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THE EFFECT OF ARTIFICIAL INTELLIGENCE ON SUSTAINABLE DEVELOPMENT GOAL¹

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Abstract

Artificial intelligence (AI), which was built for "a better world" motto, reveals its potential in many fields. Despite of such good intension, results of AI systems caused bias, and sharpened the social prejudices. Besides in order to create such powerful AI systems and unbiased machines, the massive data collected, stored, processed, also caused high energy consumption, ecological degradation. Although efforts have been made to integrate artificial intelligence into the sustainability field, the main limitation is about the AI researcher's, developer's point of view. In this study, revealing the contribution of artificial intelligence to the Sustainable Development Goals is aimed. At this point, data were collected using the analytical hierarchy process (AHP) from 30 individuals who were trained and worked as a developer in the field of artificial intelligence. As a result, it has been understood that while the developers believe that artificial intelligence will contribute mostly in the fields related to the industry and economy, they believe that it will make almost no contribution due to the bias problems on the gender equality side.

Keywords: Artificial Intelligence, Sustainability, Sustainable Development Goals, AHP.

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Yapay Zekânın Sürdürülebilir Kalkınma Hedefleri Üzerine Etkisi

Öz

Daha iyi bir dünya sloganı ile geliştirilen yapay zekâ, pek çok alanda potansiyeli ortaya koymaktadır. Ancak bu iyi niyete rağmen yapay zekâ tabanlı sistemler önyargı, yanılğı, sapmaya neden olmakta ve toplumsal önyargıları keskinleştirmektedir. Daha kuvvetli yapay zeka tabanlı sistemler, önyargısız makineler oluşturmak için toplanan işlenen depolanan yüksek yığınli veriler ise yüksek enerji sarfıyatı, ekolojik bozulmalara yol açmaktadır. Yapay zekanın sürdürülebilirlik alanına entegre edilmesine yönelik tüm çalışmalara rağmen, temel kısıt geliştiricinin bakış açısıdır. Bu çalışmada sürdürülebilir Kalkınma Amaçları'na yapay zekânın katkısının nasıl gerçekleştiği araştırılmıştır. Bu noktada yapay zekâ alanında geliştirici olarak çalışan, eğitim almış 30 bireyden analitik hiyerarşi prosesi kullanılarak veri toplanmıştır. Sonuç olarak geliştiriciler yapay zekânın en çok endüstri, ekonomi ile ilgili alanlarda katkı yapacağına inanırken, toplumsal cinsiyet eşitliği tarafında önyargı, yanılğı ve sapma sorunları nedeniyle yok denecek kadar az katkı yapacağına inandıkları anlaşılmıştır.

Anahtar Kelimeler: Yapay Zekâ, Sürdürülebilirlik, Sürdürülebilir Kalkınma Hedefleri, AHP.

INTRODUCTION

After the second artificial intelligence (AI) winter, artificial intelligence has been a standard agenda item in every sector, especially in the scientific world. Artificial intelligence has become an essential field of study, especially with the increase in computer power, the availability of large amounts of data, and the advances in learning algorithms (LeCun et al., 2015). This field is named as "computer science engineering" in 1955 and as "the new electricity of humanity" in 2017. Hanlein & Kaplan (2019) defined artificial intelligence as a combination of cognitive, emotional, and social intelligence, which means human behavior imitation. The difference in given definitions reveals how much the scope has changed over time, from the areas of application to the points it can affect.

The change that comes with artificial intelligence is not limited to making new decisions and generating new information (Mikalef, Framnes, Danielsen, Krogstie, & Olsen, 2017). It affects and changes the existence of the work (Schneider & Leyer, 2019), scope of it (Özdemir & Kılınç, 2019), the perspective of the human being, the production of more objective and efficient processes and models (Kahneman, Rosenfield, Gandhi, & Blaser, 2016), and the concepts of innovation, leadership and management (Sousa & Rocha, 2019). In summary, artificial intelligence creates symbiotic cooperation between human and machine no matter where it is applied (Miller, 2018; Özdemir & Kılınç, 2019). In artificial

intelligence field, concepts such as values, ethics, and responsibility have started to be discussed extensively since 2015 to properly construct and conduct this symbiotic cooperation.

