructional design, distribution, interaction, learning environment and management components within the context of industrialization theory in open and distance education system. In this direction, it is necessary to eliminate the lack of infrastructure for Industry 4.0, increase digitalization studies and specialize in technological competences. Also, the deficiency of a standardized production concept in Industry 4.0 such as massive production emphasized personalization and individual production in distance education. The distribution of the course materials produced must be diversified and the post-Fordist approach should be preferred in mass production. While industry-wide technologies that trigger Industry 4.0 make it easier to offer different fields of study through distance learning, it affects the centralization and concentration factors in management.

Keywords: Industry 4.0, Open and Distance Education, Digitalization, Industrialization, System Approach.

Introduction

With the desire for self-development of the educated people, the increasing population, the great global crisis and the diversification and proliferation of knowledge, the demand for education increases. In the 21st century, rapid changes and transformations occur in almost every field, including education, by the growing and developing industrialization. Increasing individual needs, personalization of learning, differentiation of used technologies and more frequent use in daily life have accelerated the work towards the objectification of education. In open and distance teaching, most teaching functions are objectified as they are determined by the distance study courses as well as technical means (Peters, 2010). Objectified education has not only gone beyond traditional educational environments but has also been delivered to learners via information and communication technologies in our daily lives with both printed materials and Industrialization. Over time, Industrialization and distance education have been influenced by each other and distance education has gained importance (Peters, 2010).

Since distance education is an interdisciplinary field dating back hundreds of years in the world, it is applied by both higher education and different institutions (Anderson and Simpson, 2012). Distance education is a system that cannot be considered separate from information and communication

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technologies, together with globalization and Industrialization, is the focus of these changes with its being independent of time and place. Due to the fact that in distance education, education services are delivered to the learner through different learning environments, not face-to-face, Diversity is increasing and changes are experienced, from digital tools used in the delivery of learning, to the structure of distance education, from course designers to learner characteristics (Parlak, 2017; Saba, 2012).

Industrialization, known as the transition from an agricultural society to industrial society in the second half of the 18th century and early 19th century, is defined as the transition from small-scale production methods to mass-based production based on technology and related social and economic changes (Turkish Academy of Sciences, 2018). Starting with the steam power along with Industrialization and the first industrial revolution, either social or industrial changes continued with the development of electricity, production line and mass production in the second industrial revolution and with the development of computers, and automation in the third industrial revolution. Computer and automation, which triggered the third industrial revolution, increased computerization, result in the digitalization of what we see in our environment and which we actively use or consume. The changes brought by digitalization have taken place and gained ground in our lives in a very short time (Schwab, 2016). In this context, because of the evaluations made, it is stated that most professions will not be occupied within the next 15-20 years and that the job of some professions will change (OECD, 2017). The source of the information is no longer school, and that digitalization allows the individual to have access to the information at the time and place they want (World Economic Forum, 2016).

Peters (2010) stated that the use of the first railways and postal system together with Industrialization also took place at the same time as the first trials in distance education. In this connection, this new form of education and learning was based on rational planning, industrialization ideologies, mechanization, technological and economic developments. Otto Peters compares the industrial production process with the structure of distance education observed that the whole production line from the raw material to the final product was rationalized in the industrial process and descriptively, there were similarities with the structure of distance education (Peters, 1967; 2010). With Otto Peters' theory of Industrialization, which forms the basis of distance education, discovered similarities between the industrial production process, the structure of distance education and the teaching-learning process, and by developing a theoretical structure in the field stated that distance education is an industrialized form of education (Gokmen, Duman and Horzum, 2016; Peters, 2010). distance education is an industrialized education system and states that distance education should be defined and realized in different ways within the context of Industrialization (Peters, 2010). Industrialization affects not only technical aspects but also organizations as structures. Industrialized education is based on elements such as planning, industrialization ideologies, mechanization of business processes. In this respect, it is necessary to examine the effects of Industrialization on the cultural, social, and societal dimensions of distance education to develop and realize distance education. Also, Industrialization has not ended yet and continues with more energy and success than ever. In this respect, it is necessary to define and implement the theory that distance education is the most industrialized form of education, especially it is necessary to determine the effects of the Industry 4.0 in which we are into the distance education.

In the world, there are -in the global context- periods and stages of distance education that have been applied for a long time and the elements that are affected. Technology has great importance in the separation of distance education into this period or stages (Bozkurt, 2017). these periods and stages which are designated as industrial (Fordism) and post-industrial (post-industrial or post- Fordism), have begun a new era with Industry 4.0. It is seen that the changes and digitalization experienced are more effective today with the fourth industrial revolution (Industry 4.0) and they affect different institutions and organizations both in terms of structure and application. Industry 4.0 affects an organization's Digitalization and integration into all processes such as product development, procurement, production, logistics and services (PricewaterhouseCoopers, 2016). According to Schwab (2016), the period we are

in is expressed as a period in which there is a big and rapid change, a wide and profound impact that can affect the business lines all over the world and also changes in the production, management, and inspection systems. At the same time, humans and talents come into prominence and the importance of well-trained manpower is increasing. There will inevitably be transformations in higher education institutions where vocational skills are gained especially in today's education where the training of individuals with high standards skills is important (Aybek, 2017).

Various studies are carried out to meet the educational needs of individuals with the increasing and developing technologies of higher education institutions. Today, many higher education institutions also have a distance education center to meet the educational needs of individuals. The Council of Higher Education in Turkey is the institution that determines the procedures and principles of distance education with the directives and regulations issued for specific objectives and purposes to establish a national standard in distance education. In accordance with these procedures and principles determined by the Council of Higher Education, universities establish their distance education centers (Baris and Mevsim, 2014). Various studies are carried out to In this context, it would be appropriate to determine in general terms how Industry 4.0 is effective in distance education, which is increasingly widespread in educational institutions, and to what extent distance education can respond to these changes and transformations.

Today, both learners and working individuals face a world where technology, internet, cloud computing and social media create difficulties for formal education systems. This period also requires different skills that are not the same as those required by the third industrial revolution (Xing and Marwala, 2017). 21st century skills, also named as critical thinking, knowledge operational thinking, emotional intelligence, knowledge generation and management (Trilling and Fadel, 2009), they are among the basic skills required by Industry 4.0 and digitalization. Both the behaviors expected from the distance learners and the qualities of the workforce that serve in the development and delivery of distance education are important today and they must be able to meet the social and work expectations.

The digitalization of production does not only affect changes in knowledge, skills and capabilities but also requires differentiation of existing products or the production of new digitalized products. Until now, while making production automation, progress has been made with artificial intelligence, and it is seen that it is towards self-regulating production which can be adapted to individual demands and has self-learning ability (Schwab, 2016). Traditional distance education systems don’t meet this demand mentioned above. It can be said that differentiation and enrichment of the content offered to the learner in distance education will be appropriate not only for the text and visual elements but also for the needs of the learners. The effects of Industry 4.0 on distance education and content development should be determined.

Differentiation of production processes in Industry 4.0 expansion of product types to be produced and improvement efforts significantly increase the development of new solutions in quality control processes (İllés, Tamás, Dobos and Skapinyecz, 2017). It is inevitable for distance education centers to improve the quality control processes applied by the distance education centers such as teaching staff, education programs and teaching, student support services, institutional operation, institution's mission, outputs, measurement and evaluation, learning resources. It is necessary to determine what these improvements and changes cover, what direction they will be and what impacts they have with Industry 4.0.

Today, children and adults can attain information whenever and wherever they want, with the increasing use of technology in social life, because the authority of information is not schools and teachers anymore. Distance education can be a significant opportunity to transform society in a better way in terms of presenting information through digital media (Xing and Marwala, 2017). In this context, how the distance education will be created and carried out in the next few years with the impacts of the Industry

4.0 will be a situation associated with the management culture of the institutions providing distance education services. In this direction, resolving the effects of Industry 4.0 on the open and distance education system within the framework of Industrialization theory creates the problem of the study.

Based upon the parts discussed above, this study aims to explore the effects of Industry 4.0 on the open and distance education system. In this context, within the framework of the elements discussed in the Industrialization theory of Otto Peters, the effects of Industry 4.0 on the open and distance education system were tried to be determined based on the opinions of experts in the field. In this context, answers to the following questions are sought:

1. What are the contributions of Industry 4.0 on resources (specialization, rationalization, preparatory work, and capital-intensive techniques) in open and distance education system?
2. What are the contributions of Industry 4.0 on instructional designs in the open and distance education system?
3. What are the contributions of Industry 4.0 regarding the distribution mechanism / processes in the open and distance education system?
4. What are the contributions of Industry 4.0 on the interaction processes in the open and distance education system?
5. What are the contributions of Industry 4.0 on the learning environment in the open and distance education system?
6. What are the contributions of Industry 4.0 on the management processes in the open and distance education system?

