ISSN: 1309-1581

AJIT-e

Academic Journal of Information Technology

Volume 14 • Issue 55 • Fall 2023

320 – 334
DOI: 10.5824/ajite.2023.04.001.x
The Effect of Project Based Learning Approach on Computational Thinking Skills and Programming Self-Efficacy Beliefs
Hayrünnisa ERGİN, Yüksel Deniz ARIKAN

335 – 364
DOI: 10.5824/ajite.2023.04.002.x
Türkiye Can Leverage the Power of Innovation, Artificial Intelligence, And Fintech to Enhance Productivity
Eyüp AKÇETİN

365 – 376
DOI: 10.5824/ajite.2023.04.003.x
Regulatory Recommendations for Fraud Problem in The Turkish Telecommunication Sector
Süleyman BAYRAM, Esma ERGÜNER ÖZKOÇ

377 – 395
DOI: 10.5824/ajite.2023.04.004.x
Digital Natives' Academician-Student Relationships
Ahmet İYİCİ, Ülfet Kutoğlu KURUÇ

Supported by
ABA
Akademik Bilişim Araştırmaları Derneği

www.ajit-e.org

ISSN: 1309-1581

AJIT-e

Academic Journal of Information Technology

Volume • **14**
Cilt

Issue • **55**
Sayı

Fall • **2023**
Güz

www.ajit-e.org

Dergide yayınlanan makalelerde belirtilen görüşler ve fikirler sadece yazar(lar)ın görüşüdür. Yayınlanan içeriklerle ilgili bütün sorumluluklar yazar(lar)a aittir. Yayınlanan eserlerde yer alan tüm içerik kaynak gösterilmeden kullanılamaz.

●●●

The opinions and ideas stated in the articles published in the journal are only the opinion of the author (s). All responsibilities regarding the published content belong to the author (s). The published contents in the articles cannot be used without being cited.

●●●

●●●

Tüm makaleler DOI ve Crossmark ile kayıt altına alınmaktadır.

●●●

All articles are registered with DOI and Crossmark.

●●●

Tarandığımız İndeksler – Indexes

●●●

AJIT-e - Academic Journal of Information Technology
Address: *Kazım Ozalp Sk. No: 15 Kat 2 34740 Şaşkınbakkal / Suadiye / KADIKÖY / ISTANBUL / TURKEY*
Tel: *+90 216 355 56 19*
Faks: *+90 216 368 43 30*
Email*: editor@ajit-e.org*

Supported by

www.ajit-e.org ● **www.abilar.org**

ISSN: 1309-1581
AJIT-e
Academic Journal of Information Technology

Volume 14 ● Issue 55 ● Fall 2023

Yeni iletişim ortamları hız ve yayın süreçleri açısından yazılı basına göre çok daha avantajlı olduğundan, akademik yayıncılığın geleceği, Internet gibi yeni iletişim ortamları etrafında şekillenmeye başlamıştır. Makaleler dergilerin basılı versiyonlarından önce yayınlanabilmektedir. AJIT-e de iletişim ve bilişim alanına ilgi duyan araştırmalar için bir kaynak ve yayın ortamı sağlamak amacıyla 2010 yılında yayın hayatına başlamıştır.

AJIT-e, uluslararası hakemli bir dergidir. Türkçe ve İngilizce, iki dilde yılda dört sayı yayınlanır. AJIT-e yayın alanları arasında başlıca şu konular yer alır:

Yeni Medya ve İletişim Bilimleri, Teknoloji, Adli Bilişim, Belge ve Kayıt Yönetimi, Bilgi Güvenliği, Bilgi Yönetimi, Bilişim Etiği, Bilişim Hukuku, Dağıtık Bilişim Sistemleri, E-Öğrenme, E-Dönüşüm, E-Devlet, E-Pazarlama, E-Reklam, E-Scm, E-Yayımcılık, E-Yayıncılık, E-Yönetim, Tıp Bilişimi, Karar Destek Sistemleri, Sayısal Eğlence ve Oyun, Sayısal Hak Yönetimi, Sosyal Ağlar, Tedarik Zinciri Yönetimi, Telekomünikasyon, Veri Madenciliği, Veritabanları, Yapay Zekâ, Yönetim Bilişim Sistemleri

●●●

As new communication environments are much more advantageous than print media in terms of speed and broadcast processes, the future of academic publishing has begun to take shape around new communication environments such as the Internet. Articles can be published long before the printed versions of journal. AJIT-e started publication in 2010 to provide a resource and publication environment for research interested in the field of communication and informatics.

AJIT-e is an international refereed journal. It is published four times a year in both languages, in Turkish and English. AJIT-e publication areas include the following topics:

New Media and Communication Sciences, Technology, Computer Forensics, Document and Records Management, Information Security, Information Management, Information Ethics, Distributed Information Systems, E-Learning, E-Transformation, E-Government, E-Marketing, E-Advertisement, E-Scm, E-Publishing, E-Management, Medical Informatics, Decision Support Systems, Digital Entertainment and Gaming, Digital Rights Management, Social Networks, Supply Chain Management, Telecommunications, Data Mining, Databases, Artificial Intelligence, Management information systems

Prof. Dr. Özhan TINGÖY
Editor-in-Chief

ISSN: 1309-1581

AJIT-e
Academic Journal of Information Technology

Volume 14 ● Issue 55 ● Fall 2023

Contents

İçindekiler

320 – 334
DOI: 10.5824/ajite.2023.04.001.x
The Effect of Project Based Learning Approach on Computational Thinking Skills and Programming Self-Efficacy Beliefs
Hayrünnisa ERGİN, Yüksel Deniz ARIKAN

335 – 364
DOI: 10.5824/ajite.2023.04.002.x
Türkiye Can Leverage the Power of Innovation, Artificial Intelligence, And Fintech to Enhance Productivity
Eyüp AKÇETİN

365 – 376
DOI: 10.5824/ajite.2023.04.003.x
Regulatory Recommendations for Fraud Problem in The Turkish Telecommunication Sector
Süleyman BAYRAM, Esma ERGÜNER ÖZKOÇ

377 – 395
DOI: 10.5824/ajite.2023.04.004.x
Digital Natives' Academician-Student Relationships
Ahmet İYİCİ, Ülfet Kutoğlu KURUÇ

AJIT-e Academic Journal of Information Technology
10.5824/ajite.2023.04.001.x

2023 . Fall - Güz . Volume – Cilt: 14 . Issue – Sayı: 55

The Effect of Project Based Learning Approach on Computational Thinking Skills and Programming Self-Efficacy Beliefs*

Hayrünnisa ERGİN, *Izmir Provincial Directorate of National Education, Teacher, nisaergin@gmail.com, 0000-0003-2625-0043*

Yüksel Deniz ARIKAN**, *Ege University, Faculty of Education, Department of Computer and Instructional Technologies Education, Asst. Prof. Dr., y.deniz.arikan@gmail.com, 0000-0002-7151-5381*

ABSTRACT

The aim of this study is to reveal the effect of project use on students' self-efficacy beliefs towards programming and their computational thinking skills. A one-group pretest-posttest experimental design was used in the study. The research was conducted in 2018 with 14 12th-grade students in a Vocational and Technical High School in Izmir. In the research, the application of project use in programming teaching lasted 18 weeks. The research data were collected with the Self-Efficacy Scale for Programming (SESP) developed by Altun and Mazman (2012) and the Computer Thinking Skill Levels Scale (CTSLS) developed by Korkmaz, Çakır, Özden, Oluk, Sarıoğlu (2015). Wilcoxon Signed Ranks Test, one of the nonparametric tests, was used to analyze the research data. As a result of the study, it was observed that the use of projects in programming instruction had a positive effect on students' self-efficacy in programming, while it did not have a significant effect on their computational thinking skills. Based on the results of the research, it is recommended to teach block-based programming before text-based programming, to include game-themed activities, to ensure active participation of students, and to use multidimensional and alternative measurement tools to measure computational thinking skills to comprehend algorithm stages in programming instruction.