In this sense, one of the first noteworthy movements is the Asilomar Principles. These principles focus on the potential risks that the sub-field areas of artificial intelligence may create and integrate ethical code into different applications of artificial intelligence (Asilomar Meeting, 2017). This is because rapidly developing technologies such as artificial intelligence need a framework for the principle of ethics (Floridi et al., 2018). Garcia (2019) stated that the failure to construct and recognize artificial intelligence principles is a significant threat and conflict point on the security and peace side, especially for developing countries. At the centre of all these concerns and warnings are the unethical, discriminatory and even racist consequences observed in the field of artificial intelligence.

Bias and algorithmic injustice discovered in artificial intelligence-based systems (Angwin et al.2016; Buolamwini and Gebru 2018; Özdemir, Kılınç, 2019), negative outputs of AI related to disadvantaged groups (Keyes 2018; Greene 2019) confirm the concerns in the field of artificial intelligence.

Despite these concerns, artificial intelligence is a problem solver in many different areas such as agriculture, education, industry, and vitality protection. This potential of artificial intelligence is also critical to ensure sustainable development. However, it is pretty new that the concept of sustainability has become a subject studied under the AI framework.

Artificial intelligence

The concept of artificial intelligence manifests itself in various sources, from Ancient Greek artefacts to ancient Chinese dynasty inscriptions. In these sources, the movements of the machine/robot are mostly illustrated. It is possible to see the robot concept in Cezeri's Book of the Knowledge of Ingenious Mechanical Devices in the 13th century and similarly in Davinci's works in 15th century.

In 1920, Czech Karel Capek published a theatre play called Rossum's Universal Robots. In this play, robot movements, in which artificial intelligence has been observed in the historical process, are named for the first time. Capek described non-human beings who worked instead of humans in the factory and defined them as robots in the play.

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Despite this historical journey, the name of artificial intelligence and its acceptance as a study field dates back to 1956. For example, Alan Turing published an article called "Computing Machinery and Intelligence" in 1943. In this article, he asked the question, "Can machines think?" and claimed that machines could think. In a similar period, known as the first electronic computers with the memory structure and changeable programs in today's computers; Z3 (1943, Germany), ENIAC (1946, US army), SSEM (1948, UK), EDSAC (1949, Cambridge) and EDVAC (1951, USA) have been produced.

In the same period, significant developments have been made in neuroscience and brain structure to shed light on future artificial intelligence studies. For example, Rushton (1946) and Lorente de No (1947) revealed neurons' electrical functioning. In 1949, Donald Hebb published the theory of neuropsychology, which includes ideas about the strengthening and weakening of synapses over time regarding neural networks' assumption. In addition to these technical moves, the hypothetical test, which reveals the level that artificial intelligence can reach, was created by Alan Turing in 1950. Turing Test contains the idea that the machine can perform a specific task at the human level, and the outputs cannot be distinguished from those created by humans.

In 1950, science fiction writer Isaac Asimov published three robot laws that regulate the relationships between robots and humans. These laws are expressed as follows in "I Robot", which consists of Asimov short stories:

First Law: A robot may not injure a human being or, through inaction, allow a human being to come to harm.

Second Law: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

Third Law: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Asimov added Zeroth Law to these laws and defined it as "A robot may not harm humanity, or, by inaction, allow humanity to come to harm." Evolving with such technical and intellectual developments, artificial intelligence attained its clear identity in 1956. During the workshop held at Dartmouth College, John McCarthy named the concept. In the workshop, researchers also planned the aspects of artificial intelligence that need to be developed in the next 20 years.

In 1955, the first artificial intelligence program called The Logic Theorist was introduced by Allen Newell, J.C. Shaw and Herbert Simon. The program that designed to prove mathematical theorems has been used logical expressions, steps, and relationships. Since it is aimed to find a way in the logical network of

relationships in the proof process, this program has been the first to consider artificial intelligence problems as search problems. In 1958, LISP (List Processing) that an artificial intelligence programming language was developed by John McCarthy, one of the essential names in artificial intelligence. In the same year, the famous mathematician Cahit Arf shared his first article on how machines can think at the conference held at Erzurum Atatürk University. In 1961, the program named Saint (Aziz), which can solve mathematical problems at the university level, was written using the LISP programming language.

