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The Effects of Management Information Systems Course on The Industry 4.0 Conceptual Awareness Level of Prospective Managers of Digital Businesses

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ABSTRACT

In recent years, the concepts of Industry 4.0 and even Industry 5.0 as well as the rapidly developing technology have brought about big opportunities and challenges for businesses. The aim of the study is to find out the Industry 4.0 conceptual awareness levels of students who are prospective managers and reveal the effects of the management information systems course, which is included in the department curriculum, on this awareness. It is also aimed in the study to find out whether the students' levels of industry 4.0 conceptual awareness vary across variables such as gender, working status outside school, the sector where they plan to work after school, grade point average (GPA) and type of high school the participants graduated from. The research population is comprised of students studying in the department of Business Administration in the Faculty of Political Sciences in a public university. The 25 students at 4th grade in the research sample who have taken the Management Information Systems course were chosen via convenience sampling method which is among non-probability sampling methods. Uncontrolled pre-test-post-test model was used in the study. Validity and reliability analyses of the scales as well as normality analysis, Mann-Whitney U test, Kruskal-Wallis H test and dependent samples t test were performed in the study. As a result of the analyses, it was found out that students' industry 4.0 conceptual awareness levels do not differ depending on gender, working status outside school, the sector where they plan to work after school, grade point average (GPA) type of high school the participants graduated from. On the other hand, average scores for pre-test and post-test regarding the students' industry 4.0 conceptual awareness levels revealed a significant increase between average pre-test scores (x= 2,97) and average post-test scores (x= 3,36). When the pre-test and post-test scores were compared, "Artificial Intelligence", "Virtual Reality", "Wearable Technologies", "Unmanned Systems", "Customizable Product Development", "Learning (Smart) Robots", "Cyber Security" and "3D Printers" were among the top fields about which the students had the highest level of awareness.

Keywords: Industry 4.0, Digital Businesses, Manager, Management Information Systems

1. INTRODUCTION

Radical changes in business and production processes are becoming compulsory in order to adapt to today's global competition environment and changing market conditions. Traditional business administration is being replaced by digital businesses. Technology-based and decentralized self-managing organizations where smart systems, automatization and flexible production are prevalent are increasing. This period, which comprises of these structures triggered by the developments in information and communication technologies, is conceptualised as the fourth industrial revolution. Named as the information age or artificial intelligence age, this era requires new competences, strategies and policies. New opportunities are arising for innovations in products and services, reduction of costs and increasing customer share and profits. Types of employment and the skills and competences demanded from the workforce are changing. It can be seen that all these developments have an influence on individuals and societies. Also, awareness about what this era has brought to us and how it is perceived is important in order to be able to adapt to change. Awareness should be increased and teaching programs should be updated so that schools from pre-school to university will help individuals develop creative thinking ability required by the new revolution. Otherwise, inconsistencies between required competencies and learnt theoretical knowledge will become a problem in the future for students. Since the need for smart and productive managers who will manage smart factories, robots and data will increase, it will be necessary to raise students who possess these skills. Therefore, the level of knowledge and interest towards this era, awareness on industry 4.0 concept, familiarity towards using information and communication technologies for regarding especially university students have gained importance.

It is seen that the curriculum of departments which involve mainly information systems and informatics supports the prospective members of the workforce so that they can be equipped with new skills and competences. To illustrate, when the academic programs of the management information systems department which has been accepting an increasing number of students in recent years are examined, it can be observed that the programs are in accordance with Industry 4.0 technologies such as algorithm and programming, data analytics, cloud computing systems. On the other hand, the students' awareness and what changes should be made in the curricula of business schools that train prospective workforce who will be managers of digitalised businesses are other issues yet to be considered. Torun and Cengiz (2019: 244) found out in their study that students of management information systems department have higher awareness on Industry 4.0 compared to students of other departments and it will be beneficial to make a comparative analysis of department curricula in order to increase awareness levels of students who are studying departments at faculties of economics and administrative sciences.

For all these reasons, the aim of this study is to measure awareness levels of students of business management department which train prospective managers who will manage the changing organization structures in the future regarding the competences and skills expected from the workforce in this age. Within this measurement, it is also aimed to apply uncontrolled pre-test and post-test before and after 14 weeks of Management Information Systems course which has been added to the department curriculum in recent years and involves the changing concepts in business understanding, work processes, competences and Industry 4.0 technologies in order to identify the effects of the course.

2. CONCEPTUAL FRAMEWORK

2.1. Industry 4.0

The stages of industrial revolution which has led to great industrial changes and compelled the businesses and countries to transform their competitive power since the Industrial Revolution are named as Industry 1.0, Industry 2.0 and Industry 3.0 (Kağnıcıoğlu and Özdemir, 2017: 901). What triggered these three revolutions are the technical innovations. Mechanical production which works with water and steam power was introduced at the end of 18th century, division of labour and serial production at the beginning of 20th century and programmable logic controller (PLC) systems for automation in production in 1970s. The fourth industrial revolution, in other words Industry 4.0, has been triggered by the internet which allows communication between humans and machines (Brettel, et al., 2017: 48).