Keywords **:** Computational Thinking, Programming Instruction, Programming Self-Efficacy Beliefs, Project-Based Learning, Purdue Model

*This article is derived from Hayrünnisa Ergin's master's thesis entitled "The Effect of Project Use in Computer Programming on Students' Computational Thinking Skills and Programming Self-Efficacy Belief", conducted under the supervision of Asst. Prof. Dr. Yüksel Deniz Arıkan.

** Corresponding Author

Araştırma Makalesi / Research Article
Date Received: 12.09.2023
Publishing Date: 22.11.2023

AJIT-e Academic Journal of Information Technology
2023 Fall/Güz – Cilt/Vol: 14 - Sayı/Issue: 55
10.5824/ajite.2023.04.001.x

Proje Tabanlı Öğrenme Yaklaşımının Bilgi İşlemsel Düşünme Becerilerine ve Programlama Öz Yeterlilik İnancına Etkisi

ÖZ

Bu araştırmanın amacı proje kullanımının, öğrencilerin programlamaya yönelik öz yeterlilik inançlarına ve bilgi işlemsel düşünme becerilerine etkisini ortaya koymaktır. Araştırmada tek grup ön test- son test deneysel desen kullanılmıştır. Araştırma 2018 yılında, İzmir ilinde bir Mesleki ve Teknik Lisesi'nde 12. sınıfta öğrenim gören 14 öğrenci ile gerçekleştirilmiştir. Araştırmada programlama öğretiminde proje kullanımı uygulaması 18 hafta sürmüştür. Araştırma verileri Altun ve Mazman (2012) tarafından geliştirilen Programlamaya İlişkin Öz Yeterlilik Ölçeği ile Korkmaz, Çakır, Özden, Oluk, Sarıoğlu (2015) tarafından geliştirilen Bilgisayarca Düşünme Beceri Düzeyleri Ölçeği ile toplanmıştır. Araştırma verilerinin analizinde parametrik olmayan testlerden Wilcoxon İşaretli Sıralar Testi kullanılmıştır. Araştırma sonucunda, programlama öğretiminde proje kullanımının öğrencilerin programlamaya ilişkin öz yeterliliklerini olumlu etkilediği görülürken, bilgi işlemsel düşünme becerilerinde anlamlı bir etkisinin olmadığı görülmüştür. Araştırma sonuçlarına dayalı olarak programlama öğretiminde algoritma aşamalarının kavranabilmesi için metin tabanlı programlamaya geçmeden önce blok tabanlı programlama öğretimin yapılması, oyun temalı etkinliklere yer verilmesi, öğrencilerin aktif katılımlarının sağlanması ve bilgi işlemsel düşünme becerilerinin ölçülmesinde çok boyutlu ve alternatif ölçme araçlarının kullanılması önerilmektedir.

Anahtar Kelimeler **:** Bilgi İşlemsel Düşünme, Programlama Öğretimi, Programlama Öz Yeterlilik İnancı, Proje Tabanlı Öğrenme, Purdue Modeli

INTRODUCTION

The information and communication technologies sector are consistently developing in our country as well as in the world. The needs of society for information technologies and the need for people with competence in the field are similarly increasing. For this reason, the importance of programming education is increasing day by day (Akpınar & Altun; Barut & Kuzu, 2017) and learning methods and tools are being investigated in education and training in this field.

Today, programming education is considered very important for the cognitive development of students for reasons such as developing questioning and thinking skills and enabling them to see the connections between events (Akçay & Çoklar, 2016). Learning programming is a difficult process because it requires cognitive activities such as analysis and synthesis, and conceptual knowledge must be acquired before it can be put into practice (Porter & Calder, 2004). According to Churches (2008), programming skill is included in the creativity stage according to Bloom's taxonomy, which shows that learning takes place in stages, as learners create their own applications to suit their needs and goals.

When we look at the factors that make programming education difficult, we see those negative prejudices against programming, programming languages being in English, and trying to teach programming logic with traditional teaching methods (Arabacıoğlu et al., 2007). In addition to these, rote learning, lack of abstract thinking ability, inadequacy of arithmetic, mathematical and analytical thinking, and inability to determine the usage areas of the applications made in programming courses in real life are among the difficulties encountered by students in programming teaching (Cevahir & Özdemir, 2017). It is stated that the three main factors affecting students' learning of computer programming are teaching approach, choice of computer programming language and programming development environment, and activities based on the constructivist approach should be emphasized in the formation of these learning outcomes (Ali, Tumian, & Seman, 2017). Different methods and strategies based on the principles of the constructivist approach, in which learners are active in their own learning processes and responsible for their own learning, and in which what is learned is associated with real-life problems, are gaining importance. Ülküdür and Bacanak (2016) state that project-based learning is one of these applications. Project-based learning environments provide systematic structuring of what is learned and offer individuals with different learning styles, intelligence, and abilities the opportunity to work individually or collaboratively (Saraçoğlu, Akamca, & Yeşildere, 2006). It is thought that these methods and strategies make students active and affect their thinking skills (Güneş, 2010).

In the process of learning programming, students not only develop their coding knowledge but also their mathematical skills and computational thinking. Thus, students are able to produce projects and share their ideas. These earnings are considered necessary for individuals from every professional group (Sayın & Seferoğlu, 2016). One of the most important 21st-century skills thought to be acquired in the process of learning programming is computational thinking skill. Computational thinking skills indicate creative thinking, algorithmic thinking, critical thinking, problem solving, collaborative learning and communication skills. The computational thinking skill includes decomposition, generalization, algorithmic thinking, evaluation, and abstraction. These steps teach students the basics of how to approach a problem and solve it in a computational context. Programming is seen as a part of this systematic approach (Nash, 2017). Computational thinking refers to the cognitive process used in basic problem-solving steps. Therefore, learning programming is a fundamental factor for developing computational thinking (Lye & Koh, 2014).

Although programming knowledge is accepted as one of the most important requirements for becoming computer literate today, it is seen as a difficult process to learn. For this reason, it is important to develop self-efficacy beliefs towards programming, which is seen as one of the most important factors that facilitate learning programming. Self-efficacy is an individual's belief in his/her own potential that his/her knowledge and skill level is sufficient to perform a function (Bandura, 1988; as cited in Azar, 2012). Many studies show that students who have developed programs before taking the programming course have high achievement and self-efficacy (Gezgin & Adnan, 2016).