In 1965, Joseph Weizenbaum developed ELIZA, which can converse in English on any topic. ELIZA, the first artificial intelligence program in natural language processing, actually does not understand natural language. It searches for a regular expression or any pattern in an expression. The psychotherapist version of this program became a very popular program at that time.

In 1968, Marvin Minsky and Seymour Papert published an article on the limits of neural networks, and the following year, they released the book "Perceptrons". In 1969, the first international conference on artificial intelligence was held. In the early 1970s, the first robot arm that could understand English commands was produced. It is hoped that artificial intelligence studies, which are gaining speed, will come to a human-level structure within ten years.

In 1972, an expert system named MYCIN, which performs detecting bacteria causing infections and recommending antibiotics was developed by Stanford University. In the same year, the first video game Odyssey and the first e-mail program were produced. In 1973, a report was published by James Lighthill for the UK Scientific Research Foundation. This report stated that artificial intelligence developments are far from the targeted artificial intelligence features. Besides, he argued that it is impossible to perform functions such as natural language, vision, and speech understanding.

Despite all these developments before 1974, the technical difficulties in that period caused the withdrawal of support in artificial intelligence. This period between 1974-1980 is called the first artificial intelligence winter.

In 1980, the idea of expert systems that one of the subfields of artificial intelligence started to rise. This idea involves bringing expertise in a particular field to the machine by modelling it with correct parameters. However, this thought could not create the desired effect, and artificial intelligence has passed into the second winter period. Despite the lack of popularity of artificial intelligence during the stagnation period that lasted until the '90s, various improvements were made.

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In 1984, the Artificial Neural Networks approach was advanced, and the backpropagation algorithm was widely used. Although robust artificial neural networks created using this algorithm are applied efficiently on different problems, they have not become widespread in practice.

In 1997, a significant development took place that caused the rise of artificial intelligence. After six matches, Deep Blue, which IBM developed, managed to defeat the world chess champion, Garry Kasparov. Deep Blue, who can calculate 200 million chess moves per second, lost the first match, won the second match, stayed draw in the next three games, and won the last match against Kasparov.

With the spread of the internet since 1998, many artificial intelligence-based programs have been developed. In the same years, the first home robot named Furby has been introduced by Dave Hampton and Caleb Chung. In 2000, Honda produced the first robot named ASIMO that could walk like a human. ASIMO's prototype started in the 1980s. Asimo, which fell while dancing, playing football with Obama, serving with a tray, left its mark on an era.

In 2006, the definition of multiple learning, which can be considered the first step of deep learning, was put forward with Geoffrey Hinton's article. In 2007, Fei Li and his friends started to create an extensive database containing object images called ImageNet to be used in visual object recognition research.

In 2008, the speech recognition feature, one of the crucial issues of artificial intelligence and the new iPhone phones, was introduced by Apple. In its first versions, the success rate could not exceed 80%. In 2009, the article "Large-scale deep unsupervised learning using graphics processors" was published by Rajat Raina, Anand Madhavan and Andrew Ng. According to this article, they stated that multi-core CPUs are insufficient in learning models that require much parallel processing; at this point, they have proven that the use of graphics processors produces revolutionary results.

In 2009, an artificial intelligence program called Stats Monkey, which can write sports news without human intervention, was developed in the Smart Computing Laboratory of Northwestern University. In 2011, a convolutional neural network won the German Traffic Sign Recognition competition against humans with 99.46% accuracy. In the same year, IBM Watson made a fast-response speech machine, which beat the two language champions. In the same year, D-Wave One, the first commercial quantum computing system, was put on the D-Wave Systems market.

In 2013, Facebook established a unique artificial intelligence team, including the founder of face.com. The team studied the processes and patterns of brain cells. He designed a deep learning method that models the shares and likes of 700 million people on Facebook.

In 2014, Google made an essential move in artificial intelligence and bought Deepmind, an artificial intelligence company, for \$ 400 million. In the same year, the deep learning-based face recognition software developed by Facebook and achieved human intelligence success in face recognition.