In the context of the effects of Industry 4.0 on the open and distance education system, the views on these questions will be discussed in detail.

Literature

Founder and President of the World Economic Forum Klaus Shwab (2016, p. 9) states that humankind is at the beginning of a period that will radically change the way we live, work and relating to the fourth industrial revolution, and the speed and measure of the changes that have occurred so far should not be ignored. In this period, in the production process, machines started to self-manage without the need for manpower (Schwab, 2016). The machines have reached this structure by combining computer, communication, and internet technologies (Onday, 2017). In this direction with Industry 4.0, from demand to development, from raw material procurement to production, from production to market, human, machine and technology are connected to each other and the decision is mostly left to machines (The Union of Chambers and Commodity Exchanges of Turkey, 2016). Besides, there will be unlimited opportunities for billions of people to connect to mobile devices, a large amount of processing power, storage and information access, and the interplay of high-tech technologies such as artificial intelligence, robotics, internet of objects, autonomous vehicles, 3D printers, etc. (Prisecaru, 2016; Schwab, 2016). Schwab (2016, p. 11) has tied the fourth developing industrial revolution to three main reasons:

1. Speed: Interconnected and multifarious new technologies are moving at a higher speed by affecting each other.
2. Width and Depth: The increase in technology used in Industry and digitalization has brought along change and accelerated to Industry 4.0.
3. System Impact: Industry 4.0 includes a holistic transformation of systems between countries, companies, sectors, and even within themselves.

With Industry 4.0, many trends have begun to transform the competition and production power of institutions and even countries, leading to changes in business practices. These trends can be grouped under four main headings (Onday, 2017, p. 56): Regional trends- interaction and commercial increase between regions, Economic trends- globalization rising with new and strong economies and financial resources, Technological trends- the development of internet technologies and increasing internet use, Meta trends- decreasing resources, environmental and security concerns. As a result of the developments in increasing globalization and internet technologies, these trends are the basis for the systems where the means of production relate to different sensors or internet and information technologies. These systems can be connected to by internet protocols in cyber physical systems, can predict errors and analyze data. In the period of Industry 4.0, becoming widespread of the structures mentioned in the process of production will provide faster, more flexible, and more efficient production (Xu, David and Kim, 2018).

The aim of Industry 4.0 is to make the production process more efficient with the self-managing technological systems and to create smart factories in which this production process is formed. To create the relevant systems in this direction, we can list the important technological elements that trigger the Industry 4.0 such as; three-dimensional printers, intelligent factories, cyber-physical systems, internet of objects, big data, intelligent robots, simulation, augmented reality, artificial intelligence, cloud computing, horizontal and vertical system integration (Firat and Firat, 2017; Herman, Pentek and Otto, 2015; Onday, 2017; Schwab, 2016; Presecaru, 2016; Cordes and Stacey, 2017).

Industrialization Theory in Open and Distance Education

The spread of distance education has increased simultaneously with the increase in Industrialization and postal services. The emergence of education by letter can be said to be a direct result of communication technologies. Regardless of the method of delivery, it is important to know that teaching by letter is the same as teaching through the text (Peters, 2010). This represents a fundamental change in traditional classroom teaching and learning. The ability to distribute the course materials economically and studies to deliver the produced materials to the learner and the work time, planning, and the experts who will take part in the project formed the first structuring works in distance education (Cleveland-Innes and Garrison, 2010). It has been observed by Otto Peters that the technologies used in this structure and the way of production are consistent with the principles of Industrialization. Initial studies on the interpretation of distance education as an industrialized form of teaching and learning started with Otto Peters (1967) states that the theory of Industrialization is not a learning and teaching theory and by indicating that it will not reflect all the distance education, he states that it is a descriptive theory. Furthermore, Farnes (1993, p. 11) points out that industrial production differs from pre-Fordism, Fordism, and post-Fordism periods, and that these differences have important contributions to the development of distance education. The discussions on this subject have increased and intensified over time (Peters, 1967; Farnes, 1993; Raggat, 1993; Rumble, 1995; Evans, 1995; Cleveland- Innes and Garrison, 2010). These debates are important to emphasize the structure and special character of distance education.

Otto Peters's Theory of Industrialization

In addition to the technical and economic characteristics of Industrialization, It is necessary to mention the social, cultural and social dimensions that lead to the formation, development, and rise of distance education. Otto Peters (2010) who emphasizes that distance education could not be developed in pre-industrial societies reports that the first postal system and with the establishment of railways and the first trials in distance education have taken place at the same time. This new form of teaching and learning is based on rational planning, Industrialization ideologies, mechanization of business processes

and beliefs in technological, economic progress. Stating that distance education is not created by pedagogues, Peters (2010) also states that the new and successful methods of industrial goods production- adopting this ideology- are constituted by entrepreneurs who apply education to make a profit. In this context, it can be said that distance education is primarily developed structurally. Distance education was used only by a minority in the 1960s and was ignored by public and educational experts. Although education has been carefully analyzed since Comenius, Pestalozzi and Dewey, distance education has not been analyzed and described (Peters, 2010). Peters (2010) stated that there is no research conducted for this form of education and that there is no awareness about the specific characteristics, the potential for future developments and how different It is from traditional education, he stated that distance education is something special with its own facilities and conditions and undertook studies on this topic. Peters (2010) stated that he primarily identified eight elements of traditional education: written instruction, printed materials, use of auxiliary equipment, audiovisual teaching, programmatic learning, published instruction, computer-based instruction, and independent study. As a result of this analysis, it has been shown that distance education is not different from traditional education but also It can be carried out by using only one or by being combined many of these elements.

Another study is to examine the prerequisites and procedures of distance education (Peters, 2010). In this respect, distance education is seen as a separate from each other but also as a process consists of interconnected incidents. In traditional education, while the process of learning and teaching takes place in a specific place and time, distance education is organized independently of time and place. This arrangement includes elements such as intensive and long-term planning, instructional design, production, and distribution of course materials that will facilitate self-learning (Peters, 2010). In order to whole process functioning properly, Peters (2010) who observes that a certain sequence must be followed, the division of labor must be done, the entire process needs to be rationalized to achieve a large output with limited input and states that this process shows similarities with the components of Industrialization theories. He also stated that there are structural similarities between the industrial production of goods and distance education.

In his first study, while Peters (1967) mentioned about fifteen aspects of similarity between industrial production and distance education, by updating his study in 2010 he augmented these aspects to twenty. As a result of the analysis, the findings of Peters' (2010, p. 15) are the rationalization, division of labor, assembly line, preparation stage, specialization, mechanization (automation, virtualization), new energy forms, planning, organization, control, formalization, standardization, change of functions, spatial separation time, objectivization, capital intensive techniques, concentration, centralization, mass production and mass distribution. Peter describes these components as follows (2010, p.15-18);

- **Rationalization:** The success of distance education is based on the efficiency of a production line' that consists of several specialized contributors: authors, course developers, administrators, distributors, correctors, correspondents, evaluators.
- **Division of labor:** Teaching is divided into several functions that are assigned to different persons: authors, instructional designers, media specialists, correctors, tutors, counselors, moderators, evaluators etc.
- **Assembly line:** The production line resembles the Fordist assembly line as pieces of the course material are passed from one station to the next from their creation until dispatch.
- **Preparatory work:** Distance education can be successful only when the production of printed or otherwise mediated course-material has been carefully prepared. A preparatory phase is necessary here as well.
- **Specialization:** Persons involved in developing, controlling and evaluating distance education are no longer generalists as teachers in the classroom or faculty in the lecture hall, but trained specialist.