The concept of Industry 4.0 has been debated in the industry and academy as well since it was introduced in Germany in 2011. The main idea of these studies was to benefit from the potential gains of new technologies such as the existence and use of the internet and internet of things (IoT), integration of work processes, smart production tools, smart factories with smart products and virtualization (Rojko, 2017: 80). It was observed that virtual and physical production systems which have become possible through smart factories started to build a flexible cooperation with each other (Kağnıcıoğlu and Özdemir, 2017: 902). Klaus Schwab, the founder of World Economic Forum, suggests three main reasons for the occurrence of Industry 4.0 (quoted from Schwab (2016): Özkoç and Karalar, 2019: 2):

- ✓ Speed: This revolution proceeds not with a linear but with an exponential speed and technologies which are interconnected and multi-directional trigger each other and open the way for technologies that require more skill.
- ✓ Width and depth: This revolution, which rises on the digital revolution brings together various technologies which lead to unprecedented changes of paradigm in the economy, business world and social structure.
- ✓ System effect: At the end of the revolution, all companies, countries and even sectors might go through a total change.

The concept of Industry 4.0 is understood as the application of cyber-physical systems into the industrial production systems (Drath and Horch, 2014: 56). In production, cyber-physical systems comprise of smart machines, storage systems and production facilities that can exchange information and control each other independently. This situation improves the processes regarding manufacturing, engineering, materials usage and supply chain management (Hermann, et al., 2015: 5).

The leading basic concepts related to Industry 4.0 are concepts such as internet of things, 3D printers, cloud computing technologies, smart factories, augmented reality, cyber-physical systems, new systems in distribution, purchasing and development of products and services, meeting human needs and corporate social responsibility (Doğan and Baloğlu, 2020: 60; Lasi et al., 2014: 240). It is important that individuals who will shape the future should be aware of these new concepts and try to understand the revolution.

The most fundamental components of Industry 4.0 revolution are as follows (Öztemel, 2018; 26);

- ✓ Autonomous robots: Robots which can act and decide on their own and have become widespread in the production environment,

- ✓ Smart informatics networks: The informatics networks which allow machines to communicate with humans and each other through software and control the data traffic,
- ✓ Cyber-physical systems and security systems: Cyber systems that allow the unification of all communication and systems and carrying out the duties and transactions in the informatics environment in a secure way,
- ✓ Internet of things: Internet, which activates data exchange protocols which communicate with each other in all parts of the society, the systems in the manufacturing environment in particular,
- ✓ Big data analyses: Analysis of data which provides decision makers with required information in order to make the right decisions automatically,
- ✓ Simulation and augmented reality: The use of real environment with the simulated environment in an integrated way,
- ✓ Cloud computing: The ability to provide both storage systems and software facilities at quite low costs,
- ✓ Additive manufacturing and 3D printers: Production with desired size and quality just by entering the model details in a computer.

Moreover, it is also possible to add bitcoin and blockchain technologies, unmanned vehicles, energy storage and renewable energy resources and new generation genes.

The unique feature of Industry 4.0 is that it allows real-time communication, definition and connections between humans, machines and products and develops smart manufacturing models specifically for customer demands with high flexibility. It is the transformation from central production to local, from standardisation to customisable production. It is the activation of the structures known as cyber-physical production systems, which combines the limits of the real world with the opportunities of the virtual world (Fırat and Fırat, 2017: 11). Since Industry 4.0 practices will introduce new technologies in many fields in the future from supply to production and from logistics to communication, it is not wrong to say that the most important weapon for competitiveness is technological leadership (Çetinkaya, 2021: 575).

Industry 4.0 practices bring along challenges as well as many positive developments. Positive developments and expectations can be stated as higher efficiency, increased customer satisfaction, reduced costs and new service and work models. Challenges, on the other hand, are listed as insufficient number of competent employees, the necessity to graduate students with competences required by today’s world, deficiencies in the international standards and the need to improve the network infrastructure (Soylu, 2018: 49).

2.2. Preparation for The Technologies of The Industry 4.0 Age

Countries which are developed in terms of industry and technological facilities led by Germany started the Fourth Industrial Revolution for purposes such as lowering labour costs and reducing the dependence on qualified workforce (Soysal and Pamuk, 2017: 45). Therefore, traditional businesses of the previous revolutions are transformed into digital businesses.

There are differences between the digitalised businesses of the Industry 4.0 age and traditional businesses. Traditional businesses aim to offer high quality products or services at low costs, increase profit rates and identify and fix errors. In the businesses of Industry 4.0 age, systems aim to make predictions as well as collecting data and using existing data and solve problems before the error appears. This situation means just in time maintenance and non-stop production.

In the Industry 4.0 age, many technologies described in science-fiction movies are actualised. 3D printers have disturbed the balance of the fashion industry and additive manufacturing is combined with synthetic biology to help develop products that involve microorganisms. These changes and developments which occur in almost every field require the adults of the future to be equipped individuals in this sense (Özkoç and Karalar, 2019: 3). Hence, it is thought that the technological infrastructure and information systems necessary for application of Industry 4.0 technologies cannot be met by existing business structures and strategic changes will take place in human resources policies of businesses. The workforce is expected to gain the new skills and competences that will meet the needs that arise due to these new systems. It is obvious that new occupations will be created and certain jobs will lose their importance owing to these changes, which will have positive or negative impacts on employment (Kamber and Bolatan 2019: 846). In the report titled “The Future of Jobs” published by World Economic Forum in 2016, it was stated that the developments in fields such as robotics, genetics and biotechnology, nanotechnology, artificial intelligence and 3D printers would lead to significant differences in the form of doing business. This situation makes great contribution to the occurrence of new job opportunities in the sectors that involve numerous technologies (Işık and Erol, 2020: 86).