In 2014, Vicarious announced that they have developed an artificial intelligence-supported technology that can solve a CAPTCHA, which distinguishes between people and computers, especially in activity entries (login-login, some service calls, etc.) in public website software. In the same year, the virtual assistant named Amelia trying to understand human thinking instead of imitating human behaviour made a worldwide impact.

In 2015, a robot that could learn to cook by watching YouTube videos was developed by the University of Maryland Computer Engineering students. In the same year, Google DeepMind AI played 49 arcade games by itself, learned these games, and completed all games.

In 2015, a self-learning robot project was developed in the project carried out by researchers at the Zurich Federal Institute of Technology and Cambridge University. Firstly, a "mother" robot prototype was produced that capable of improving itself and increasing its performance without human intervention. This robot has produced 10 "doll" robots that are made of plastic and contain a motor. This robot has produced 10 "baby" robots that are made of plastic and contain a motor. It has been observed that after a certain period of time the newly produced dolls become more "skillful".

In 2016, scientists at Carnegie Mellon University developed an artificial intelligence player that can play poker named Libratus. Libratus won \$ 1.77 million in a 30-day game with 120,000 rounds against the world's best poker players (Dong Kim, Jimmy Chou, Daniel McAulay, Jason Les).

In 2017, a deep learning-based artificial intelligence system called PilotNet by NVIDIA learned how to drive a car by observing and analyzing people. In the same year, a significant success was achieved in adding memory to artificial intelligence models with a new algorithm developed by Google Deep Mind researchers.

In 2017, an artificial intelligence application was developed by Nottingham University researchers that can predict whether patients will have a

stroke or heart attack within ten years. Comparing the doctors who make predictions with traditional methods with the application, the result is scientifically confirmed that artificial intelligence detects 355 cases more accurately than doctors.

In 2018, Google announced that it has developed BERT, unsupervised language representation that can be used in a variety of natural language processing tasks using transfer learning. In the same year, Samsung introduced Bixby, an artificial intelligence supported virtual assistant that designed to be used on all its devices.

Sustainability

The concept and possibility of a sustainable development has been on the agenda since the 1960s' environmental concerns especially Rachel Carson's *Silent Spring* (Carlson, et.al, 1962), although the fundamentals of the idea and the first essays date back to as early as 1800s with Malthusian catastrophe (Malthus & Appleman, 1976) where it is predicted that there will be a time when the needs of the increasing population will or could not be met with the resources of the globe. As pessimistic as it sounds and some counter theories may exist but the term sustainable development has firmly fixated itself in to the agenda of the nations.

Sustainability in its broadest definition and as the word suggests is to be able to sustain what one has today for a certain period of time and sometimes it is aligned with the term sustainable development which is basically meeting the needs of today without endangering the needs of future generations (Brundland, 1987). In this respect, both have similarities and differences, where both can be discussed based upon the most known approach as the triple bottom line (Elkington, 2013) listed as, social sustainability, environmental sustainability and economic sustainability. These pillars are sometimes referred to as people, planet and prosperity (Elkington, 2013).

The major difference between the two is the notion of improvement or moving forward from today's conditions; a progress. A basic example here could be the case for land classified as forest per km for a country, which could fall under environmental sustainability, but increasing that number in accorda with the increasing population and possible demands, would be more relevant to the idea of sustainable development. As before said, these terms can sometimes replace each other and when public is considered the difference in the notion may not prove out to be very significant as long as the issues relevant to environment-economy-society nexus are emphasised. Following this understanding, the roles

and responsibilities regarding sustainability as well as the interactions between the three pillars -environment, society and economy- can be conversed at different levels; individual, institutional including private companies, regional, country or even global.

Since 1987 where in the famed report of the Brundtland Commission (Brundland, 1987), the term sustainable development, was coined, there have been many UN led meetings before and after this date, all trying to find a solution in bringing nations collectively towards this goal. As the millennium was neigh upon the globe, the nations signed the Millennium Development Goals, a total of 8 goals, with associated targets and indicators, to put and drive nations on the sustainable development track (Sachs, 2012). A lot can be discussed on the success or incompetencies of MDGS but as they were only covering the 2000-2015 period, as 2015 was approaching the need to follow up these goals became evident, albeit with a room for how to do it. UN Sustainable development Goals, following MDGs were not just spreading out the initial 8 goals to 17, but rather a bottom-up approach replaced that of MGGs top-down one. Additionally there were new goals like the Peace and strong institutions. The requirement for such global goals as well as their relevant targets and indicators are this time for the 2015-2030 period (Sachs, 2012).