Different applications need to be developed to make programming teaching more effective and to facilitate overcoming the difficulties encountered. For this reason, within the scope of the research, it is thought that it would be useful to use the project in programming teaching, which is based on the principles of the constructivist approach, responds to the

interests, and needs of learners, and enables learning to take place through real-life problems. In this study, the effect of project use in programming instruction on students' self-efficacy beliefs towards programming and computational thinking skills was examined. In this context, the following questions were searched for answers.

1. What is the effect of project use on students' self-efficacy beliefs about computer programming?
2. What is the effect of project use on students' computational thinking skills?

1. METHOD

This section includes the research design, participants, experimental process, data collection tools and data analysis.

1.1. Research Design

In this study, one group pretest-posttest experimental design method was used. The experimental design used in the study is shown in Table 1.

Table 1: Research Design

Group	Pre-test	Process	Post-test
Experiment	SESP-CTSLS	PT	SESP-CTSLS

SESP: Self-Efficacy Scale for Programming, *CTSLS:* Computer Thinking Skill Levels Scale, *PT:* Project-oriented teaching.

As seen in Table 1, the independent variable of the study was the learning environment in which the project was used, and the dependent variables were students' self-efficacy beliefs about programming and computational thinking skills.

1.2. Participants

The research was conducted in 2018 with the participation of 12th-grade students of a Vocational and Technical High School in Izmir. Purposive sampling was used to determine the participants. This school is where one of the researchers works. Participants were included in the study because they took a programming course. All 14 students were male in the study.

1.3. Experimental Process

Within the scope of the research, firstly, the curriculum was prepared in accordance with the three-stage Purdue model by considering the existing course curriculum. At the beginning of the experimental implementation process, SESP and CTSLS were applied as a pretest. Then, the prepared curriculum was implemented. Within the scope of the application, students worked individually or collaboratively. Students were allowed to choose project topics based on different ideas. In this process, the teacher-researcher guided the students in the process of resource searching and implementation. In the application, the students presented their projects, and their feedback was received to improve the projects. In the last stage of the research, SESP and CTSLS were applied as a post-test.

1.3.1. Needs Analysis

First, it was decided to use the project method to transform the knowledge acquired in the programming teaching process into learning products. The project method is a teaching method applied in developed countries to prevent the curriculum content from being taught in small pieces of information that are not associated with each other (Çakallıoğlu, 2008). In the research process, a curriculum was needed for students to develop their prior knowledge to comprehend the algorithm logic required by programming and to create independent project studies. Considering that prior knowledge of the subject to be learned has a significant effect on academic success according to the research (Coşar, 2013), it was decided to prepare a curriculum according to the three-stage Purdue model, which enriches project-based learning and emphasizes the importance of prior learning, created by Feldhusen and Kolloff (1988). The content of the curriculum is based on Bloom's taxonomy and the cognitive skill sequence required by the curriculum. Before the implementation, it is expected that conceptual knowledge is acquired, and the synthesis step is expected to be realized by bringing these basic concepts together on a different problem situation. Accordingly, the implementation process of the curriculum was carried out in accordance with the three-stage Purdue model. Table 2 shows the steps corresponding to the three-stage Purdue model and the implementation process in the curriculum of the learning outcomes to be acquired according to the conceptual framework of the components of programming knowledge.

Table 2: Comparison of the Components of Programming Knowledge and Curriculum with the Three-Stage Purdue Model

	Stages of the Purdue model	Components of programming knowledge	Curriculum
Phase I Knowledge and Comprehension Level	Development of scientific process skills. Practices for creative and critical thinking skills	Syntactic (Spelling) Information	Variables, Arithmetic Operators, Loops, Arrays, Flowcharts, Creating Algorithms
Phase II Application and Analysis	Facing a problem situation. Discussion, brainstorming, etc. with the teacher and small groups, active student participation	Conceptual (Procedural) Knowledge	Two-person dice throwing game, creating a quiz, making a stopwatch, Button catching game

10.5824/ajite.2023.04.001.x

Phase III Synthesis and Evaluation	Independent project work. Problem-solving. Acquired in the first two stages, and the use of high-level cognitive skills	Strategic Knowledge	Creation, development, and evaluation of independent project work

While creating the curriculum content, attention was paid to ensure that the activities selected were of a quality that could attract students' interest and were appropriate for the achievements of the course. The realization of learning through the theme of games makes the lessons interesting, provides a better understanding of abstract concepts and the creation of connections between concepts that are effective in establishing the algorithmic structure, and thus increases the motivation to learn (Çatlak, Tekdal, & Baz, 2015). It is stated that learners learn better and enjoy the learning process while working on meaningful projects in line with their interests and needs. While developing the Scratch programming interface, two design criteria were given importance. The first one is that it includes many different story situations and game designs, and the second one is that the activities can be shaped according to personal interests and needs (Resnick et all., 2009). For these reasons, game-themed activities were included in the curriculum, allowing students to work on different problem situations.

1.3.2. Curriculum

The three-stage Purdue model created by Feldhusen and Kolloff (1988) was used in the preparation of the curriculum. Kutlu and Gökdere (2013) stated that although this model was developed for gifted students at the primary education level, it can also be applied in regular education institutions by making necessary arrangements since it enriches project-based learning and provides appropriate learning opportunities for each student. The stages of the curriculum are presented in Table 3, Table 4, and Table 5.

Table 3: *Curriculum Stage 1*

	Activity 1	Activity 2	Activity 3	Learning out comes	Time
1. Week	Ability to print sample value according to the data type selected in Combo box			Will be able to use variables in an object-oriented programming environment.	9 class hours

2. Week	To be able to create the change table according to the order of operation of variables			Will be able to use arithmetic operators.	9 class hours
3. Week	Area and perimeter calculations of different geometric objects	Favorite team voting using Progress Bar object		Will be able to create the algorithmic structure.	9 class hours
4. Week	Calculation of the grade range of the grade point average in the 5-point system	Listing the properties of the element selected from the combo box with Switch Case structure		Will be able to use logical operators and conditional statements.	9 class hours
5. Week	Creating an array of numbers and initializing the array,	Accessing array elements, for each expression array copy	Guide application created by entering the array elements by the user	Will be able to use arrays.	9 class hours
6. Week	Transferring array elements to list box with for loop	Addition of array elements and use of nested for loops with two-dimensional arrays	Factorial calculation	Will be able to use loop expressions.	9 class hours

Table 4: *Curriculum Stage 2*

	Activity	Learning out comes	Time
7. Week	Two-person dice rolling game	will be able to use the Random class and logical operators.	9 class hours
8. Week	Creation of a knowledge competition	Problem Solving and Application of Creative Problem-Solving Models	9 class hours
9. Week	Stopwatch making		9 class hours
10. Week	Button capture game		9 class hours

Table 5: *Curriculum Stage 3*

	Activity	Learning out comes	Time
11. Week	Independent project work	It will be carried out under student control and teacher guidance.	9 class hours
12. Week	Independent project work		9 class hours
13. Week	Presentation of independent project work		9 class hours

The process of developing projects in the light of new acquisitions

	Activity 1	Activity 2	Learning out comes	Time
14. Week	Creating a database, Creating a connection to a database,	Querying data, closing the connection	Will be able to query information in a database.	9 class hours
15. Week	Data update,	Adding and deleting data	Will be able to perform operations on data.	9 class hours
16. Week	Development of Independent Project Studies		It will be carried out under student control and teacher guidance.	9 class hours
17. Week	Development of Independent Project Studies			9 class hours
18. Week	Presentation of Independent Project Work			9 class hours

As seen in Table 3, Table 4, and Table 5, the curriculum prepared based on the Purdue model consists of three stages. In the first stage of the curriculum, knowledge and skills were acquired, in the second stage, sample applications were developed based on problem-solving models, and in the third stage, independent project studies were carried out under the guidance of the teacher.