- **Mechanization,automation; virtualization:** Distance education is based on the use of quite a number of technical devices: typewriter, paper, duplicating machines, printing press, post office, railway, cars, telephone, computer, and, since 1995, also the Internet and the Web. These technical devices are absolutely necessary, as neither teaching nor learning can take place without them.
- **New forms of energy:** Whereas traditional teaching and learning is based on bodily energy distance education is mainly dependent on the availability of steam engines, petrol, and electricity.
- **Planning:** Teachers in the classroom have their individual and personal ways of planning their instruction over a year and from day to day. In distance education this activity must be done in a systematic and long ranging way because too many persons may be involved in teaching and learning, major investments must be made, and often extremely large numbers of students are envisaged and have to be dealt with. Planning specialists are often employed to tackle this task.
- **Controlling:** The distance teaching institution has a section that analyzes continuously how a course is accepted, how the students learn and how the organization reacts to failures. Empirical methods are used.
- **Formalization:** Whereas in face-to-face situations teachers and learners are free to change their learning spontaneously, this is not possible in distance education. Here the process of learning is largely unified and formalized.
- **Standardization:** Distance teaching institutions are forced to adopt a greater degree of standardization than is required in the traditional classroom. This is necessary because machines are used for producing, multiplying and distributing learning units, set books and magazines.
- **Change of functions:** To be part of a technological and organized process changes the function of the persons involved. Division of labor leads to the separation of functions that are traditionally united in one person, the teacher or lecturer. In distance education these functions are assigned to several specialists: planners, content providers, instructional designers, media specialists, writers, lecturers, printers, tutors, mentors, counselors, moderators.
- **Time-space separation:** Teachers and taught are separated with regard to time and space.
- **Objectifying:** Teaching and learning in distance education is largely objectified, especially when it is programmed and automated. This involves a depersonalization of teachers. However, objectification is a necessary precondition for quite a number of advantages: teaching becomes a product that can continuously and empirically be improved, it can be multiplied by machines, it can be mass produced and adapted to any number of students, it can be sold.
- **Capital-intensive techniques:** The possibility of mass production enables institutions of distance education to enroll large and even enormous numbers of students. In the same way in which goods of industrialized mass production are cheaper than products made by craftsmen, so that more people can afford them, industrialized education can be cheaper so that more students can be catered for than is possible in traditional educational institutions.
- **Mass production:** The carefully and expensively developed high quality distance teaching course is the standardized object that can be easily mass produced.
- **Mass distribution:** Distance teaching institutions establish dispatch offices that distribute and post the self-instructional learning material to thousands and thousands of students living everywhere in the country or abroad.
- **Concentration:** Distance teaching institutions, especially open universities, often become the biggest in the country. This leads to a concentration of funds, experts, teachers and technical equipment. The concentration of financial investment and of highly skilled manpower is a prerequisite for high quality teaching.

Centralization: Considerable sums of money must be invested in order to establish a viable distance teaching institution – for the preparation, development and testing of high-quality self-teaching material and for evaluations.

The theoretical background of the study is the system approach of Moore and Kearsley (1996) and the industrialization theory of Otto Peters (1967; 2010). According to Moore and Kearsley (1996), distance education system consists of all component periods that make up distance education; resources, design, distribution, interaction, learning environments, management and even history and institutional philosophy. These components are subsystems that are a system in themselves. For example, in the distance education system, many components that deal with course design and work together to produce the course in a timely, affordable, and high-quality form constitute the subsystem (Moore and Kearsley, 1996). In this context a subsystem is linked to other subsystems that make up the whole system, and anything that happens in one of the subsystems influences other parts of the system. this effect in the system approach coincides with the integrity principle of industry 4.0.

Methodology

In this section, research design, participants and setting, data collection tools, data analysis, the credibility of the research are explained.

Research Design

This study is a qualitative research method to determine the opinions of experts in the field of the effects of Industry 4.0 on the open and distance learning area. The study group of the study consisted of 10 academicians working at Anadolu University Open Education Faculty as experts. Purposive sampling is used for sample selection to specify the participants. Purposive sampling assumes that the researcher selects the best example he can learn to gain insights, understand, and discover (Meriam and Tisdell, 2016, p. 96). According to Patton (2015), the logic and power of the purposeful sample lie in the selection of information-rich situations for in-depth study. Knowledge-rich situations are topics that can learn a lot about the issues that are of great importance for the research.

Participants and Setting

The participants of the study were selected among academicians who gave lectures and conducted scientific research in this field. The demographic information of the participants is as follows (Table 1).

Table 1: Demographical characteristics of participants.

Demographical Characteristics of Experts		f
Age	30-40 years	6
	41-50 years	3
	51 years and older	1
Gender	Female	3
	Male	7
Seniority	1-10 years	4
	11-20 years	3
	21-30 years	2
	30 years and above	1
Management Duty	Yes	8
	No	2

As shown in Table 1, the participants were 3 female and 7 male experts. While most of the experts are between 30 and 40 years of age, some of them are 41-50 years old and others are 51 years of age or older. The seniority of the experts is between 1 and 10 years, there are 3 participants between 11-20 years, 1 between 21-30 years and 1 participant with 30 years or more seniority. 8 of the participants

have management duties while 2 participants do not have any management duties. Besides, participants 1 Prof. Dr., 3 Assoc. Dr., 3 Faculty Member, 1 Instructor, and 2 Research Assistants. As a result of the interviews, it was observed that the data were repeated after 10 participants and the number of participants was limited to 10.

Data Collection Tools

Interview, observation, and analysis are the activities at the center of qualitative research (Meriam and Tisdell, 2016, p. 2). In this study, research data was collected by semi-structured interview technique. For identification of interview questions, the literature review was made by taking into consideration the components of Industrialization theory of Otto Peters (1967; 2010) and the system approach components of Moore and Kearsley (1996) and then expert opinion was consulted. A pre-interview form was generated, and the form was sent to a group of 3 experts to put into its final form. In accordance with the feedback received, semi-structured interview form with 6 questions was put into its final form.

Data Analysis

Experts are called U1, U2, U3 and so on in accordance with the interview order. Interview forms were given to volunteer experts who wanted to participate in the study and their answers were recorded one by one and the recordings evaluated by analyzing and grouping. In the interviews with the experts, the opinions about the interview questions were recorded in the voice record in accordance with their permissions and were put the audio recordings in writing and prepared for analysis. Data collected as audio recordings were first written in computerized form and then analyzed by using content analysis from qualitative research techniques. In qualitative research, the researcher doing content analysis should decide how to form a theme to form a pattern, what constitutes a theme, how to name it and how to express the result from case studies (Patton, 2015). After putting the voice recording data in writing, the data were analyzed through the NVivo 11 program. NVivo is a software that has features that are very important for qualitative data management such as character-based coding, rich text features, and multimedia functions (Zamawe, 2015). In this direction, the researcher transferred the recorded sound recordings to the NVivo program, and the data were coded, and themes were formed in accordance with the interview questions. The answers of the experts to each question were interpreted in line with the themes created in terms of their similarities, and some answers to the questions were also presented as are. It was consulted the expert opinions in the creation of themes and the compatibility of the encoded content with themes. The data were examined by two researchers to ensure the validity of the research. The agreement rate in the study was %94. Miles and Huberman note that %70 or greater inter rate agreement is acceptable for the reliability of the findings.

Research Credibility

Variation is used in qualitative research to increase validity and reliability. Diversification is the diversification of data sources, data collection method and researcher to verify the findings (Meriam and Tisdell, 2016, p. 259). In qualitative research, can achieve variation by combining both interviews and observations, mixing different types of purposeful examples, or examining how theoretical perspectives lead to an analysis. In this study, researcher, and theory variation from the four variation methods stated by Patton (2015) was used to increase validity and reliability and to verify the findings reached.

- Data diversity
- Method variation
- Researcher variation
- Theory variation

Researcher variation controls potential biases in data collection and analysis (Patton, 2015). In the study, a person other than the researcher and the advisor faculty member participated in the activities, thus data diversification was made. In addition, within the scope of the research, the system approach of Moore and Kearsley (1996) and the system effect of industry 4.0 and the industrialization theory of Otto Peters (1967; 2010) were based on the theoretical framework.

In order to increase the validity of the study, first of all, the selection of the experts was based on volunteerism and it was stated that their names would be kept confidential and would not be disclosed in any way so that they could answer the questions sincerely. The volunteerism of the participants to participate in the study is an important issue for the validity and reliability of the study (Yıldırım and Şimşek, 2013). In addition, face-to-face interviews were held with experts to collect data. In order to increase the reliability of the study, the opinions of three experts were used for the interview form. In addition, the opinions of the participants were given as in the findings section.

Findings and Discussions

Findings and Comments on the Effects of Industry 4.0 on Resources in Open and Distance Education System

It is asked experts that what will be the effects of Industry 4.0 on resources in the distance education system. The opinions of the experts are explained on the themes of "specialization", "rationalization", "preparatory work" and "capital intensive techniques". Under the main theme of "specialization", there are sub-themes of "competencies", "mechanization", "technology" and "culture", and under the main theme of "rationalization", there are sub-themes of "personalization" and "technology (data mining)" (Figure 1).