UN Sustainable Developmet Goals are 17 goals presented with the motto "blueprint to achieve a better and more sustainable future for all" (UNDP, 2021). These goals are formed by integrated and interlinked themes as No Poverty (SDG 1), Zero Hunger (SDG 2), Good Health and Well-being (SDG 3), Quality Education (SDG 4), Gender Equality (SDG 5), Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), Decent Work and Economic Growth (SDG 8), Industry, Innovation and Infrastructure (SDG 9), Reduced Inequality (SDG 10), Sustainable Cities and Communities (SDG 11), Responsible Consumption and Production (SDG 12), Climate Action (SDG 13), Life Below Water (SDG 14), Life on Land (SDG 15), Peace and Justice Strong Institutions (SDG 16), and Partnerships to achieve the Goal (SDG 17) (UNDP, 2021). SDGs have 168 targets with associated numeric indicators. Looking at the crosscutting issues of the SDGs, it can be stated that trade-offs and synergies exist making the monitoring of the progress towards these goals more complex. To overcome this challenge, an increasing number of studies are focusing on the clarification of these. Among others, for an itegrated monitoring of SDG trade-offs and synergies, Biggeri et.al. (2019) introduced an adjusted 'Integrated Sustainable Development Index' (I-SDI) that can while taking into account the trade-offs and synergies between goals and targets, can as well discuss this across the economic, social and environmental spheres of sustainable development.

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SDG 1: No Poverty implies ending poverty in all its forms everywhere focusing on extreme poverty, social protection systems and measures for all, vulnerable people and situations as well as equal rights to economic resources.

SDG 2: Zero Hunger implies ending hunger, achieving food security and improved nutrition and promoting sustainable agriculture for everyone including vulnerable people.

SDG 3: Good Health and Well-being implies ensuring healthy lives and promoting well-being for all at all ages including maternal mortality, still births and under 5 mortality, epidemics and communicable diseases, mental health, substance abuse, death related to accidents, and a universal health coverage by access to health services.

SDG 4: Quality Education implies ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all, especially equal access to primary, secondary education, improved access to technical and vocational skills training.

SDG 5: Gender Equality implies achieving gender equality and empowering all women and girls by ending all kinds of discrimination against women by access to education and health rights and social protection policies.

SDG 6: Clean Water and Sanitation implies ensuring availability and sustainable management of water and sanitation for all by achieving universal and equitable access to safe and affordable drinking water as well as sanitation.

SDG 7: Affordable and Clean Energy implies ensuring access to affordable, reliable, sustainable and modern energy for all by universal access to affordable, reliable and modern energy services increase substantially the share of renewable energy in the global energy mix as well as improved energy efficiency.

SDG 8: Decent Work and Economic Growth implies promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all including development-oriented policies and measures against forced labor and youth labor.

SDG 9: Industry, Innovation and Infrastructure implies building resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation including regional and transborder infrastructure, inclusive and sustainable industrialization, scientific-research and technology based industrial sectors.

SDG 10: Reduced Inequality implies Reducing inequality within and among countries including empowering and promoting the social, economic and political inclusion of all, facilitating safe mobility and migration, and enhancing representation and voice for developing countries in decision-making in global international economic and financial institutions.

SDG 11: Sustainable Cities and Communities implies making cities and human settlements inclusive, safe, resilient and sustainable by adequate, safe and affordable housing, basic services, transportation, good urban planning, protection of natural and cultural heritage.

SDG 12: Responsible Consumption and Production implies ensuring sustainable consumption and production patterns by taking into consideration natural resources, food waste, chemicals and all wastes, procurement, reporting.

SDG 13: Climate Action implies Taking urgent action to combat climate change and its impacts, Strengthen resilience and adaptive capacity as well as integrate climate change measures into national policies, strategies and planning.