In the first 10 weeks of the study, the first and second stages of the three-stage Purdue model were carried out. In the third stage, independent project studies were conducted. Throughout the research, the students studied in a computer laboratory consisting of 15 student computers and 1 teacher computer. Each student had a computer that they could use regularly in their studies. Students who wanted to continue their studies brought their personal computers. The course teacher, who was also one of the researchers, helped the

students comprehend the programming logic and develop sample applications in the first and second stages of the model and guided the students in the independent project development process. Students carried out the project development process in the school environment. At the end of the independent project studies, which was the third stage of the research, the SESP and CTSLS were applied as a post-test.

1.3.3. The Role of Researchers

One of the researchers is the teacher of the course and one is the advisor. The researchers prepared a curriculum in line with the needs of the participants and carried out the necessary work to enable programming instruction to be carried out using projects. The teacher-researcher guided the students in the process of creating and developing project ideas. The researchers collected the data by providing the necessary information about the scales used as pre-test and post-test. The researchers analyzed and reported the data in an unbiased manner.

1.4. Data Collection Tools

1.4.1. SESP

The SESP, the validity, and reliability study of which was conducted by Altun and Mazman (2012), was applied to the students. The Turkish version of the SESP consists of 9 items and 2 factors (Simple programming tasks and complex programing tasks). The Cronbach Alpha coefficient of the SESP is 0.928.

1.4.2. CTSLS

The CTSLS was developed to measure the computational thinking skills of individuals who can be defined as adult learners. The internal consistency coefficient of the CTSLS is 0.822. CTSLS consists of 29 five-point Likert-type items and 5 sub-factors. CTSLS sub-factors are creativity, algorithmic thinking, collaborative work, critical thinking and problem-solving.

1.5. Analyzing the Data

For the sub-problems of the study, the Wilcoxon signed-rank test and dependent groups T test were used to analyze whether there was a difference between the pretest and posttest scores of the SESP and CTSLS.

2. FINDINGS

2.1. The Effect of Project Use on Students' Self-Efficacy in Computer Programming

The results of the Wilcoxon Signed Ranks Test conducted for the analysis of the first sub-problem of the study, "How is the effect of using projects on students' self-efficacy beliefs about computer programming?" are presented in Table 6.

Table 6: *Wilcoxon Signed-Ranks Test Results of SESP Pre-Test-Post-Test Application Scores*

		n	Rank Mean	Row Total	z	p
Programming Self-efficacy	Negative Sequence	3	5,50	16,50	-2,030	0,042
	Positive Sequence	10	7,45	74,50		
	Equal	1				

When Table 6 is examined, it is seen that the difference between students' self-efficacy in programming before and after programming instruction is significant (z=-2,030, p= 0,042). These data were also analyzed with paired samples t-test (t= -2,44, p= 0,029), and a significant difference was found. Accordingly, it is seen that the use of project-based learning method in programming instruction has a positive effect on self-efficacy beliefs about programming (p<0.05). The results of the analysis of the sub-factors of the scale of students' self-efficacy beliefs about computer programming are presented in Table 7.

Table 7: *Wilcoxon Signed-Ranks Test Results of SESP Pre-Test-Post-Test Application Scores According to Sub-Factors*

		n	Rank Mean	Row Total	z	p
Simple Programming Tasks	Negative Sequence	1	3,5	3,5	-2,46	0,014
	Positive Sequence	9	5,72	51,5		
	Equal	4				
Complex Programming Tasks	Negative Sequence	3	7,5	22,5	-1,61	0,107
	Positive Sequence	10	6,85	68,5		
	Equal	1				

Table 7 shows the results of the analysis of students' self-efficacy beliefs about computer programming on the sub-factors of simple programming tasks and complex programming tasks. Accordingly, it is seen that the difference in the sub-factor of simple programming tasks is significant (z= -2,46, p= 0,014), while the difference in the sub-factor of complex programming tasks is not significant (z= -1,61, p= 0,107).

2.2. The Effect of Project Use in on Students' Computational Thinking Skills

The results of the Wilcoxon Signed Ranks Test conducted for the second sub-problem of the study, "How is the effect of project use on students' computational thinking skills?" are presented in Table 8.

Table 8: *Wilcoxon Signed-Ranks Test Results of CTSLS Pre-Test-Post-Test Application Scores*

		n	Rank Mean	Row Total	z	p
Computational Thinking	Negative Sequence	7	6,50	45,50	-0,440	0,66
	Positive Sequence	7	8,50	59,50		
	Equal	0				

When Table 8 is examined, it is seen that there is no significant difference between the pre-test and post-test scores of the students' computational thinking skills (z= -0,440, p= 0,66). These data were also analyzed with the Paired Samples T Test (t= -0,372, p= 0,716) and no significant difference was found. Accordingly, it can be said that the use of projects has no significant effect on students' computational thinking skills (p>0.05). When the analysis results related to the sub-factors of computational thinking skills were examined, it was seen that the difference between the pre-test and post-test scores of creativity (z= -0,47, p= 0,63), algorithmic thinking (z= -1,47, p= 0,14), collaboration (z= -0,25, p= 0,79), critical thinking (z= -0,42, p= 0,67), problem solving (z= -0,63, p= 0,52) was not statistically significant.

3. DISCUSSION AND CONCLUSION

In this study, the effect of using projects on students' self-efficacy beliefs towards programming and computational thinking skills was examined. As a result of the research, it was concluded that the project-based learning method had a significant positive effect on students' self-efficacy beliefs towards programming. There are similar studies in the literature (Wiedenbeck, 2005; Jegede, 2009; Aşkar & Davenport, 2009; Davidson, Larzon, & Ljunggren 2010; Mazman & Altun, 2013). Wiedenbeck (2005), in a study with 120 university students who took C++ programming course for five academic semesters, stated that previous experiences affect perceived self-efficacy and that self-efficacy towards programming also affects success in programming courses. According to a study conducted with 190 engineering students randomly selected from six different engineering departments at the University of Nigeria, it was revealed that the number of programming courses taken by students and their success based on their scores in programming courses significantly predicted their Java programming self-efficacy (Jegede, 2009). Aşkar and Davenport (2009), in their study with engineering students, focused on gender, choice of major, previous computer skills and frequency of computer use as factors determining self-efficacy beliefs. It was found that students who used computers every day had significantly higher self-efficacy scores than those who used computers several times a week and computer engineering students had significantly higher self-efficacy scores than students in other engineering departments. Davidson, Larzon, and Ljunggren (2010) examined how self-efficacy beliefs towards programming changed after a

one-year introduction to a programming course. As a result of the study, although students' self-efficacy scores did not show a significant difference, a significant increase was observed in self-regulation and in many of the skills related to the course objectives. Mazman and Altun (2013) examined the self-efficacy beliefs of the students of the department of ITTE according to whether they had prior experience after the programming course they took. At the end of the study, they found that the programming course provided a significant increase in self-efficacy beliefs about programming in both groups with and without prior experience, and this increase was higher for the group without prior experience. It was also observed that the difference between the self-efficacy beliefs of the groups with and without prior experience decreased after the programming course.