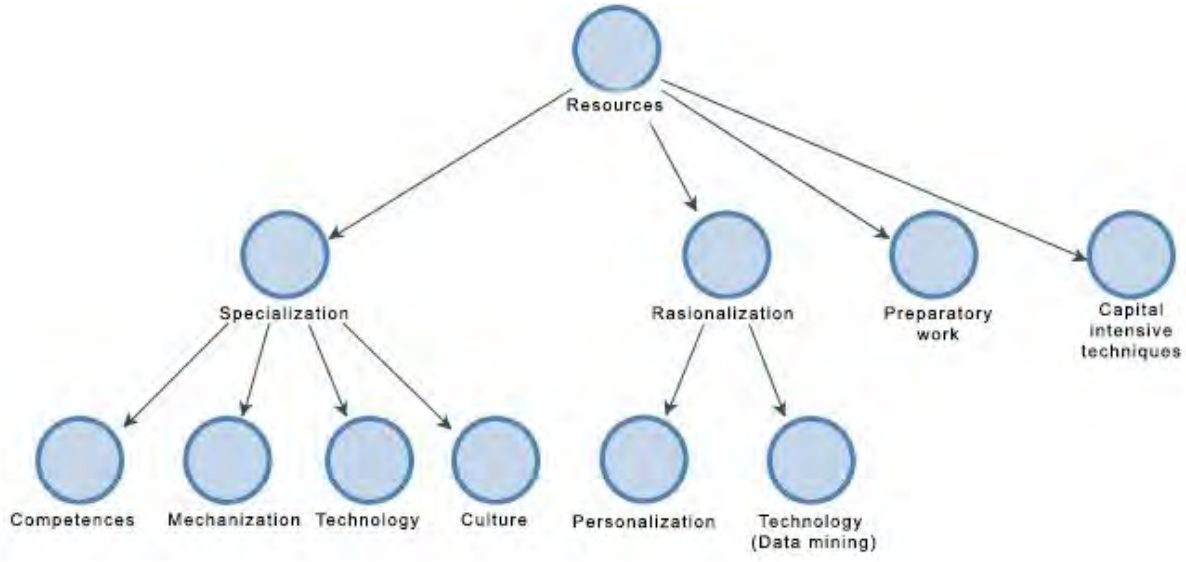

Figure 1. *Visualization of the themes obtained as a result of the answers given about the effects of Industry 4.0 on resources in the distance education system.*

In the main theme of "Specialization", it is emphasized that in which fields will specialization be, what are the factors, technologies affecting specialization and their competencies. It is stated that under the “Competencies” sub-theme, there is a rapid change with industry 4.0 and it is necessary to keep up with it. It is stated in the sub-theme of “mechanization” that specialists could be not only people but also machines, less people and less labor would be needed. It is stated in the sub-theme of “Technology” that specialization can be in different technological fields. When the opinions of the experts are examined, it is seen that the technologies such as big data, data mining and learning analytics are the technologies that trigger industry 4.0. In this context, it is stated that technologies to be used in distance

education will change in this direction and specialization will increase on these Technologies. Besides, experts stated that the areas of specialization in distance education will increase. An expert who stated that specialization in the “Culture” sub-theme should be done without leaving daily life, stated that experts should know what culture is. Under the main theme of “rationalizing”, it was stated that studies regarding mass education will be personalized and technology will be used more intensively in the context of planning and analyzing the distance education process. In the sub-theme of “Personalization”, it was emphasized that individual features should be taken into consideration in the preparation of training together with industry 4.0 and personal production should be made.

> U3: Each component of the open and distance education system will need to be well-organized and interconnected with each other. Because with the role of the teacher in the traditional classroom, the role of principal, dean or assistant will turn into roles such as semantic web administrator, central system automation manager.

> U1: Experts will be added not just humans, but experts in the form of computer-based robots, or smart agents.

> U4: Specialization should be done without breaking away from social life. This means learning culture. There should be many specialization areas in distance education. These experts also need to learn about culture. There should be hybrid specialization, not specialization disconnected from each other.

In the sub-theme of “Technology (Data Mining)”, It was stated that big data, data mining and learning analytics should be used in rationalizing the process. Thus, it was emphasized that the process will be rationalized more quickly and effectively.

> U7: We can analyze it with learning analytics, evaluate students, do students read a book, click on a link, where there is the highest density, it is necessary to provide rationalization accordingly.

It was stated in the main theme of “Preparatory Work” that increasing technological resources should be employed, infrastructure should be established for using the resources in a virtual environment, and new systems should be established.

> U6: It will require preparatory work in the first place, in the context of the establishment of these new systems.

In the theme of “capital-intensive techniques”, it was emphasized that in the context of Information Technologies, Industry 4.0 may be the first investment but later on, it may bring the products cheaper later, and industry 4.0 is more effective in terms of cheapening the product for technology producing countries.

> U10: It will help information technologies become cheaper, especially when we say industry 4.0. With the decision taken in open education in the past weeks, offering the digital book instead of printed material is an important decision in terms of reducing costs. Similarly, the workforce will be the same. There are problems with audiobooks right now, we still read people. There is a problem in Turkish right now, but computers can read the book in English. We will be able to reduce the cost in terms of audiobooks in the future.

Industry 4.0 and triggering technologies impress the specialization of resources in the distance education system, which cannot be considered separate from technology, rationalizing the process, preparatory work, and capital-intensive techniques. Distance education system cannot be considered without experts. That is why Industry 4.0 expects experts to reform the traditional outlook and have an ingenious vision. Experts should be supplied with multidisciplinary information such as educational, managerial, and technological. Also, in the With Industry 4.0, increased mechanization and less labor and human needs, the use of intelligent robots or agents may substitute for experts, especially in support

services. On this basis, specialization will increase in the technological field and the areas of expertise will be distinct. In general, education and universities require new skills and higher education human resources to meet changes in the labor market trends (Tung and Long, 2018, p. 852). Feshina, Konovalova and Sinyavsky (2018, p. 116) stated that the most popular specialization is in information and communication technologies. In the new era, scientific knowledge, and technology will have great importance (Peters, 2005, p. 43).

In the distance education system, personalization studies should be at the forefront in rationalization, analysis, and planning of the process. Industry 4.0 's distance education system will be more personalized in the production process, so it has to be produced accordingly. In the rationalization of the process, data are taken from learners, learning analytics will facilitate rationalization in distance education. In this context, it has great importance to complete the infrastructure works at the stage of preparatory work.

In terms of cost reduction in distance education, capital intensive techniques are an advantage in making the Industry 4.0 products cheaper for countries that produce technology. In the context of cost reduction and capital-intensive techniques, printed materials used in Anadolu University Open Education System were transferred to digital media.

Findings of the Experts on Industry 4.0's Impact on Instructional Design in Open and Distance Education System

It was asked the experts that, what will be the effects of Industry 4.0 on instructional design in distance education system. The opinions of the experts were compiled under the themes of "assembly line", "mechanization", "planning", "formalization", "standardization" and "objectification". There are “Personalization”, “Culture” and “Technology” under the main theme of “Formalization” while are the sub-themes of “Personalization”, “Design” and “Technology” under the main theme of “Production Line” (Figure 2).

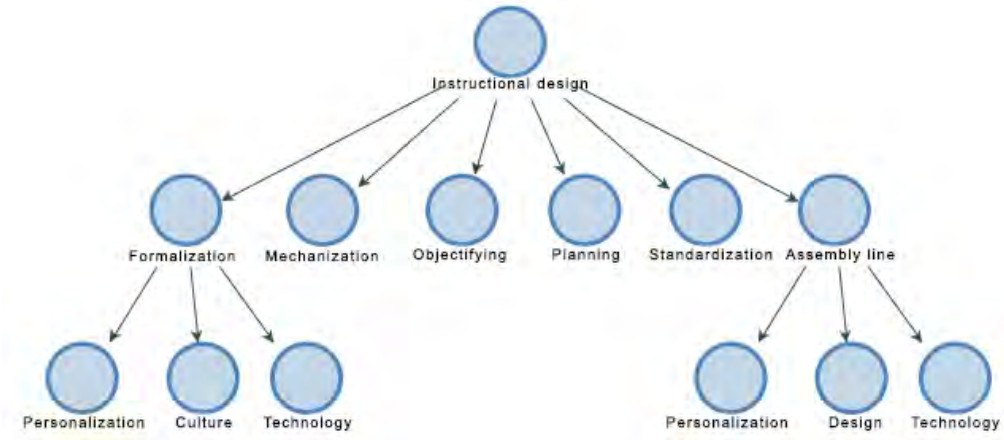

Figure 2. *Visualization of the themes obtained as a result of the answers given about the effects of Industry 4.0 on instructional design in the distance education system.*

In the main theme of “formalization”, it was emphasized that instructional design should be suitable for the characteristics of the learner, and how important culture is in terms of appropriate technologies and design. In the sub-theme of “personalization”, it was emphasized that formatting should be done in the context of the data received from the learner, design at the micro-level is prominent, it is necessary to diversify and differentiate the design. In the sub-theme of “Culture”, it was stated that formalization is related to culture and attention should be paid to cultural features in the design. In the sub-theme of “Technology”, technological tools that can be used in shaping were mentioned. An expert stated that content can be created by itself in formatting thanks to artificial intelligence and mechanization.

> U2: Analyzing data is now at the forefront, data from students will differentiate the design.
> U10: Nowadays, there are more interactive software's, and instructional designers may need to train them. Of course, there should be feedback in this software's, there should be learning analytics. In the content we have prepared, where the student has lost his interest, where he has shown more interest, it is necessary to go to more improvement studies in the material.