SDG 14: Life Below Water implies conserving and sustainably using the oceans, seas and marine resources for sustainable development focusing on marine pollution, marine and coastal ecosystems, ocean acidification, fishing practices.

SDG 15: Life on Land implies protecting, restoring and promoting sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

SDG 16: Peace and Justice Strong Institutions implies ensuring to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

SDG 17: Partnerships to achieve the SDG implies strengthening the means of implementation and revitalize the global partnership for sustainable development.

Albeit the advancing research towards better interpretation in respect to implementation, the good intentions of the nations and the global agreement on the SDGs can only be fully realised based upon two major requirements. The first one is the solution for the financing required for achieving the targets as for many developing or underdeveloped nations, this will be an imminent problem and hinder the achievement of nation-based indicators (Kabore, et.al. 2018).

Discussions on such financing mechanisms are available but still much needs to be done (Olwig, 2021).

METHODOLOGY

In this study, Analytical Hierarchy Process is used to evaluate the relationship between Artificial Intelligence and Sustainable Development Goals developed by UNDP. Analytical Hierarchy Process (AHP) is a decision analysis approach developed by Thomas L. Satty in 1971 (Satty, 1980). AHP is an easy-to-use tool with the simple theoretical background. Determining the weight of each factor through binary comparisons and how these factors affect the hierarchical structure can be seen through AHP. In the AHP questionnaire style, participants are only asked to compare the importance of two needs. These comparisons are called judgments, and judgments generate a great deal of information. AHP analysis includes the creation of a hierarchical structure and the calculation of weights between factors at different levels (Shiau, 2002).

In this study, 30 people who have the potential to work as developers and adapters in the field of artificial intelligence were interviewed. Participants, 15 female and 15 male, have taken a course on the social technical dimension of artificial intelligence, successfully completed the course and developed a basic level artificial intelligence application. In the meeting with the participants, it was tried to determine what they suggest as the sustainable development area where artificial intelligence would contribute the most in line with their vision and the products they plan to develop. The data collection tool is designed with 9 points scale. 1 is equally important and 9 is extremely important. Geometric mean was used to calculate the level of significance indicated by the participants in 9 points. The geometric mean seems to be the most suitable method for calculating average of judgments (Aczél and Saaty, 1983; Ryu, 2005).

Matrix calculations and other calculations were carried out with Microsoft Excel package program. The judgements of 30 respondents were combined with geometric mean. Consistency Ratio (CR) was checked first for each sub-criterion and for the main dimensions. Comparison matrices are acceptable if the consistency ratio (CR) is less than 10 percent.

Table 1

AHP Results

Main Criteria (L =5.08 CI=00.1 CR=00.1	Priority Vector	Order
No Poverty	0,004	15
Zero Hunger	0,005	14
Good Health and well-being	0,124	3
Quality education	0,096	4
Gender equality	0,001	17
Clean water and sanitation	0,083	6
Affordable and clean energy	0,091	5
Decent work and economic growth	0,194	2
Industry innovation and infrastructure	0,211	1
Reduced inequalities	0,003	16
Sustainable cities and communities	0,045	10
Responsible consumption and production	0,074	7
Climate action	0,018	9
Life below water	0,013	12
Life on land	0,009	11
Peace justice and strong institutions	0,007	13
Partnership for the goals	0,021	8

When analyzed Table 1, it is seen that the obtained CR value is a consistent value. This situation indicates that the reliability of the study is appropriate. When the priority vectors related to the dimensions of Sustainable Development are examined, it is understood that industry innovation and infrastructure are seen as the dimension which artificial intelligence will make the most important contribution. Artificial intelligence applications, which have been developed since the beginning of the 2000s, contribute especially in the industrial area. This situation causes every individual who faces into the artificial intelligence field or works in this field to put industrial innovation on their agenda first.

The second most important contribution of artificial intelligence is decent work and economic growth. Despite the jobs that disappear with artificial intelligence, the surplus of new types of jobs, the strengthening of the startup culture with artificial intelligence, the momentum gained by the countries / institutions that allocate budgets for artificial intelligence confirm this view. Most of the countries that have announced their artificial intelligence strategies one after another since 2017 have addressed artificial intelligence as the key to economic growth.