In other words, it is estimated that Industry 4.0 will cause many jobs to disappear and new professions to arise just as it happened in the previous industrial revolutions and there will be no increase in unemployment but on the contrary, employment opportunities will increase with jobs such as data centre technician and robot mechanic (Koca, 2018: 251).

There are some elements to meet the needs of the Industry 4.0 age which are also reflected in the education system. These are designer individuals and organizations that use high level thinking skills, customized data and open-source content, utilize digital technologies and create and transfer knowledge in such a way that will meet global needs (Demir, 2018: 147). This means that changing the curriculum alone will not be sufficient. Also, it is necessary to raise individuals who are "creative, flexible, think in a scientific way, question things, realize problems and create solutions and make their own decisions" instead of individuals who are loaded with memorised information (Gümüşoğlu, 2017: 1588).

It is quite important that quality must be increased in education rather than quantity. This is because not only low paid jobs that require low level skills but also high-quality jobs that require high level of skills are expected to disappear due to automatization. Thus, education must be offered with higher quality instead of higher quantity. Besides, higher quality education can be supportive under certain circumstances. Required extra qualifications depend on the specific characteristics of the job itself. For instance, it is estimated that it is 98% probability that accounting work will be carried out by smart software in the future and it will not matter if an accountant has extra qualifications (Özsoy, 2018: 265).

On the other hand, workforce candidates of this era must be aware of continuous learning and the transition from muscular power to brain power in order to adapt to the requirements to be introduced by the Industry 4.0 technologies (Bonekamp and Sure, 2015: 33). It is important that the effects of this transition will become a part of educational curricula so that the components and technologies of the era can be taught to students. It will be the right choice to modify department curricula in accordance with the expectations of the industry and employers and include course that involve today's technologies.

The Management Information Systems course which has been added to the business administration department curricula in recent years is an example for this. The objective of the course is to convey the global importance of communication system tools and management, its fundamental principles taking into account the technology, management and organization elements and how to use these systems to get competitive advantage for organizations. The course involves basic information about management information systems. It includes technologies related to the Industry 4.0 age such as the main components of communication systems, technologies that are classified under communication systems, telecommunication, internet, communication systems used in organizations and the effect of these systems on decision making processes, strategies necessary to use the communication systems to get competitive advantage, data mining, e-trade and mobile trading systems, foundations of business intelligence, knowledge and project management, system design and development and information security.

3. METHODOLOGY

3.1. The Aim of The Study

As a result of changes in digitalization and production technologies, businesses need to ready their background for new systems in terms of competitiveness. As well as technical regulations, by changing their social structures and human resource policies, that the skills and competencies required in the workforce of the Industry 4.0 age become prominent in recruitment is expected. Updating the education curriculum and strengthen the industry-university cooperation is important to equip the graduates with the demand skills. In this direction, it is aimed to reveal whether the workforce candidate business students follow the technological developments and to determine whether they are aware of the key concepts of the Industry 4.0 era. It is also aimed to applying uncontrolled pre-test and post-test before and after 14 weeks of Management Information Systems course which has been added to the department curriculum and involves the changing concepts in business understanding, work processes, competences and Industry 4.0 technologies in order to determine the effects of the course on students' awareness of the key concepts of the Industry 4.0 era.

3.2. Hypotheses

In the study, the research hypotheses created to examine the Industry 4.0 conceptual awareness levels of university students registered in the business department waiting to be employed in the sector are as follows:

H1: Industry 4.0 conceptual awareness levels of students change according to gender.

H2: Industry 4.0 conceptual awareness levels of students change according to working situaiton except school.

H3: Industry 4.0 conceptual awareness levels of students change according to sector in that they want to work after school.

H4: Industry 4.0 conceptual awareness levels of students change according to grade point average.

H5: Industry 4.0 conceptual awareness levels of students change according to high school type.

H6: The averages of students' industry 4.0 conceptual awareness levels show a significant difference between pre-test and post-test.

3.3. Research Model and Method

Uncontrolled pre-test-post-test model was used in the research to examine the student's Industry 4.0 conceptual awareness levels. In this model, the effect of not knowing the pre-experimental/test status of the group members that were not controlled in the previous model is eliminated. Whether the results are significant or not was tested with the "t-test for dependent groups", in which the averages of the pre-test and post-test scores are compared.

The inability to control the time-related errors between the pre-test and the post-test creates the limitation of the study (URL-1). Questionnaire technique was used to collect data in the research. For this purpose, personal information form and Industry 4.0 conceptual awareness scale were used.

Personal Information Form: Participants' gender (female/male), out-of-school employment (working/not working), grade point avarage (GPA) low (below 2.5)/mean(2.5 - 2.99)/good (3 and above), sector in which he/she thinks to work after school (private/public), secondary school graduation type (Vocational and Technical Anatolian/Social Sciences/Anatolian/Anatolian Imam Hatip/Science High Schools) was created by the researcher to determine personal information.