Secondly, in this study, it was observed that the use of projects in programming instruction did not have a significant effect on students' computational thinking skills. In the studies conducted in the literature, it is seen that different application-based methods have been studied to measure the development of computational thinking skills (Denner & Werner, 2011; Brennan & Resnick, 2012; Grover, 2015; Kert, Yeni, & Şahiner, 2017). Denner and Werner (2011) developed a method called Fairy assessment by suggesting not to use scales in the assessment of computational thinking, but rather to make measurements based on qualitative analysis. This method is designed to measure whether middle school students understand the stages of programming, as well as whether they have gained skills such as abstraction, modeling, and whether they can apply algorithmic thinking to solve a problem. In this study, each student was assigned three tasks to be performed in the Alice programming environment and a scoring system ranging from 0 to 10 was developed to measure student performance in each task. They stated that each task given in the assessment process should be as independent as possible from other assessment tasks to measure a different dimension of computational thinking. Like this result, Brennan, and Resnick (2012) stated that applications for computational thinking should focus on the learning process and how it is learned rather than what is learned. Brennan and Resnick (2012), who analyzed the practices shared in online Scratch workshops, developed three basic dimensions for the assessment of computational thinking. These dimensions consist of computational concepts (conditional statements, loops, triggers, arithmetic, and logical operators, etc.), computational practices (algorithm creation, abstraction), and perspectives on practices (communication, inquiry). After identifying these dimensions, they defined three approaches to assess the development of computational thinking in students who design programs with Scratch. As a result of the study, it was thought that a single approach was not sufficient, and that it was appropriate to use a combination of approaches in environments suitable for assessment. Similarly, Grover (2015) stated that assessment systems that are more comprehensively structured than the traditional methods used in the assessment of computational thinking, that include multiple assessment tools such as formative assessments, open-ended programming assignments, that are based on applied learning, that can transfer what is learned to different situations and that can measure algorithmic thinking skills are necessary. Kert, Yeni, and Şahiner (2017) stated that for computational thinking to be measurable, the relationship between the sub-skills it contains should be revealed. In this context, they put forward a model that includes sub-skills such as formulation, abstraction, dividing the problem into small parts, algorithmic thinking,

and indirectly associates collaborative learning and communication skills. As a result of the study, they stated that to monitor the development of computational thinking, the sub-skills it covers should be measured. In line with these results in the literature, it is seen that it would be more appropriate to use multidimensional and alternative measurement tools to measure computational thinking skills.

During the research process, it was observed that students had difficulty in creating algorithms and synthesizing the information they learned in different problem situations. For this reason, it is thought that block-based programming instruction may be useful to comprehend the algorithm stages before moving on to text-based programming in the process of learning programming. It is thought that instead of giving the students the algorithmic process that takes place during the coding phase of the programs, it would facilitate learning if the interrelated particles were given in order and these stages are done simultaneously with the students. In the research process, it was observed that teaching the concepts learned in programming education through game-themed programs attracted students' attention and increased their motivation. For this reason, it is thought that including game-themed activities in programming teaching will make learning interesting and thus enable students to actively participate in the learning process. In addition, it is thought that it is important for teachers to choose different methods in which they can make students active and to provide the necessary help as a guide to overcome the difficulties in the process of writing a program and not to decrease motivation. In the research process, it was seen that determining the boundaries in the planning of the project applications and the development of the projects contributed to the smoothing of the process and not overburdening the teacher. In cases where similar teaching methods are used, proper task sharing in collaborative working groups will help the process to work. Since the high level of students' self-efficacy beliefs about programming is one of the most important factors facilitating learning, it is recommended to include more experiences that can improve self-efficacy. Although project-based programming makes learning meaningful and interesting, limiting the number of students will enable the teacher to perform the guidance task effectively.

As a result, researchers can examine the effects of project-based instructional practices in programming instruction at different educational levels in terms of the dependent variables of the study. In addition, researchers can examine the effects of different learning methods to overcome the difficulties encountered in programming teaching. In future studies, measurement tools that are structured in a process-oriented way and organized to include the subcomponents of computational thinking skills can be developed and applied to measure computational thinking skills. The researchers expect this study to contribute to future research.

Note:

This research was carried out with the permission of the Izmir Directorate of National Education Research Evaluation Commission dated 09.02.2018 and the permission of the İzmir Directorate of National Education dated 12.02.2018 and numbered 12018877-604.01.02-E.2938219.

REFERENCES

Akçay, A., Çoklar, A. N. (2016). A proposal for the development of cognitive skills: Programming education. In: A. İşman, H. F. Odabaşı, B. Akkoyunlu (Eds.), *Educational technology readings* (pp.121-140). TOJET- The Turkish Online Journal of Educational Technology.

Akpınar, Y., Altun, A. (2014). The need for programming education in information society schools. *İlköğretim Online, 13(1)*, 1-4.

Ali, A. M., Tumian, A., Seman, M. S. A. (2017, July). A conceptual approach for understanding computer programming skills development. *Proceeding of Research and Innovation in Information Systems (ICRIIS) 2017*, Malaysia, pp. 1-5.

https://doi.org/10.1109/ICRIIS.2017.8002526

Altun, A., Mazman, S. G. (2012). Validity and reliability study of the Turkish form of the perception of self-efficacy for programming scale. *Journal of Measurement and Evaluation in Education and Psychology, 3(2),* 297-308.

Arabacıoğlu, C., Bülbül, H., & Filiz, A. (2007, January-February). A new approach in computer programming teaching. *Academic İnformation'07 - IX. Proceedings of Academic İnformation Conference*, Turkey- Kütahya, pp.193-197.

Aşkar, P., Davenport, D. (2009). An investigation of factors related to self-efficacy for Java programming among engineering students. *The Turkish Online Journal of Educational Technology, 8(1).*

Azar, A. (2012). Self-efficacy beliefs of prospective secondary science and mathematics teachers. *International Journal of Management Economics and Business, 6(12*), 235-252.

Barut, E., Kuzu, A. (2017). Comparison of Turkey and England information technologies curricula in terms of objectives, learning outcomes, activities, measurement, and evaluation processes. *Trakya University Journal of Faculty of Education, 7(2),* 721-745.