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The good health and well-being dimension has been calculated as a dimension to which artificial intelligence can contribute in the third place. Indeed, the fact that artificial intelligence reveals more successful diagnoses than doctors, the use of IOT systems for individuals to lead a healthier life, and the artificial intelligence applications that prominent in the COVID-19 process support this contribution.

The dimension that artificial intelligence will contribute to in the fourth place is quality education. One of the main reasons of this dimension risen to top places is pandemic. Transferring artificial intelligence applications to educational processes was seen as less profitable and controversial in terms of privacy before the COVID-19 pandemic. Collecting data from educational processes carried out in classical way and making this data valid and qualified was considered more costly compared to enterprises. However, due to COVID-19, conducting education and training activities over digital media has facilitated data collection and processing processes. When this situation is combined with the need to conduct education with more innovative solutions, artificial intelligence has become dominant in ensuring quality in education.

Among the Sustainable Development dimensions, reduced inequalities ranks 16th and Gender Equality ranks 17th in terms of the contribution of artificial intelligence. Artificial intelligence, which has successful applications from industry to medical fields and from the protection of natural life to the entertainment sector, deal big blow the equality side with the bias and explainability problems frequently encountered in these applications. The sexist approach of artificial intelligence in the Google Translate cases in the year 2018 and 2021 from the year 2012 Amazon case, identifying some professions and jobs with only men is the most basic proof of the low expectations, especially by gender equality. The GPT-3 case in 2021 also reveals the potential of artificial intelligence to cause injustice on the basis of beliefs.

CONCLUSION

Artificial intelligence creates a new frontier in many areas from the business world to the health sector, from lifestyle to labour market. Smart machines, robots, cobots, chatbots, videobots, RPAs build different processes in different areas and create a disruptive and innovative effect by reshaping current processes. In another words Artificial intelligence creates a new culture that affect the world and global sustainability.

The AI researchers and developers may continue AI development process without thinking about the integrity of the ecosystem and the effective and efficient use of resources. However, whenever the sustainability framework is ignored by researchers and developers, the idea of "artificial intelligence for a better world" takes a major hit. The potential of artificial intelligence to shape, change and reshape is strong enough to support the sustainability framework. The emergence of that power is closely related to the fact that AI researchers and developers understand both the sustainability and the contribution of artificial intelligence.

This study aims to reveal how the contribution of artificial intelligence to the Sustainable Development Goals set forth by UNDP is seen by those working in the field. With that aim 30 individuals, who were trained to develop AI and who took part in machine development processes, were included. A quantitative decision-making method, AHP, was used as a data collection tool in order to detect the choices of individuals regarding the contribution of artificial intelligence.

Based on the results of AHP, it is seen that "AI contribution to the goals related to industrial development and economy" is much more dominantly selected when it is compared to "AI contribution to the goals related to the protection of the world". Although there are successful artificial intelligence applications such as the protection of bees and global warming simulation, most of the AI developers mainly focus on the words innovation and industry and this has gradually turning into a common opinion.

The goal, where artificial intelligence is believed to contribute the least, was calculated as gender equality. In order to understand that result, the interviews were made with the participants. In those interviews, it was stated that the sexist approach and gender based bias problems in artificial intelligence applications are the main reasons. It was also among the prominent views that artificial intelligence has become an important barrier rather than positively contributing to gender equality.

The contribution of artificial intelligence in sustainable development is within the scope of the developer's perspective. If the developer focuses solely on the industry, employment and economy sides of the sustainable development goals, artificial intelligence will not be able to reveal its positive power in other goals.

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EXTENDED ABSTRACT

Hanlein & Kaplan (2019) defined artificial intelligence as a combination of cognitive, emotional, and social intelligence, which means human behavior imitation. The difference in given definitions reveals how much the scope has changed over time, from the areas of application to the points it can affect. The change that comes with artificial intelligence is not limited to making new decisions and generating new information (Mikalef, Framnes, Danielsen, Krogstie, & Olsen, 2017). It affects and changes the existence of the work (Schneider & Leyer, 2019), scope of it (Özdemir & Kılınç, 2019), the perspective of the human being, the production of more objective and efficient processes and models (Kahneman, Rosenfield, Gandhi, & Blaser, 2016), and the concepts of innovation, leadership and management (Sousa & Rocha, 2019).