Industry 4.0 Conceptual Awareness Scale (I 4.0-CAS):

A 39-item scale developed by Doğan (2019) was used to measure the Industry 4.0 conceptual awareness levels of university students in the management process of digital transformation.

The Cronbach Alpha internal coefficient of consistence of the scale developed by the author was found to be .96. “Internet of Things”, “Artificial Intelligence”, “Learning (intelligent) Robots”, “Energy 4.0”, “Digital Supply Chain” can be given as examples of expressions in the scale. Answer options in the form of a 5-point Likert scale were presented to these statements in the scale, with my awareness level as None [1], Little [2], Mean [3], A lot [4], Full [5]. In this study, the Cronbach Alpha internal coefficient of consistence of the scale was found to be .97. It has been found that it is a valid and reliable tool to measure the Industry 4.0 conceptual awareness levels of university students.

3.4. Population and Sample/Study Group/Participants

The research population is comprised of students studying in the department of Business Administration in the Faculty of Political Sciences in a public university. The 25 students at 4th grade in the research sample who have taken the Management Information Systems course were chosen via convenience sampling method which is among non-probability sampling methods.

4. FINDINGS and ANALYSIS

4.1. Descriptive Statistics of the Sampling

Descriptive statistics about the students participating in the study are presented in Table 1. Considering the gender distribution of the students participated in the research, 56% (14 people) are male and 44% (11 people) are female; 20% (5 people) work outside of school, 80% (20 people) do not work outside of school; it is seen that 44% (11 people) graduated from Anatolian High School, 36% (9 people) from Anatolian Imam Hatip High School and 20% from Vocational and Technical Anatolian High School.

In addition, 68% (17 people) of the students stated that they intend to work in the private sector after school, and 32% (8 people) in the public sector. When the overall grade point averages of the students are examined, according to the 4-point system, 36% (9 people) are below 2.5, 40% (10 people) are between 2.5 and 2.99, and 24% (6 people) is 3 or above.

Table 1. Descriptive Statistics on the Research Sample

Demographic Features	**Variables**	**N**	**%**
Gender	Male	14	56
	Female	11	44
	Total	25	100
Do you work outside of school?	Yes	5	20
	No	20	80
	Total	25	100
Secondary school graduation	Vocational and Technical Anatolian	5	20
	Anatolian	11	44
	Anatolain Imam Hatip Science High Schools	9	36
	Total	25	100
Sector in which you intend to work out of school	Private	17	68
	Public	8	32
	Total	25	100
Grade point avarage (GPA)	Low (below 2,5)	9	36
	Mean (2,5 - 2,99)	10	40
	Good (3 and above)	6	24
	Total	25	100

4.2. Data Analysis/Hypothesis Testing

The research hypotheses created to examine the Industry 4.0 conceptual awareness levels of the students were tested using the SPSS-22 package program by the data obtained. Uncontrolled pre-test-post-test model was used in the study. Validity and reliability analyses of the scales as well as normality analysis, Mann-Whitney U test, Kruskal-Wallis H test and dependent samples t test were performed in the study.

When Kolmogorov-Smirnova and Shapiro-Wilk values were examined in the normality test of variable data such as gender, out-of-school employment status, the sector in which they intend to work after school, grade point average (GPA) and secondary school graduation type, it was seen that the data did not show a normal distribution ($p < 0.05$). It was accepted that the data in the study did not show normal distribution and nonparametric tests were applied. The reliability analysis of the scale used in the study was made. In order to determine whether the Industry 4.0 conceptual awareness levels of university students differ according to gender (female/male), out-of-school employment status (working/not working), sector (private/public) in which they intend to work, in both pre-tests with the collected data and Mann-Whitney U test analysis was performed in the post-test. Such as grade average point of student's (GPA) is low (below 2.5)/mean (2.5 - 2.99)/good (3 and above), secondary school graduation type (Vocational and Technical Anatolian/Social Sciences/Anatolian/Anatolian Imam Hatip/Science High Schools), Kruskal-Wallis H test was used in both the pre-test and post-test to test the significance of the difference between the means of three or more groups.

Table 2. Reliability Coefficient of Scales, KMO Analysis and Bartlett Test Values

Type of Scale	**Number of Expressions**	**Cronbach's Alpha Result of pre-test**	**Cronbach's Alpha Result of post-test**
Industry 4.0 Conceptual Awareness Scale (I 4.0-CAS)	39	,969	,970

It is seen that according to the reliability analysis results of the Industry 4.0 conceptual awareness scale in both the pre-test and the post-test ($0.80 \leq \alpha$) are a highly reliable scale.