Brennan, K., Resnick, M. (2012, April). New frameworks for studying and assessing the development of computational thinking. *In Proceedings of the 2012 Annual Meeting of The American Educational Research Association*, Vancouver, Canada, Vol. 1, p. 25.

Cevahir, H., Özdemir, M. (2017). Teacher opinions and solution suggestions for the difficulties encountered in programming teaching. *11th International Computer and Instructional Technology Symposium Proceedings*, Turkey- Malatya, pp. 24-26.

Churches, A. (2008). Bloom's taxonomy blooms digitally. *Tech & Learning, 1*, 1-6.

Coşar, M. (2013). *The effects of computer programming studies in a problem-based learning environment on academic achievement, critical thinking tendency and attitude towards computers.* [Unpublished Doctoral Dissertation]. Gazi University.

Çakallıoğlu, S. N. (2008). *The effect of science teaching based on project-based learning approach on academic achievement and attitude.* [Unpublished master's thesis]. Çukurova University.

Çatlak, Ş., Tekdal, M., Baz, F. Ç. (2015). The status of teaching programming with Scratch software: A document review study. *Journal of Instructional Technologies & Teacher Education, 4(3),* 13-25

Davidson, K., Larzon, L., & Ljunggren, K. (2010). *Self-efficacy in programming among STS students*. Retrieved from http://www.it.uu.se/edu/course/homepage/datadidaktik/ht10/reports/Self-Efficacy.pdf.

Denner, J., Werner, L. (2011, April 8-12). *Measuring computational thinking in middle school using game programming.* Annual Meeting of the American Educational Research Association (AERA), New Orleans, Louisiana. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=f629baf5301d843c9f1d448edca901d0632dd278

Feldhusen, J. F., & Kolloff, M. B. (1988). A three-stage model for gifted education. *Gifted Child Today Magazine, 11(1),* 14-20. https://doi.org/10.1177/107621758801100104

Gezgin, D. M., Adnan, M. (2016). Investigation of mechanical engineering and econometrics students' self-efficacy perceptions about programming. *Journal of Ahi Evran University Kırşehir Faculty of Education, 17(2),* 509-525.

Grover, S. (2015, April 15-20). Systems of assessments" for deeper learning of computational thinking in K-12. *In Proceedings of the 2015 Annual Meeting of The American Educational Research Association (AERA), Chicago, Illinois.* https://www.sri.com/wp-content/uploads/2022/04/aera2015-_systems_of_assessments_for_deeper_learning_of_computational_thinking_in_k-12.pdf

Güneş, F. (2010). Innovations coming with constructivist approach in education. *Journal of Education Review. 6(16), 3-10*

Jegede, P. O. (2009, August). Predictors of java programming self-efficacy among engineering students in a Nigerian university. *International Journal of Computer Science and Information Security, IJCSIS*, USA. Vol. 4, No. 1&2, https://doi.org/10.48550/arXiv.0909.0074

Kert, S. B., Yeni, S., Şahiner, A. (2017, May 24-26). Investigation of sub-skills associated with computational thinking. *International Computer and Instructional Technologies Symposium Full Textbook*, Malatya, Turkey. 726-738.

Korkmaz, Ö., Çakır, R., Özden, M. Y., Oluk, A. & Sarıoğlu, S. (2015). Investigation of individuals' computer thinking skills in terms of different variables. *Ondokuz Mayıs University Journal of Education Faculty, 34 (2),* 68-87. Retrieved from https://dergipark.org.tr/tr/pub/omuefd/issue/20284/215276.

Kutlu, N., Gökdere, M. (2013). Enriching project-based learning: The three-stage Purdue model. *Journal of Dicle University Ziya Gökalp Faculty of Education, 20(2013*), 293-311.

Lye, S. Y., Koh, J. H. L. (2014). Review on teaching and learning of computational thinking through programming: What is next for K-12? *Computers in Human Behavior, 41,* 51-61.

Mazman, S. G., Altun, A. (2013). The effect of the Programming-I courses on the self-efficacy perceptions of the students of the Department of ITIT on programming. *Journal of Instructional Technologies & Teacher Education, 2(3),* 24-29

Nash, J. (2017). *Turn coders into computational thinkers | ISTE*. ISTE. https://www.iste.org/explore/Innovator-solutions/Turn-coders-into- computational thinkers

Porter, R., Calder, P. (2004, January). Patterns in learning to program: an experiment? *In Proceedings of the Sixth Australasian Conference on Computing Education*, Australian Computer Society, Inc., 30, 241-246.

Resnick, M., Maloney, J., Monroy-Hernández, A., Rusk, N., Eastmond, E., Brennan, K., ... & Kafai, Y. (2009). Scratch: programming for all. *Communications of the ACM, 52(11)*, 60-67.

Saracaloğlu, A. S., Akamca, G. Ö., Yeşildere, S. (2006). The place of project-based learning in primary education. *Turkish Journal of Educational Sciences, 4(3),* 241-260.

Sayın, Z., Seferoğlu, S. S. (2016, February 3-5). Coding education as a new 21st century skill and the impact of coding on education policies. *Academic İnformation Conference,* Aydın, Turkey. https://yunus.hacettepe.edu.tr/~sadi/yayayin/AB16_Sayin-Seferoglu_Kodlama.pdf

Ülküdür, M. A., Bacanak, A. (2016). Comparison of project-based learning activities and game-based learning activities in preparation (development) dimension. *Bayburt Education Faculty Journal, 8(1),* 21-43.

Wiedenbeck, S. (2005, October). Factors affecting the success of non-majors in learning to program. *In Proceedings of The First International Workshop on Computing Education Research (ICER'05),* 13-24. https://doi.org/10.1145/1089786.1089788

AJIT-e Academic Journal of Information Technology
10.5824/ajite.2023.04.002.x

2023 . Fall - Güz . Volume – Cilt: 14 . Issue – Sayı: 55

Türkiye Can Leverage the Power of Innovation, Artificial Intelligence, and Fintech to Enhance Productivity

Eyüp AKÇETİN, *Muğla Sıtkı Koçman Üniversitesi, Seydikemer Uygulamalı Bilimler Yüksekokulu, Doç. Dr., eyup.akcetin@mu.edu.tr, 0000-0001-7232-2154*

ABSTRACT

The aim of this study is to reveal what Türkiye should do to increase its economic and social productivity according to the GII, fintech index, and AI index analyses. Based on the total scores of the GII, fintech, and AI indices were analyzed with K-Means clustering algorithm and linear projection methods. Türkiye needs to make a breakthrough in areas such as fintech and artificial intelligence, which are at the beginning of the digital age. In particular, it needs to focus on innovation and imitation, which can be combined into a new term, "imovation." Türkiye needs to increase its production of innovative products on a global scale. Focusing on and improving its competencies in this field is critical for economic and social productivity. Unlike previous studies, this study has been analyzed by selecting 51 countries that include all three of the Global Innovation, Fintech and AI indices. Based on these indices, Türkiye has been compared with other countries and what Türkiye needs to do for economic and social productivity has been revealed.