In this sense, one of the first noteworthy movements is the Asilomar Principles. These principles focus on the potential risks that the sub-field areas of artificial intelligence may create and integrate ethical code into different applications of artificial intelligence (Asilomar Meeting 2017). This is because rapidly developing technologies such as artificial intelligence need a framework for the principle of ethics (Floridi et al.2018). Bias and algorithmic injustice discovered in artificial intelligence-based systems (Angwin et al.2016; Buolamwini and Gebru 2018; Özdemir, Kılınç, 2019), negative outputs of AI related to disadvantaged groups (Keyes 2018; Greene 2019) confirm the concerns in the field of artificial intelligence. Despite these concerns, artificial intelligence is a problem solver in many different areas such as agriculture, education, industry, and vitality protection. This potential of artificial intelligence is also critical to ensure sustainable development. However, it is pretty new that the concept of sustainability has become a subject studied under the AI framework.

The concept and possibility of a sustainable development has been on the agenda since the 1960s' environmental concerns especially Rachel Carson's *Silent Spring* (Carlson, et.al, 1962), although the fundamentals of the idea and the first essays date back to as early as 1800s with Malthusian catastrophe (Malthus & Appleman, 1976) where it is predicted that there will be a time when the needs of the increasing population will or could not be met with the resources of the

globe. As pessimistic as it sounds and some counter theories may exist but the term sustainable development has firmly fixated itself in to the agenda of the nations. Sustainability in its broadest definition and as the word suggests is to be able to sustain what one has today for a certain period of time and sometimes it is aligned with the term sustainable development which is basically meeting the needs of today without endangering the needs of future generations (Brundland, 1987). In this respect, both have similarities and differences, where both can be discussed based upon the most known approach as the triple bottom line (Elkington, 2013) listed as, social sustainability, environmental sustainability and economic sustainability. These pillars are sometimes referred to as people, planet and prosperity (Elkington, 2013).

In this study, Analytical Hierarchy Process is used to evaluate the relationship between Artificial Intelligence and Sustainable Development Goals developed by UNDP. In this study, 30 people who have the potential to work as developers and adapters in the field of artificial intelligence were interviewed. Participants, 15 female and 15 male, have taken a course on the social technical dimension of artificial intelligence, successfully completed the course and developed a basic level artificial intelligence application. In the meeting with the participants, it was tried to determine what they suggest as the sustainable development area where artificial intelligence would contribute the most in line with their vision and the products they plan to develop. Based on the results of AHP, it is seen that "AI contribution to the goals related to industrial development and economy" is much more dominantly selected when it is compared to "AI contribution to the goals related to the protection of the world". Although there are successful artificial intelligence applications such as the protection of bees and global warming simulation, most of the AI developers mainly focus on the words innovation and industry and this has gradually turning into a common opinion. The goal, where artificial intelligence is believed to contribute the least, was calculated as gender equality. In order to understand that result, the interviews were made with the participants. In those interviews, it was stated that the sexist approach and gender based bias problems in artificial intelligence applications are the main reasons. It was also among the prominent views that artificial intelligence has become an important barrier rather than positively contributing to gender equality.

Artificial intelligence creates a new frontier in many areas from the business world to the health sector, from lifestyle to labour market. Smart machines, robots, cobots, chatbots, videobots, RPAs build different processes in different areas and create a disruptive and innovative effect by reshaping current processes. In another words Artificial intelligence creates a new culture that affect the world and global sustainability. The AI reseachers and developers may

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continue AI development process without thinking about the integrity of the ecosystem and the effective and efficient use of resources. However, whenever the sustainability framework is ignored by researchers and developers, the idea of "artificial intelligence for a better world" takes a major hit. The potential of artificial intelligence to shape, change and reshape is strong enough to support the sustainability framework. The emergence of that power is closely related to the fact that AI researchers and developers understand both the sustainability and the contribution of artificial intelligence. The contribution of artificial intelligence in sustainable development is within the scope of the developer's perspective. If the developer focuses solely on the industry, employment and economy sides of the sustainable development goals, artificial intelligence will not be able to reveal its positive power in other goals.