The test results of the hypotheses formed within the scope of the research are as follows:

H1: In order to measure whether the Industry 4.0 conceptual awareness levels of the students differ according to gender, the Mann-Whitney U test was performed both in the pre-test and post-test, and it was observed that $p > 0.05$ result of the test. Students' Industry 4.0 conceptual awareness levels do not differ according to gender. The difference is not statistically significant. *H1 hypothesis was rejected*

H2: In order to measure whether the Industry 4.0 conceptual awareness levels of the students differ according to working situaiton except school, the Mann-Whitney U test was performed both in the pre-test and post-test, and it was observed that $p > 0.05$ result of the test. Students' Industry 4.0 conceptual awareness levels do not differ according to working situation except school. The difference is not statistically significant. *H2 hypothesis was rejected.*

H3: In order to measure whether the Industry 4.0 conceptual awareness levels of the students differ according to sector in that they want to work after school, the Mann-Whitney U test was performed both in the pre-test and post-test, and it was observed that p> 0.05 result of the test. Students' Industry 4.0 conceptual awareness levels do not differ according to sector in that they want to work after school. The difference is not statistically significant. *H3 hypothesis was rejected.*

H4: In order to measure whether the Industry 4.0 conceptual awareness levels of the students differ according to their grade point average (GPA), Kruskal-Wallis H test was applied both in the pre-test and post-test, and it was seen that p > 0.05 result of the test. According to this result, no significant relationship was found between the students' Industry 4.0 conceptual awareness levels and their overall grade point average. *H4 hypothesis was rejected.*

H5: In order to measure whether the Industry 4.0 conceptual awareness levels of the students differ according to the secondary school graduation type, the Kruskal-Wallis H test was conducted both in the pre-test and the post-test, and it was seen that p > 0.05 result of the test. No significant relationship was found between the type of the secondary school graduation type. *H5 hypothesis was rejected.*

H6: The averages of students' industry 4.0 conceptual awareness levels show a significant difference between pre-test and post-test. The t test for dependent groups was used to test whether there was a significant difference between the pre-test and post-test mean. The assumption of this test is that the two variables are at least equally spaced and that the pre-test and post-test scores are obtained from the same students (URL-2).

Since it was observed that the skewness and kurtosis values of the difference scores of the pre-test and post-test scores were in the range of -1, +1, it was accepted that they showed a normal distribution and the t-test was performed for the dependent groups and the results are given in Table 3. According to the t-test results for addicted groups, although the post-test mean score ($\bar{x}$=3.3559) was found to be higher than the pre-test mean score ($\bar{x}$=2.9662), it did not show a significant difference (p=0.174 > 0). .05). According to this result, the program applied to increase the students' Industry 4.0 conceptual awareness levels was not effective. H6 hypothesis was rejected.

Table 3. Result of T-Test for Dependent Groups About Industry 4.0 Conceptual Awareness Level

Measure	**N**	**$\bar{X}$**	**S**	**t**	**sd**	**p**
Pre-test	25	2,9662	0,891	-1,400	24	0,174
Post-test	25	3,3559	0,777			

As seen in Table 4, as a result of the pre-test averages of the above 39 statements directed to measure the Industry 4.0 Conceptual Awareness levels of university students;

The title of “Artificial Intelligence” ranks first as the area with the highest awareness level with an average of 4.08. Then, “Virtual Reality” and “Unmanned Systems” titles took the second place with an average of 3.8, while such as Personalized Product Development (x= 3.68), Learning (intelligent) Robots (x= 3.64), Cyber Security (x = 3.64) and 3D Printers (x= 3.52) are included in the first group.

“Artificial Neural Networks” and “Embedded Systems” titles take the first place as the field the lowest Industry 4.0 Conceptual awareness level of university students with an average of (x= 2.04). The following titles are “Additive Manufacturing” (x= 2.08), Rapid Prototype Production (x= 2.20), Mixed Reality (x= 2.28), Dark Factories (x= 2.32) and Deep Learning (x= 2.36) and Micro Factories (x= 2.36) mean and expressions in the last group.

Table 4. Industry 4.0 Pre-test and Post-test Results on Conceptual Awareness Level

Expressions	**Pre-test average**	**Post-test average**
Artificial Intelligence	4,080	3,640
Virtual Reality	3,800	4,040
Unmanned Systems	3,800	3,880
Customized Product Development	3,680	3,840
Learning (intelligent) Robots	3,640	3,640
Cyber Security	3,640	3,600
3D Printers	3,520	3,600
Digital Supply Chain	3,360	3,360
Technological Innovation	3,320	3,480
Nanotechnology	3,280	3,840
Self-Producing Factories Their Own Energy	3,280	3,320
Wearable Technologies	3,200	3,880
Energy 4.0	3,160	3,360
Simulation Technologies	3,160	3,320
Sensor Technologies	3,160	3,840

Smart Manufacturing Technologies	3,080	3,600
Digital Diagnosis, Diagnosis, Treatment	3,040	3,680
Cloud Computing Technology	3,040	3,640
Intelligent Storage and Transfer Technologies	2,960	3,160
Advanced Production Techniques	2,960	3,320
Agile and Flexible Production Service	2,920	2,800
Advanced Automation	2,920	3,240
Data Oriented Service	2,920	3,360
Cyber Physical Systems	2,880	3,160
Internet of Things	2,840	3,440
Industrial Internet	2,800	3,320
Machine-Machine Cooperation	2,800	3,240
Hologram Technologies	2,760	2,960
Computer Vision	2,760	3,040
Augmented Reality	2,720	3,640
Big Data and Data Analytics	2,520	3,600
Micro Factories	2,360	3,080
Deep Learning	2,360	3,080
Dark Factories	2,320	3,280
Mixed Reality	2,280	2,800
Rapid Prototype Production	2,200	2,840
Additive Manufacturing	2,080	2,600
Embedded Systems	2,040	2,520
Artificial Neural Networks	2,040	2,840
	Total	**Total**
	2,97	**3,36**

As seen in Figure 1, as a result of the post-test averages of the above 39 statements administered to measure the Industry 4.0 Conceptual Awareness levels of university students;

The title of “Virtual Reality” ranks first as the area with the highest awareness level with an average of (x= 4.04). Then, "Wearable Technologies" and “Unmanned Systems” are in the second place with an average of 3.88, while Personal Product Development, Nano Technology and Sensor Technologies are in the third place with an average of (x= 3.84).