In the main theme of "Mechanization", it was emphasized that mechanization will increase in distance education and that it will be a machine intensive production instead of labor-intensive production. In mechanization, manual workforce has been replaced with industrial revolutions by using steam engines, heavy construction equipment, and computers. Distance education is also based on the use of many technical devices. It can be said that increased mechanization with Industry 4.0 and the increase in the use of software on the machines have resulted in the automation of the work to be done by the individual. According to the expert opinions, increasing mechanization in distance education will transfer most applications made with manpower to the machines. Accordingly, it is stated that technologies such as robots, smart agents, artificial intelligence, and machine learning will be used more widely in distance education.

> U9: It depends on your country, conditions, and possibilities. Production through machines may increase, for example, let's think of audiobooks, now it is done with human voices, perhaps with the effect of industry 4.0, there will be a reading close to the human voice and reading will take place in a shorter time. Maybe we will be able to have a book read by a machine and make it sound. This is also thought-provoking in terms of costs.

Under the main theme of "objectification", it was emphasized that different disciplines can now be given through distance education and will be more effective for learners. When the expert opinions are examined, it was emphasized that different disciplines can be given through distance education with objectification. It is stated that objectification will increase with Industry 4.0, and we can make objectification especially with technologies such as 3D printers, simulations, augmented reality, artificial intelligence and IoT. It was pointed out that it would also be easier to provide especially areas such as medicine, environment, and ecology as distance education While U1 emphasized that the staff should be qualified enough to realize the objectification, U4 emphasized that those who learn to objectify will do it themselves.

> U4: With Industry 4.0, learning will now be in the virtual environment, learners will make their own objectification. Objects were placed in front of the learner in the physical world, now these will be produced in a virtual environment.

In the main theme of "Planning", it was emphasized that planning should be made according to student characteristics, subjects and learning outcomes. Experts stated that planning should be made for the audience in line with accessibility, usability, facilitation and cost. It was stated that the characteristics of the mass should be taken into consideration in the technology selection, the environment or technology to be designed should be known very well, the course materials should be produced in accordance with the subjects and the new paradigm should be used. This situation has been stated to bring specialization.

> U1: Before Industry 4.0, we had a mass education approach, so we prepared one material and presented it to everyone.
> U9: What really matters in distance education is not technology but design, content, we should never ignore it. By analyzing the audience correctly, what is the most appropriate course material for that audience, what is the most appropriate design, what materials I use for the audience will be more successful, and this should be analyzed and selected by technology. Technology is a means, not a goal. It should be considered.

Under the main theme of "Standardization", it is emphasized that industry 4.0 will no longer be standardized and individual designs can be realized. Experts stated that with the reflection of industry 4.0 to distance education, standardization will no longer be available, and studies are carried out for individual education rather than mass production. In this direction, experts who state that the produced course materials and designs are diversified emphasized that designs suitable for the age, psychological level and even sociological characteristics of the micro level can be made. They stated that standardization will be in a certain standard of quality control, accreditation, environment, and content offered, but there will be no standardization in products. It is stated that in the absence of standardization, the content can be presented in different ways by using different technologies such as the development of virtual networks, sensors, big data, and analysis.

> U6: If we consider standardization, we can achieve this easily. I think we can produce customized products. When big data and its analysis, learning analytics can be extracted on a personal basis and the technological possibilities offered to us according to these inferences, we can produce personalized products.

Under the main theme of the "production line", it was emphasized that personalization is at the forefront and that technology would be intensive in design. Under the “personalization” sub-theme, it was emphasized that the materials and designs produced should be diversified and appropriate for the person.

> U8: It will create differences in terms of support resources, follow-up, and evaluation processes in the mechanization. Here, too, it can provide an advantage for personalized learning in distance education over data mining. Regarding this, it may be necessary to prepare the material at the time of design at the time of production.

Experts stated that mechanization will create differences in terms of support resources, follow-up and evaluation processes in production, and suitable designs should be made for each student by analyzing the mass correctly. Also, it is stated that we should prioritize the design in production and the technology is a tool, not the goal. In the sub-theme of "Design", it is stated that the design differs both in the context of the course and the materials. While experts state that big data and analysis, which is one of the technologies that trigger industry 4.0, will be effective in line with the data received from students, they stated that the design of a small learning area comes to the fore and the materials to be produced in this context should be produced with a current and new paradigm. Technologies that can be used in production are mentioned in the sub-theme of “Technology”. Experts stated that different technologies such as wearable technologies, adaptive systems, intelligent learning systems, algorithms, semantic web, and social networking that come into our lives with industry 4.0 can be employed in providing meaningful learning environments. In this process, experts emphasized that production will be technology-intensive rather than labor-intensive and that production will be faster and easier.

> U2: Analyzing data is now at the forefront, data from students will differentiate the design.
> U3: Not the instructional design of a course, but the design of a small learning space. Because each area is different from each other.

The effects of Industry 4.0 in terms of personalization are observed in the design of distance education. When personalizing in production, the demands of learners should be considered as informative. Thus, while the needs of both learners and distance education institutions are met, cost-effective training is provided (Moore and Kearsley, 1996, p. 9). Culture is another important point in formalization. The learning environment of the learners, the changing social and individual characteristics and cultural values should be taken into consideration. It can be stated that the technologies used in formalization will change with Industry 4.0. In this framework, virtual reality, simulation, virtual environments, learning analytics and artificial intelligence technologies should be used in formalization. Artificial intelligence and the instructional design with the mechanization of the content will be produced by itself for the learners. Instead of designing instructions for specific goals with a minimalist perspective to the experience of learners, designers will design to achieve the same learning objective as the existing

technological options for rich experience (Moller, Robinson and Huett, 2012, p. 17). Anadolu University's application "Anadolum e-Kampus" which is developed in this direction has a systematic design with a modular structure that offers open and distance education services in a full package. This application includes learning management systems, tracking of learner analytics, live lessons, and mobile application components (Anadolum eKampus, 2018).

In instructional design, information and communication technologies are generally handled in the distance education system as mechanization. Increasing mechanization and the automation of the work of experts will enable most of the works and processes to be transferred to the machines. Particularly, 3D printers, simulations, augmented reality, artificial intelligence, and the development of technologies such as IoT will also facilitate objectification in distance education. In this context, fields such as medicine, environment and ecology can be given as distance education together with objectification.

Instructional design planning should be made primarily in accordance with the audience by regarding accessibility, availability, facilitation, and costs. In this sense, it has high importance for the experts to pursue the technology knowledge, environment information and current paradigms to be used. To develop experts in this respect, it should be ensured that they receive professional education about technology literacy and contemporary teaching design and pedagogy paradigms (Banerjee, 2018, p. 177). It was possible to produce products in a standard way in previous industrial periods, but with Industry 4.0 there may not be standardization in distance education. In this context, more studies should be carried out for individual education than mass production. Virtual networks, sensors, big data and analysis, there will be technologies that are suitable for personal designs rather than standardization.

With the increase of the technologies used in education, the spread of e-learning and the increase in the rate of using learners' mobile technologies have made access to information faster. Text or videos designed specifically for the person / institution used here, internet-based learning interface and evaluations are a process in which the knowledge thirst of the learners is tailor-made in the desired place and time (Barkan and Ozdamar, 2007; Kumar, Banerjee, Gahan and Mohanta, 2016). It is one of the conclusions that in Industry 4.0 and open and distance education private designs should be done more.

Findings and Comments on the Effects of Industry 4.0 on Distribution in Open and Distance Education System

It was asked the experts that, what will be the effects of Industry 4.0 on distribution in distance education system. The opinions of the experts were compiled under the themes of "Mass distribution" and "mass production". There are "diversification", "speed" and "technology" under the main theme of "Mass Distribution", while are the sub-themes of "Personal production-post Fordist" and "mass production-Fordist" under the main theme of "Mass Production" there (Figure 3).