Keywords **:** Global Innovation Index, Fintech Index, AI Index, Productivity

Türkiye Verimliliği Artırmak için İnovasyon, Yapay Zekâ ve Fintech'in Gücünden Yararlanabilir

ÖZ

Bu çalışmanın amacı, GII, fintek endeksi ve yapay zekâ endeksi analizlerine göre Türkiye'nin ekonomik ve sosyal verimliliğini artırmak için neler yapması gerektiğini ortaya koymaktır. GII, fintek ve yapay zekâ endekslerinin toplam puanları baz alınarak K-Means kümeleme algoritması ve doğrusal projeksiyon yöntemleri ile analiz edilmiştir. Türkiye'nin dijital çağın başlangıcında olan fintek ve yapay zekâ gibi alanlarda atılım yapması gerekmektedir. Özellikle, yeni bir terim olan "imovasyon" ile birleştirilebilecek inovasyon ve taklit üzerine odaklanmalıdır. Türkiye'nin küresel ölçekte yenilikçi ürün üretimini artırması gerekmektedir. Bu alandaki yetkinliklerine odaklanması ve bunları geliştirmesi ekonomik ve sosyal üretkenlik açısından kritik önem taşımaktadır. Bu çalışma, önceki çalışmalardan farklı olarak Küresel İnovasyon, Fintech ve Yapay Zekâ endekslerinin üçünü de içeren 51 ülke seçilerek analiz edilmiştir. Bu endeksler baz alınarak Türkiye diğer ülkelerle karşılaştırılmış ve Türkiye'nin ekonomik ve sosyal üretkenlik için yapması gerekenler ortaya konulmuştur.

Anahtar Kelimeler **:** Küresel İnovasyon Endeksi, Fintech Endeksi, Yapay Zeka Endeksi, Verimlilik, Türkiye

Araştırma Makalesi / Research Article
Date Received: 28.08.2023
Publishing Date: 22.11.2023

AJIT-e Academic Journal of Information Technology
2023 Fall/Güz – Cilt/Vol: 14 - Sayı/Issue: 55
10.5824/ajite.2023.04.002.x

INTRODUCTION

Innovation and Productivity

Innovation boosts productivity by creating efficient products and services, leading to increased output and reduced costs. However, research productivity has been declining, as seen in Moore's Law, where the number of researchers required to double computer chip density has increased by 18 times since the 1970s (Bloom et al., 2017, 2020). The relationship between innovation and productivity is not generally linear. There is an inverted U-shaped relationship between product market competition (PMC) and innovation. High PMC can increase incremental profit from innovation, while excessive competition may reduce incentives. Innovations in materials, software, and technologies like carbon fiber, 3D printing, artificial intelligence, and robots have improved efficiency, output, and customer satisfaction. Empirical evidence supports these predictions, as seen in UK firms' patenting activity.(Aghion et al., 2002). Innovation drives productivity growth through research effort, productivity, and competition. It creates new markets, jobs, and businesses, boosting the economy. The internet has increased e-commerce productivity, and as innovation accelerates, it is expected to have an even greater impact on productivity in the future.

AI and Productivity

AI, a rapidly evolving field, has the potential to revolutionize various industries by automating tasks, making predictions, and improving decision-making in areas like finance, education, cybersecurity, and defense (Raban & Hauptman, 2018), (Pătraşcu, 2021). AI, a rapidly evolving field, has the potential to revolutionize various industries by automating tasks, making predictions, and improving decision-making in areas like finance, education, cybersecurity, and defense (Acemoglu & Restrepo, 2019). AI can automate repetitive tasks, freeing employees to focus on more complex work. It can also automate customer service tasks, allowing representatives to focus on complex cases and customer relationships. AI can analyze large data, identify patterns, and make better decisions in product development, marketing, and pricing. Automation complements labor and increases output, interacting with labor supply adjustments (Autor, 2015). AI technologies may automate jobs; however, employment growth has been observed in industries undergoing rapid technological change. A demand model predicts future job changes (Bessen, 2018). AI technology could potentially worsen income inequality by increasing access to AI technology. It could also provide a competitive advantage for businesses by automating tasks, leading to higher profits and higher prices. AI can also personalize products, increasing customer satisfaction and loyalty. However, it could also lead to job displacement in certain industries and bias in AI systems, potentially causing unfair outcomes. Therefore, it's crucial to weigh the potential benefits and risks before deploying AI technologies.

Fintech and Productivity

Financial Technology (Fintech) can enhance productivity by automating manual tasks like payment processing, account management, and customer service, freeing up employees to focus on more complex, strategic work, despite potential negative effects on efficiency and

productivity. Automation reduces employment and labor share, but encourages new tasks. Fintech can temporarily decrease productivity during transition periods, but the impact varies depending on technology. Fintech can make financial services accessible to underserved groups, increasing economic activity and productivity. The effects of fintech on productivity depend on technology type and workforce skills (Acemoglu & Restrepo, 2019; Bloom et al., 2014). Fintech uses data analytics to provide insights into financial performance, which aids in resource allocation and productivity. It also creates new markets for financial products and services, such as peer-to-peer lending and crowdfunding platforms. These advancements increase economic activity and productivity, automating manual tasks, making financial services more accessible, providing new insights, and fostering efficient operations.

Other Important Fields and Productivity

Internet of Things (IoT): IoT, a network of connected physical objects, is a promising sector for innovation, enhancing infrastructure protection, national security, and environment optimization (Pătraşcu, 2021).

Emerging Educational Technologies (EETs): Early-stage EETs, utilizing technologies like mobile, analytics, VR, AR, gamification, adaptive learning, machine learning, and blockchain, have the potential to revolutionize K-12 education (Dubé & Wen, 2021; Wali & Popal, 2020).

Cybersecurity Technologies: Cyber-attacks are increasing, necessitating technologies like homomorphic encryption, blockchain, and cyber resilience for defense, while emerging IoT and autonomous technologies pose challenges and potentially contribute to attack capabilities (Raban & Hauptman, 2018).

Advanced Manufacturing Technologies (AMTs): Cyber-attacks are increasing, necessitating technologies like homomorphic encryption, blockchain, and cyber resilience for defense, while emerging IoT and autonomous technologies pose challenges and potentially contribute to attack capabilities (Prabhaker et al., 1995).

Computational Technologies: Computational technologies, which utilize computers for problem-solving and task execution, are rapidly evolving due to increased demand and scientific advancements, with the potential to revolutionize various applications and societal aspects (Thampi & Adamuthe, 2015).

The adoption of advanced technologies, which are expected to significantly impact sectors like education, finance, cybersecurity, manufacturing, and national security, presents significant challenges and ethical implications (Onderco & Zutt, 2021; Raban & Hauptman, 2018).

1. LITERATURE REVIEW

The knowledge economy, based on innovation, research and development (R&D), technology, AI, machine learning, and big data analysis, is transforming information into a value-added commodity, impacting the future of the world.

Innovation for Productivity

The authors propose a multidisciplinary definition of organizational innovation, addressing the lack of a common definition and knowledge-based operationalizations. They emphasize the need for a comprehensive and adaptable definition that covers various aspects of innovation, distinguishing between traditional and knowledge management literature (Baregheh et al., 2009; Quintane et al., 2011).