With the average of “Embedded Systems” (x= 2.52) and “Additive Manufacturing” (x= 2.60), it ranks first as the field with the lowest Industry 4.0 Conceptual awareness level of university students. The following titles are “Mixed Reality” (x= 2.80), “Agile and Flexible Manufacturing-Service” (x= 2.80), “Artificial Neural Networks” (x= 2.84), “Rapid Prototype Production” ” (x= 2.84), “Hologram Technologies” (x= 2.96) mean and expressions in the last group.

When the pre-test and post-test averages of the Industry 4.0 Conceptual awareness levels of university students are examined, it is seen that the pre-test average (x= 2.97) and the post-test average (x= 3.36) are. Looking at this result, it was seen that there was a significant increase in the comparison of the post-test results with the pre-test results. At the end of the 14-week course, it is evaluated that this difference stems from practices such as the content of the course, homework research, and performance evaluations.

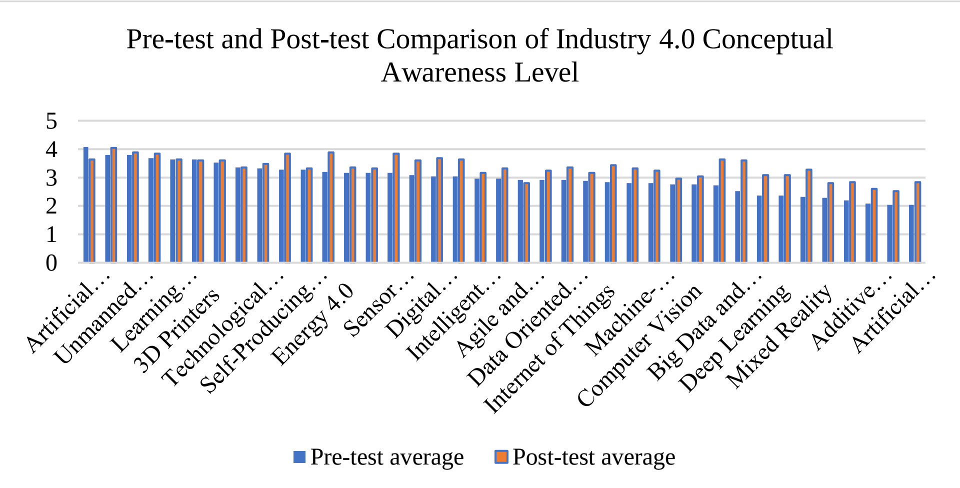

Figure 1. Pre-test and Post-test Comparison of Industry 4.0 Conceptual Awareness Level

5. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

Although it is predicted that automatization and robotic revolution will decrease employment, what businesses should do in order to reach the qualified human resources required by the current age remains an important issue.

Analyses were performed in order to find out the conceptual awareness levels of university students who are studying in the department of business administration regarding Industry 4.0 and examine the effect of Management Information Systems course, which has been added to the department curriculum in recent years, on this awareness. Furthermore, it was also investigated whether the students' conceptual awareness levels regarding Industry 4.0 showed any difference based on variables such as gender, working status outside school, the sector where they plan to work after school, grade point average (GPA) and type of high school the participants graduated from.

It was found out that students' conceptual awareness levels regarding Industry 4.0 does not show any difference according to variables of gender (male-female), working status outside school (yes-no), the sector where they plan to work after school (private-state), grade point average (GPA) (low-medium-high) and type of high school the participants graduated from (Vocational and Technical Anatolian High School-Anatolian High School-Anatolian Religious High School).

Regarding the students' Industry 4.0 conceptual awareness levels, the title "Artificial Intelligence" ranks the first with the highest level of awareness with an average score of 4,08. It is followed by the dimensions of "Virtual Reality", "Unmanned Systems", "Customizable Product Development" (x= 3,68), "Learning (Smart) Robots" (x= 3,64), "Cyber Security" (x= 3,64) and "3D Printers" (x= 3,52).

In the post-test application carried out after 14 weeks of course, the title "Virtual Reality" ranks the first as the highest level of awareness with an average score of (x= 4,04). "Wearable Technologies" and "Unmanned Systems" categories rank the second with an average score of (x= 3,88), followed by "Customizable Product Development", "Nanotechnology" and "Sensor Technologies" as the third rank with an average score of (x= 3,84). The increase in the average scores after the course is notable.

In the pre-test application, the titles "Artificial Neural Networks" and "Embedded Systems" rank the first as the lowest level of university students regarding Industry 4.0 conceptual awareness. These titles are followed by "Additive Manufacturing" (x= 2,08), "Rapid Prototype Production" (x= 2,20), "Mixed Reality" (x=2,28), "Dark Factories" (x= 2,32), "Deep Learning" (x =2,36) and "Micro Factories" (x= 2,36).