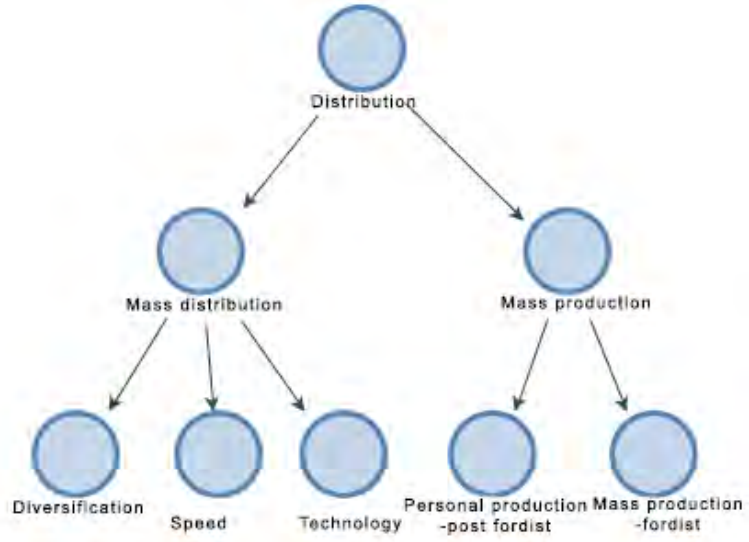

Figure 3. *Visualization of the themes obtained as a result of the answers given about the effects of Industry 4.0 on distribution in the distance education system*

How to distribute the learning materials produced in distance education to the mass was emphasized in the main theme of "mass distribution". In the “Diversification” sub-theme, it was emphasized that the distribution should be diversified. Experts stated that it would be appropriate to make the mass distribution with the packs considering the wishes of the learners, and in this context, access would also be easier. It is stated in the "Speed" sub-theme that the mass distribution will be faster. The experts, who stated that the produced learning materials would be delivered to the learners faster, emphasized the importance of speed in issues such as elimination of errors. In this context, they stated that costs such as logistics, organization, storage will decrease, quality will increase, and access will be easier. In the sub-theme of "Technology", the technologies used in mass distribution are emphasized. Experts stated that with the development of information and communication technologies in the distribution of mass, the delivery of the produced material to the learners, the access will increase and become easier. They emphasized that the production of printed materials may not continue especially with digitalization.

In the main theme of "mass production", the production of distance education materials was evaluated as personal production (post-Fordist) and mass production (Fordist). It is stated in the sub-theme of “Personal Production- Post-Fordist” that personal production will increase in distance education. Experts stated that personal production in distance education will increase with industry 4.0, that while the product is produced in a certain number in the old paradigm, it will be produced in line with the needs in the new paradigm. Experts who stated that changing the delivery methods of education instead of the delivering the standardized products of distance education in Industry 4.0 and the production of different materials affects the distribution, stated that contains characteristics of the post-Fordism period, where personal production is at the forefront. It was also emphasized that with digitalization, physical distribution would also be digitalized, thus facilitating access and distribution. It was emphasized in the sub-theme of “mass production-Fordist” that mass production may not continue in distance education. Experts stated that mass production contradicts with Industry 4.0, and that the development of digitalization and mobile technology in distance education facilitates access to content, and production and delivery will be easier. It is stated that mass production of printed materials will not continue especially in distance education.

> U5: Therefore, I think that industry 4.0 will bring difficulties in terms of distribution component, and on the other hand, distribution channels will diversify and in this sense will facilitate access.
> U10: Packages will now be suitable for the resource to deliver to the person.

In distance education, distribution and Industry 4.0 should be considered together with the wishes of learners. Academic staff should deliver the curricula according to the needs of the learners by keeping the autonomous control of the courses (Brooks and Kanuka, 2010, p. 73). Thus, access to the products to be distributed will also be easier. Delivering to learners, the distribution which is faster than before will also result in a reduction in costs such as logistics and storage. With developments in information and communication technologies and digitalization, the production of learning materials such as printed materials produced in distance education, may not be continued. According to Evans and Pauling (2010, p. 213), learners will register to the institutions of their choice by considering a number of criteria that will include not only the subject, the corporate status and the quality of the faculty but also levels of technology, such as ease of access, delivery speed.

Instead of mass production in the concept of Fordism with Industry 4.0, the concept of mass production, which is specific to the individual in the concept of post-Fordism, comes to the fore. In this context, the reflections of Industry 4.0 on distance education in mass production, especially the development of digitalization and mobile technologies, facilitated access to the content and transportation. The concept of post- Fordism production is characterized by flexible mass production forms with the principle of timely, aiming to respond quickly to changes in consumer demand (Brooks and Kanuka, 2010, p. 71).

Findings and Comments on the Interaction Effects of Industry 4.0 in the Open and Distance Education System

It was asked the experts, what are the effects of Industry 4.0 on interaction in the distance education system. The opinions of the experts were compiled under the themes of "consultants", "trainers", "learners", "practitioners" and "management team". Under the main theme of "learners" there are sub-themes of "speed", "learner-institution", "learner-learner" and "learner-social network" (Figure 4).

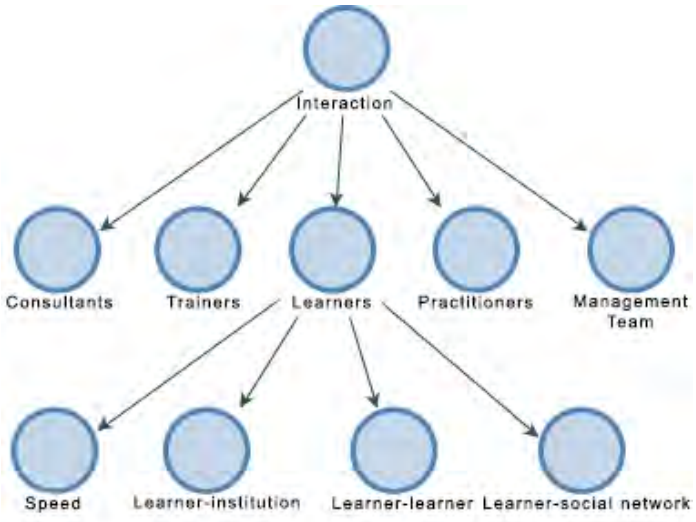

Figure 4. *Visualization of the themes obtained as a result of the responses given to the effects of Industry 4.0 on interaction in the distance education system.*

It was emphasized that bot systems could be used instead of clients in the main theme of "Consultants". U7 who indicated that the interaction in distance education with Industry 4.0 will be via the bots instead of consultants, states that bot implementation for standard answers will facilitate rapid response.

> U7: We are planning to activate bot systems while communicating with live people. Students are looking for standard answers such as exam dates, looking for answers on social media, to be faster. With Industry 4.0, they will be able to access such information faster and more precisely. Bot accounts will make it easy to respond quickly to them.

Increasing interaction with trainers and types of interaction channels were emphasized in the main theme of “Trainers”. The experts, who stated that the interaction with the trainers continues today but is weak, stated that there is an interaction with industry 4.0, virtual teachers, smart assistants and that they can end the interaction between the teacher and the learner. It was emphasized that the interaction with the trainers is getting even faster, and new technologies such as e-mail, web, online ticket, and social media affect this situation. Also, the experts stated that the interaction between the learner and the learner increases the interaction between the instructors.

> U10: Learning analytics need to be collected for the lecturer, so his/her interaction with the student will be further increased.

In the main theme of "learners", it was emphasized that the interaction will be faster and the interaction with the learners and other learners, institutions and social networks will increase even more. It was stated in the "Speed" sub-theme that the interaction of learners is faster. While the experts emphasized that the interaction with learners with industry 4.0 will differ and the strategies to be used for this are important, the interaction of the learners with the instructor, the institution and the content will be faster. In the “Learner-Institution” sub-theme, it was emphasized that the communication with the institution turned from formal to instant communication. It is stated that the effects of Industry 4.0 on internet technologies and interaction with cloud system and augmented reality will be more effective. In the “learner-learner” sub-theme, it was stated that the interaction of learners with each other will increase. Experts stated that the interaction between learner-learner will increase, especially applications such as social media, e-mail, web, online tickets will increase the interaction. It is stated that increasing learner-learner interaction also increases the interaction between the instructors. In the “learner-social media” sub-theme, it was stated that an environment of interaction with social media was created especially for learners. Experts stated that learners with industry 4.0 have increased interaction with other learners, especially with social networks.

> U7: While it was much more formal in the past, now there is instant communication. It causes the birth of new communication channels. There is e-mail, there is the web, there is an online ticket system, there is social media, learners can reach through the channels they want, thus creating an interaction environment.

> U8: Thanks to the opportunities it offers on the internet, Industry 4.0 supports this through distribution channels whenever you want and wherever you want, especially the cloud system, it will be more effective in augmented reality.

The importance of communication and data networks in the interaction with the practitioners was emphasized in the main theme of the "Practitioners". Experts stated that the communication channels should be good and appropriate communication and data networks should be established with the practitioners to make an organization in the education system.

> U8: In order to be able to organize in an education system, your communication channels must be very good and you must have a very good communication network and data network with your design team, supervisor, support team, executive team and students.

The interaction between the learner and management team, and between experts and management was emphasized in the main theme of the “Management Team”. Experts stated that with the interaction between the learner and the management has increased as the interaction has changed from formal to informal and digitalization effects on this situation. Besides, experts who emphasized that industry 4.0 cannot be considered independent from interaction and that instant feedback should be received, stated that management should be a good team. The experts who stated that the interaction between the management team and the experts should be increased in subjects such as exams, emphasized that this would also increase the workload.

U1: Increased in interaction with management, the interaction between learner and management needs to be a little more involved in this digitization process. The interaction has changed from formal to informal, which I think is more appropriate for the structure of distance education.

U4: In Industry 4.0, nothing happens without interaction. In this case, you need to get continuous feedback. In other words, this may be instantaneous, hourly, daily, monthly, or continuous feedback should be received. Here you have to be so flexible that you can transform and change immediately with these feedbacks. There must be a good team in this. These feedbacks need to be evaluated by a team. A joint decision must be made.

The value of technology in interaction with Industry 4.0 and developing technology structure in distance education is expanding. The advancement of technology can result in the replacement of bots, especially advisors. Therefore, the interaction between the instructor and the learner is affected by this situation. Consequently, technologies such as intelligent assistants and the virtual teachings that will reduce the interaction with the actual teachings will emerge. Today, there is a need for specialists who see the potential of emerging technologies to develop and maintain interaction and collaboration with cost-effective communication technologies and their choice (Cleveland- Innes and Garrison, 2010, p. 18).

Increasing the interaction between the learner and the learner increases the interaction between the instructor and the learner. In this context, the increasing use of social media and the interaction of learners with social media increase the interaction with both the learner and the learner. Again, increasing the use of developing technologies and accelerating the interaction has changed the formal communication structure between the learner and the management team as an instant communication structure. It can be said that the interaction between the organization and the employees is accelerated and facilitated in terms of the organizational developments. In this respect, interactions must be supported with instant feedback.

Findings and Comments on the Effects of Industry 4.0 on Learning Environments in the Open and Distance Education System

It was asked the experts that what will be the effects of Industry 4.0 on learning environments in the distance education system. Experts' opinions were compiled under the themes of “transactional distance” and “new technologies”. Under the main theme of "new technologies", there are sub-themes of "Area (Section)" and "personalization" (Figure 5).

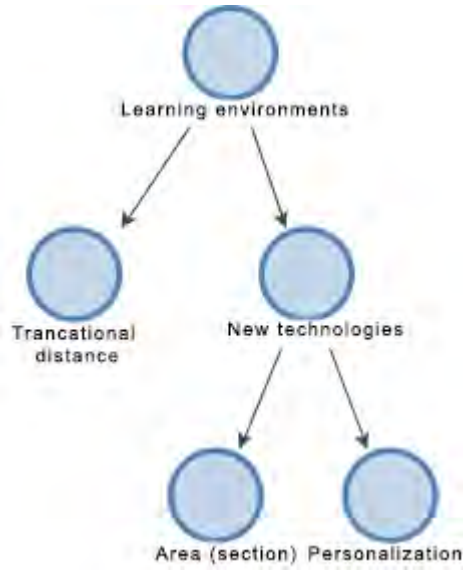

Figure 5. *Visualization of the themes obtained as a result of the answers given about the effects of Industry 4.0 on learning environments in the distance education system.*

It is stated in the main theme of “Transactional Distance” that time spatial separation will increase with technology. Experts stated that there is no time and space separation with the mobile technologies developed for time-spatial separation in learning environments and industry 4.0, and this situation has become more suitable for distance education. Experts who emphasize that the overusing Technologies that bring students, instructors and content together in different learning environments in design processes will be effective in spatiotemporal separation, stated that it should not be too flexible or it will lose its effectiveness.

> U6: By increasing flexibility, industry 4.0 has made the time-spatial separation more suitable for distance education.

> U8: Places that bring students, teachers, and content together in a different environment. The more industry 4.0 begins to be used in the design processes in the next stage, the greater its impact on learning environments will be.

How new technologies affect, and guide learning environments were emphasized in the main theme of "new technologies". In the “area (department)” sub-theme, it is emphasized that the technologies that trigger industry 4.0 will enable teaching in different fields in distance education. Experts stated that distance education is dominated by social studies, and that developing technology will pave the way for distance education in science, health, or technical fields. In the "Personalization" sub-theme, it was emphasized that new technologies to be used in learning environments should be used in accordance with the wishes of the learners. Experts emphasized that new technologies provide diversity in learning environments, and different presentations should be made to each learner with the data collected from the content created. In this context, it is important to know the audience and use appropriate technologies for the audience.

> U1: Distance education is a bit more focused on social sciences, here I think science, science or health or technical fields will be as much as social. Because technology will support us in terms of learning environments. For example, the learner can perform science experiments remotely, thanks to the technologies mentioned. Piloting, doctor, such training can be given remotely, doctors will be able to even perform surgical intervention.

> U10: In some areas, industry 4.0 can gain more technological efficiency.

In distance education, learners and instructors are separated by time and space. Time and space separation in learning environments is reduced by Industry 4.0 and developing mobile technologies. Both the development of learner and instructor and the technologies that bring the content together in different learning environments will be effective in the separation of time and space. It is necessary to select the appropriate learning environment for the delivery of the curriculums that are most effective in reducing the time separation (Moore, 1993, p. 26).

In Industry 4.0, it will be ensured that the developing and changing technologies will be organized in distance education, in addition to social studies, in science, health or technical fields. In this context, new technologies provide diversity in learning environments. To meet the learning needs and desires of distance learners, they demand that distance learning institutions creatively use technology, a new generation of distance education should use the newest technology everywhere (Moller, Robinson and Huett, 2012, p. 12).

Findings and Comments on the Effects of Industry 4.0 on Management in Open and Distance Education System

It was asked the experts that what are the effects of Industry 4.0 on management in the distance education system. The opinions of the experts were compiled under the themes of "change of functions", "division of labor", "control", "centralization", "organization" and "concentration". Under the main theme

of "functional change" are sub-themes of "transformation" and "new unit", while, there are sub-themes of "leadership" and "technology under the main theme of “control”, under the main theme of "organization" are sub-themes of "operation" and "structure" (Figure 6).

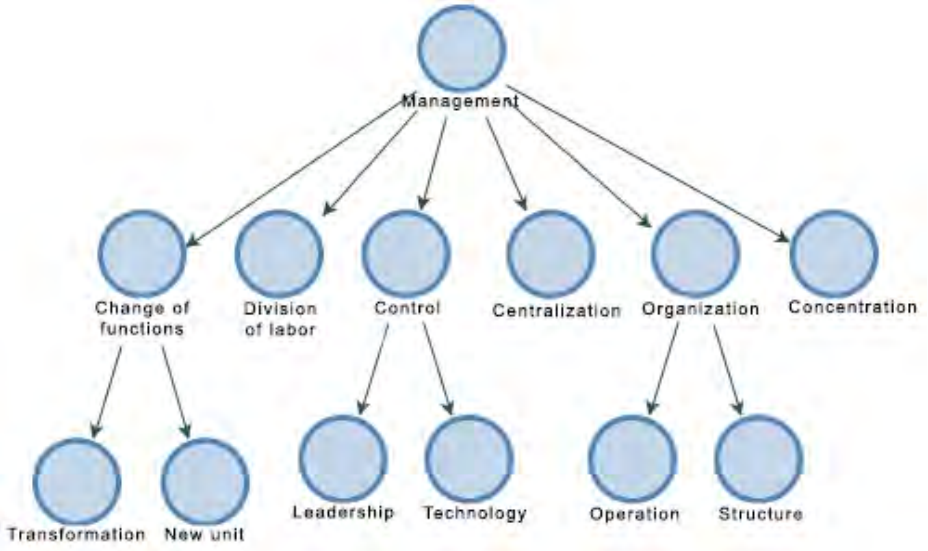

Figure 6. *Visualization of the themes obtained as a result of the responses given to the effects of Industry 4.0 on management in the distance education system.*

What kind of change and transformation will be experienced in distance education units were emphasized in the main theme of "functional change". The transformation to be experienced in the working environment and functions of some units in distance education is stated in the sub-theme of “Transformation”. Experts stated that the functions also have changed along with the digitalization in the transformation. In this direction, they stated that applications such as book distribution and registration processes, which are among the duties of offices, have become completely digital, offices can work as career counseling, or they may undergo a different transformation or be closed. Experts who stated that it is necessary to make innovations by predicting social and technological changes to take place of transformations, also stated that there will be changes in work environments. In “new unit” sub-theme, it was emphasized that new units may be formed in the functional change in distance education. Experts stated that, with Industry 4.0, new units will emerge depending on new professions in distance education and technologies offered by Industry 4.0. Digital media laboratory, student psychology unit, units analyzing data from sensors are cited as examples of these units.

> U5: There will be changes as the working environment.
> U7: With the change of functions, offices will now start to carry out transactions other than book distribution or registration. It can work like career counseling, and innovations are needed by anticipating social and technological changes.

The changes and transformations in the division of labor in the management of distance education were emphasized in the main theme of the “division of labor”. Experts stated that there will be technological differences in the division of labor and some tasks in the management of distance education and new tasks will occur. The experts, who stated that smaller workpieces will be formed in Industry 4.0, emphasized that human resources will be needed in the software field such as the use of social networks, learning analytics, data control and security. Experts also stated that Mssive Open Online Courses (MOOC) affects human resources in the context of the division of labor, and that fewer jobs and human resources may be needed, and in this context, Open University has to dismiss the staff and make a reduction on units.