Similarly, in the post-test application, the titles "Embedded Systems" (x= 2,52) and "Additive Manufacturing" (x= 2,60) ranked the first as the lowest Industry 4.0 conceptual awareness levels. These titles were followed by "Mixed Reality" (x= 2,80), "Quick and Flexible Production-Service" (x= 2,80), "Artificial Neural Networks" (x= 2,84), "Rapid Prototype Production" (x= 2,84), "Hologram Technologies" (x= 2,96). It is thought that this situation can be interpreted as the mentioned concepts comprise of contents and skills that could be included more in the interests and courses of engineering students and it is recommended that further studies can be carried out in the future with different populations and samples.

When the pre-test and post-test average scores of students' Industry 4.0 conceptual awareness levels are examined, it is seen that the average score of pre-test is (x= 2,97) and average score of post-test is (x= 3,36). Based on this result, the comparison of the average scores of the pre-test and the post-test revealed a significant increase. It can be observed that this difference resulted from practices such as the course content, exercises for assignment and performance assessment at the end of 14 weeks of course.

Research results demonstrated that the findings of the study are in parallel with the previous studies in the literature. In the study carried out by Doğan (2019), it was found out that Industry 4.0 conceptual awareness levels did not vary according to grade point average (GPA) and type of high school which the participants graduated from. However, it was revealed that awareness levels showed a difference based on gender and male students have higher levels of conceptual awareness compared to female students.

Yelkikalan et al. (2019: 42) aimed to identify the awareness levels of students studying in the faculty of economics and administrative sciences and vocational high schools regarding Industry 4.0 in a comparative way. In the study, the level of perceived benefit regarding Industry 4.0 technologies, perceived ease of use and intention to use this technology showed a significant difference based on gender.

Arıkan et al. (2021: 23) carried out a study in order to reveal the relationship between tourism students' levels of conceptual awareness regarding Industry 4.0 and technology usage habits. It was found out that there is a meaningful difference in students' Industry 4.0 awareness levels depending on the gender variable and male students had a higher average score compared to female students.

Yıldız and Fırat (2020) developed a model based on the literature in order to identify the variables that affect the level of knowledge of university students in Turkey regarding Industry 4.0. The research findings showed that the university students' perception levels regarding Industry 4.0 are above average and insufficient.

Özkoç and Karalar (2019) aimed to identify the perceptions of K12 and university students regarding Industry 4.0 through metaphors. The perceptions categorized under the main themes of two edges of the knife and change demonstrated that the students had more negative opinions compared to positive ones, which are one of the two edges of the knife.

It is significant to discuss both the positive and the negative aspects of the research results. In this respect, studies intended for eliminating the effects of worries and perceptions of unemployment caused by the rapid technological developments and changes in students and graduates must be prioritized. Actions should be taken in order to prevent escaping change for reasons such as the failure to use technology or adapt to new business processes and quitting outdated practices and methods. At this point, responsibilities fall upon policy makers, researchers, education sector and employers. The most important of these responsibilities is to strengthen the collaboration among these actors. Sector representatives should put forward the competences they expect from graduates and provide new opportunities for employment. Besides, they should come together with educators and academicians and prioritize practices such as updating the course curricula in accordance with contemporary requirements, adding courses and opening departments which offer new competences and skills, etc. Technology use should be increased in areas where distant education which became obligatory and common in the pandemic process is effectively carried out and the infrastructure of courses which can be offered through distant education should be prepared. Applied and on-the-job training should be given utmost importance and working environments which the candidates will come across should be simulated and the candidates should be offered the chance to gain experience. Employment shortage and postponed unemployment should be stopped and qualified, young and competent workforce should be utilized with full capacity to increase efficiency in every field.

REFERENCES

1. Arıkan, E., Bayram, A. T., Kavlak, H. T. & Erkol Bayram, G. (2021). "Turizm Öğrencilerinin Endüstri 4.0 Kavramsal Farkındalık Düzeyleri ve Teknoloji Kullanım Alışkanlıkları Arasındaki İlişki", Türk Turizm Araştırmaları Dergisi, 5(1): 19-33, DOI: 10.26677/TR1010.2021.649.
2. Bonekamp, Li & Sure, M. (2015). "Consequences of Industry 4.0 on Human Labour and Work Organization", Journal of Business and Media Psychology, 1, 33-40.
3. Brettel, M. , Friederichsen, M. K. & Rosenberg, M. (2017). "How Virtualization, Decentralization And Network Building Change The Manufacturing Landscape: An Industry 4.0 Perspective", World Academy of Science, Engineering and Technology. International Journal of Information and Communication Engineering, 2014, 8 (1), 47-62.
4. Çetinkaya, F. F. (2021). "Endüstri 4.0 Farkındalığının İnovasyon Üzerindeki Etkisi", Anadolu Üniversitesi Sosyal Bilimler Dergisi, 21 (2), 571-598.
5. Demir, A. (2018). "Endüstri 4.0'dan Eğitim 4.0'a Değişen Eğitim-Öğretim Paradigmaları", Turkish Studies International Congress on Social Sciences II, 13 (15), 147-171.
6. Doğan, Onur (2019). "Dijital Dönüşümün Yönetimi Sürecinde Üniversite Öğrencilerinin Endüstri 4.0 Kavramsal Farkındalık Düzeyleri". Kırşehir Ahi Evran Üniversitesi Sosyal Bilimler Enstitüsü (Yüksek Lisans Tezi), Kırşehir.
7. Doğan, O. & Baloğlu, N. (2020). "Endüstri 4.0 Kavramsal Farkındalık Ölçeği", KMÜ Sosyal ve Ekonomik Araştırmalar Dergisi, 22 (38): 58-81.
8. Drath, R. & Horch, A. (2014). "Industrie 4.0: Hit or Hype?", IEEE Industrial Electronics Magazine, 10.1109/MIE.2014.2312079.
9. Fırat, S. Ü. & Fırat, O. Z. (2017). ""'Sanayi 4.0 Devrimi Üzerine Karşılaştırmalı Bir İnceleme: Kavramlar, Küresel Gelişmeler ve Türkiye", Toprak İşveren Dergisi, 114, 10-23.
10. Gümüşoğlu, F. (2017). "İlköğretim Ders Kitaplarında Bilişim Teknolojisi", Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 22 (15), 1587-1598.