> U2: Data analytics will be used from management organization to human resources and division of labor.
>
> U5: I think there will be changes in the division of labor and some job descriptions, it will cause the creation of new tasks. There will be changes as the working environment.

In the “Control” main theme, leadership and technology practices are mentioned for control in management. In the “Leadership” sub-theme, features for the control skills of leaders are mentioned. Experts stressed the importance of leadership skills for control in management practices in the distance education system. In this context, experts who stated that leaders should listen to the people around them and include them in their decision processes stated that leaders should be individuals who know the needs of the society and can follow what is being done globally. The technology applications required for control are mentioned in the sub-theme of “Technology”. Experts stated that with digitalization in industry 4.0, control could be easier in management processes with virtual networks, analytics and gamification and that they can perform control over a system to be created without coming face-to-face or connected to a center.

> U3: The manager will need to analyze the analytical results well.
>
> U9: In terms of leadership, its impact on management is very important. Individuals who can control this distributed structure are needed.

In the main theme of “Centralization”, it was emphasized that there is no need to establish an institution or a central place for the distance education system. Experts stated that centralization is a habit of the industrial society, that in cases where communication and access are limited management is carried out from a center, but that won’t need to be centralization in industry 4.0, there won’t be too many places, buildings, that could be a virtual central office. Emphasizing that distance education may be a distributed order due to its structure, experts stated that the decisions will be made at the center.

> U4: Management is completely changing in Industry 4.0. There will be no central administration from a single top, units will be autonomous within themselves, but accountability is also important.
>
> U6: Frankly, I think there might be no need for centralization. Distance education can be a little more distributed due to its nature.
>
> U7: There will be decision making at the center in the context of centralization.

The changes and transformations in the structure and functioning of the distance education organization emphasized the main theme of the "Organization". In the sub-theme of "Operation", the change of organizational process and the technological applications used in the process are emphasized. Experts emphasized that the paradigm shift in management has also caused the changes and transformations in operation with Industry 4.0, accordingly, that cooperation with other countries, continuous control, feedback, and data analytics came to the forefront. The experts, who stated that the systems established in Industry 4.0 can manage themselves, expressed that the importance of the software increased in the process, and virtual smart systems and support systems have also started to be used in education. They also stated that the organization should be divided into units and that autonomous freedom should be given.

Under the “Structure” sub-theme, it was emphasized that Industry 4.0 to change the structure in the context of human resources and units in distance education organizations. Experts stated that structural changes in distance education organizations with industry 4.0 are experienced especially in the context of management. Accordingly, experts who emphasized that the units will be autonomous in themselves and less human resources will be needed rather than traditional, systematic, and hierarchical

management mentality, expressed that mutual benefits and accountability are important in these units. Experts who stated that the structure started to change with the digitalization of books in open education also stated how the books should be made more interactive instead of production.

> U7: The system works according to the decisions taken by the administrators. So here will demand learning analytics, instructional designer and most importantly learner. In this case, it will go beyond the decision of a distance education manager alone. Stakeholders will be involved in this decision.

> U9: Maybe less human resources will be needed in the organizational structure.

In the main theme of "concentration", it was emphasized that with Industry 4.0 there is no need to bring the workforce together in a certain place and the effect of technology. While experts were emphasizing that there is no need to concentrate in management, that is, to bring employees to a center or a building with industry 4.0, they stated that there should be no working hours today, most people do their job on the internet. In this context, it can be said that the development of internet technologies has reduced concentration, but accountable freedom is crucial.

> U5: I think there will be changes in the division of labor and some job descriptions, it will cause the creation of new tasks. There will be changes as the working environment.

> U9: There will be teams but they will be dispersed, people anywhere in the world can work together.

Technological implications and structural effects of Industry 4.0 lead to a change in functions in distance education. For example, by digitalization there may be changes and transformations in the functions of open education offices like student registration and book distribution. So, the offices can transform. Innovations should be made by predicting technological and social changes to comprehend the transformations. With Industry 4.0 different fields of expertise have emerged. With the changes in functions, new units may arise such as digital media laboratory, student psychology unit, data analysis unit.

After the increasing mechanization in production with Industry 4.0, some fields have become significant for the division of labor and human resources such as social networks which will be used in distance education, learning analytics, data control and security. With the developing technology, the need for human resources in distance education will be reduced.

The value of leadership skills is strengthening with Industry 4.0 in distance education. In this context, leaders require to know the needs of the society and be able to follow what is done globally. It will be appropriate for individuals who think about the future of the country to be developed for changes and transformations, to follow the practices in other countries, to know the expectations of the society from education and to catch up with the age (Balyer and Oz, 2018). Additionally, leaders are supposed to be able to analyze the data as expected.

Otto Peters (2010, p. 19) expresses that a substantial amount of money must be invested in the preparation of a quality distance education material, development, testing and establishing a viable distance learning institution for assessment. And he also states that to be successful, many experts should work in close cooperation. According to the obtained results, it is concluded that there will be no demand to centralize with Industry 4.0. So, business and operations can be carried out with a virtual management center. Decisions must be taken from the center, but the decision-making authority should be transferred to the sub-units. In decentralization sub-managers and non-management staff have the authority to make their own decisions and senior management permission are not required, in an uncertain environment in which the situation change so often decentralization is preferred by many institutions (Shamim, Zhang, Yu and Li, 2016).

It can be said that Industry 4.0 leads changes and transformations as a structure in distance education. In this context, cooperation, control, feedback, and data analytics with other countries come to the fore. Besides, Massive Open Online Courses (MOOC) come off as the portal systems where the fastest developments in distance education are experienced and offering courses that can reach the large masses (Yamamoto, 2018). Anadolu University has reached 58 lessons and 28,000 individual users with the implementation of AKADEMA, a MOOC project launched in 2014 (Aydin, 2018). It can be said that the broaden usage of MOOC portals will be a new term for open and distance education in respect of human resources management and the desire of learners. Furthermore, it can be said that virtual smart systems and support systems will be used in operation and education.

Conclusion and Suggestions

This study examines the effects of Industry 4.0 in the field of open and distance learning within the framework of the elements discussed in Otto Peters' theory of Industrialization. Conducting this case study, it was determined that the effects of Industry 4.0 in the open and distance education system in terms of resources, instructional design, distribution, interaction, learning environment, and Industrialization theory. In this direction, it is necessary to eliminate the lack of infrastructure for Industry 4.0, increase digitalization studies and specialize in the context of technological competences. It can be said that Industry 4.0 as a structure in distance education caused changes and transformations in the operation. In this context, cooperation, control, feedback, and data analytics with other countries come to the fore. In addition, the lack of a standardized production concept in Industry 4.0 emphasized personalization and individual production in distance education. The distribution of the course materials produced must be diversified and the post-Fordist approach should be preferred in mass production. While industry-wide technologies that trigger İndustry 4.0 make it easier to offer different areas through distance learning, it affects the centralization and concentration factors in management. And it will provide training in the fields of science, health or technical, apart from social studies, in the technology of developing and changing technology in Industry 4.0.

The recommendations of this study were developed and presented in accordance with the findings of the study:

- The structures of Industry 4.0 should be comprehended very well by institutions and vision, and implementation studies should be planned.
- Institutions should plan professional training in recruitment process or for current experts.
- Institutions should follow current technology practices on interaction and feedback between learners, teachers, practitioners, consultants, and management teams.
- It is very important for the experts to educate themselves about the technologies that trigger Industry 4.0 and to take relevant and necessary training and to catch up with the current paradigm.
- Cultural elements and values should be prioritized in the changes and transformations to be experienced with İndustry 4.0. and improvements should be made accordingly with It.
- In production, instead of Fordist mass production concept, individual production should be made. İn this context, it is of great importance to make production in accordance with the needs of the individual and to choose technologies.
- The use of current technologies should be increased in the distribution of the products produced and appropriate technologies should be used in accordance with the needs of the learners.
- In distance education with Industry 4.0, data mining and learning analytics come to the forefront. In this respect, human resources training or recruitment should be carried out and a data analysis unit should be established.
- Due to increased technology use and speed and increase in interaction, the interaction needs to be well designed.

- Developed instructional designs should be presented in appropriate learning environments by considering the current technologies and considering the needs and learning desires of the distance learners.
- The work of distance education institutions with appropriate individuals in terms of leadership characteristics for structural changes and transformations is of great importance for both organization and control.
- For Industry 4.0, institutions should prepare their own development plans and be prepared for the relevant changes and transformations.
- The research is limited to opinions from distance education experts, researchers can conduct qualitative or quantitative studies with individuals from different areas of expertise.
- The research can be conducted with interviews with experts from open and distance education institutions in different countries.

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