11. Hermann, M., Pentek, T. & Otto, B. (2015). "Design Principles for Industrie 4.0 Scenarios: A Literature Review", Technische Universität Dortmund Fakultät Maschinenbau Audi Stiftungslehrstuhl Supply Net Order Management www.snom.mb.tu-dortmund.de (working paper).
12. Işık, M. & Erol, H. Ö. (2020). "Endüstri 4.0 Farkındalığı ve İşgücü Nitelikleri Üzerine Etkileri: Süleyman Demirel Üniversitesi Öğrencileri Üzerine Bir Araştırma", Avrasya Uluslararası Araştırmalar Dergisi, 8 (24), 86-112.
13. Kağnıcıoğlu, C. H. & Özdemir, E. (2017). "Evaluation Of Smes In Eskisehir Within The Context Of Industry 4.0. PressAcademia Procedia (PAP)", V.3, p. 900-908.http://doi.org/10.17261/Pressacademia.2017.672.
14. Kamber, E. & Bolatan, S. G. İ. (2019). "Endüstri 4.0 Türkiye Farkındalığı", Mehmet Akif Ersoy Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 11 (30), 836-847.
15. Koca, K.C. (2018) "Sanayi 4.0: Türkiye Açısından Fırsatlar ve Tehditler", Sosyoekonomi, 26 (36), 245-252.
16. Lasi, H., Fettke, P., Kemper, H. G., Feld, T., & Hoffmann, M. (2014). "Industry 4.0". Business & Information Systems Engineering, 6(4), 239-242.
17. Rojko, A. (2017). "Industry 4.0 Concept: Background and Overwiev", International Journal of Interactive Mobile Technologies, 11 (5), 77-90, https://doi.org/10.3991/ijim.v11i5.7072.
18. Özkoç, H. H. & Karalar, H. (2019). "K12 ve Lisans Öğrencilerinin Endüstri 4.0 Kavramına İlişkin Algıları", Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi, 20, DOI: 10.17494/ogusbd.
19. Özsoy, E. C. (2018). "Industry 4.0 and Its Potential Impact on Employment", Journal of CurrentResearches on Business and Economics, 8 (2), 249-270, doi: 10.26579/jocrebe-8.2.16.
20. Öztemel, E. (2018). "Eğitimde Yeni Yönelimlerin Değerlendirilmesi ve Eğitim: Eğitim 4.0", Üniversite Araştırmaları Dergisi, 1 (1), 25-30. Doi: 10.26701/uad.371662.
21. Schawb, K. (2016). Dördüncü Sanayi Devrimi (Çev. Z. Dicleli). Optimist Yayın Dağıtım, İstanbul.
22. Soylu, A. (2018). "Endüstri 4.0 ve Girişimcilikte Yeni Yaklaşımlar", Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 32, 43-57. DOİ: 10.30794/pausbed.424955.
23. Soysal, M. & Pamuk, N. S. (2017). "Yeni Sanayi Devrimi Endüstri 4.0 Üzerine Bir İnceleme", Verimlilik Dergisi, (1), 41-66.
24. Torun, N. K. & Cengiz, E. (2019). "Endüstri 4.0 Bakış Açısının Öğrenciler Gözünden Teknoloji Kabul Modeli (TKM) İle Ölçümü", UİİİD-IJEAS, 22, 235-250, DOI: 10.18092/ulikidince.442734.
25. Yelkikalan, N., Özcan, S. & Temel, K. (2019). "Endüstri 4.0 Farkındalığının Belirlenmesi: Çanakkale Onsekiz Mart Üniversitesi Örneği", Girişimcilik ve Kalkınma Dergisi, 14 (1), 31-44.
26. Yıldız, S. C. & Fırat, S. Ü. (2020). "Türkiye'deki Üniversite Öğrencilerinin Endüstri 4.0 Bilgi Düzeylerinin Belirlenmesi", Endüstri Mühendisliği, 31 (0), 1-16.
27. URL-1 (https://parantezanaliz.com/wp-content/uploads/2014/12/deney_duz.istatistik.pdf), Erişim tarihi: 30.05.2022
28. URL-2 https://docplayer.biz.tr/85205079-Bagimli-gruplar-icin-t-testi-wilcoxon-isaretli-siralar-testi.html, Erişim tarihi: 30.05.2022