The references emphasize the need for a comprehensive definition of innovation that considers multiple perspectives. Innovation in technology includes new products, new technologies, new business models, teaching methods, and healthcare delivery models. It is essential for economic growth and social progress, helping solve problems, create new products, and improve lives. Technology is the most important innovation tool in a country, whether used for peace or war.

AI for Productivity

AI is the development of computer systems capable of performing tasks requiring human intelligence, such as visual perception, speech recognition, decision-making, and problem-solving. Reinforcement learning, a method combining psychological and neuroscientific perspectives, optimizes control of an environment using high-dimensional sensory inputs. Recent advancements in deep neural networks have enabled artificial agents like deep Q-networks to learn successful policies directly from high-dimensional sensory inputs. AI has applications in healthcare, finance, transportation, and entertainment. Recent research has demonstrated that deep Q-network agents can excel at diverse tasks, bridging the gap between high-dimensional sensory inputs and actions (Mnih et al., 2015).

Silver et al., (2016); introduced a new approach to computer Go using deep neural networks trained from supervised learning from human expert games and reinforcement learning from self-play games. AI, the simulation of human intelligence processes by machines, has been successful in solving various problems, including game playing and medical diagnosis. Machine learning allows computers to learn without explicit programmed, powering recommendation engines and self-driving cars. Natural language processing (NLP) and computer vision techniques extract meaningful information from digital images, used in self-driving cars and medical image analysis. AI has the potential to revolutionize industries and improve our lives, but it's crucial to develop safeguards to mitigate risks.

Fintech for Productivity

Fintech combines financial services and information technology, evolving over different eras. FinTech 1.0, from 1866-1987, supported globalization. FinTech 2.0, 1987-2008, digitizes financial processes. Since 2008, a new era, driven by start-ups, presents challenges for regulators and market participants (Arner et al., 2015). FinTech's rise is a response to the evolving global landscape, posing significant challenges for regulators and banks (Anagnostopoulos, 2018). FinTech 1.0 (1966-1987) marked the beginning of financial globalization, followed by FinTech 2.0 (1987-2008) as financial services firms digitized processes, presenting a new era in both developed and developing nations (Arner et al., 2015).

The financial sector is undergoing significant transformation due to financial innovation, introducing new products, services, output processes, and business models to drive future growth (Anagnostopoulos, 2018).

Fintech refers to the use of technology to automate financial services, offering more convenient, efficient, and affordable alternatives. It includes mobile banking apps, peer-to-peer lending platforms, robot advisors, cryptocurrencies, insurtech, regtech, blockchain, crowdfunding platforms, and stock trading apps. These technologies enable users to check balances, transfer money, and pay bills from their smartphones. They also enable peer-to-peer lending, automate investment portfolio management, and ensure regulatory compliance. Fintech is a growing industry that aims to make financial services more accessible, affordable, and efficient for everyone, particularly those unfamiliar with money management due to asymmetric information.

What Is the Relationship Between Innovation, Fintech and AI?

Innovation, fintech, and AI are interconnected and mutually influential. Fintech combines financial services and technology, using AI for advanced data analysis, automation, and personalized services. AI techniques like machine learning and deep learning improve fraud detection, risk assessment, and credit scoring. Innovation drives fintech and AI, creating new business models and enhancing productivity in many industry areas such as fintech (Cao et al., 2021; Donepudi, 2017; Shin & Choi, 2019). AI is a technological innovation enhancing fintech's capabilities, enabling the development of novel solutions and services, driving further industry innovation (Jiang et al., 2022; Li et al., 2021). Innovation, fintech, and AI are interconnected and mutually reinforcing. Fintech uses AI to drive financial services innovation, while AI enhances fintech's capabilities, driving further industry growth. This combination makes financial services more accessible, efficient, and personalized, shaping the future of money management. AI and fintech have significantly impacted financial services, automation, and customer experiences. AI technologies like machine learning and big data analytics have developed intelligent solutions, enhancing banking industry competitiveness (Dwivedi et al., 2021). Fintech adoption promotes corporate innovation, but AI automation raises concerns about job displacement and inequality (Acemoglu & Restrepo, 2019; Li et al., 2021).

The impact of AI, innovation, and fintech on employment and sustainable development is expected to continue, with the integration of blockchain and AI potentially humanizing the AI economy. However, challenges like job displacement and resistance to innovation need to be addressed. The future of AI and fintech will depend on factors like demand dynamics, sustainable development goals, and the integration of emerging technologies (Bessen, 2018; Farahani et al., 2022; Jiang et al., 2022; Kazachenok et al., 2023; Sun et al., 2022).

Innovation, AI, and fintech are rapidly changing the world, transforming our lives, work, and business. Innovation drives economic growth and social progress, while AI automates tasks and improves decision-making in finance, healthcare, and transportation. Fintech, using AI, blockchain, and other technologies, improves financial services by making them more accessible, efficient, and personalized. These advancements disrupt traditional industries and significantly impact money management.

10.5824/ajite.2023.04.002.x

2. METHOD

The data includes the Global Innovation Index (GII), Fintech Index, and AI Index. Countries with data in these indexes were compared, while those without data were not (AI Index Steering Committee, 2023; Hussein Kassim et al., 2021; WIPO, 2022). Orange and Quasar data mining analysis tools were used to compare 51 countries meeting these conditions, ensuring comprehensive analysis of innovation, fintech, and AI (Demšar et al., 2013; Hartigan & Wong, 1979; Lloyd, 1982; Steinley, 2006; Toplak et al., 2017, 2021).

Table 1: Countries' index scores

Countries	Innovation Score	Fintech Score	AI Score
Argentina	28,60	2,69	17,50
Australia	47,10	13,73	30,90
Austria	50,20	5,25	27,70
Belgium	46,90	4,61	26,60
Brazil	32,50	8,16	22,10
Canada	50,80	10,26	40,30
Chile	34,00	2,93	20,20
China	55,30	8,07	61,50
Colombia	29,20	3,07	17,80
Denmark	55,90	6,08	30,50
Egypt	22,70	0,67	16,90
Estonia	50,20	10,45	26,00
Finland	56,90	8,30	34,90
France	55,00	5,93	32,80
Germany	57,20	11,12	39,20
Greece	34,50	1,42	18,30
Hungary	39,80	2,53	20,70
India	36,60	5,90	31,40
Indonesia	27,90	3,13	18,20
Ireland	48,50	6,36	28,80
Israel	50,20	19,41	40,00
Italy	46,10	4,15	26,50
Japan	53,60	6,05	33,90
Kenya	22,80	4,48	8,30
Lithuania	37,40	11,11	19,70
Luxembourg	49,80	5,33	29,20
Malaysia	38,70	3,04	19,60
Malta	49,10	3,39	22,40
Mexico	31,00	4,44	16,90
New Zealand	47,20	4,52	21,60
Nigeria	16,90	1,46	9,30
Norway	48,80	5,64	26,40
Pakistan	23,00	0,32	10,10
Poland	37,50	4,17	24,80
Portugal	42,10	4,33	23,70
Russia	34,30	6,13	23,70
Saudi Arabia	33,40	0,87	23,30
Singapore	57,30	15,83	49,70
Slovakia	34,30	1,24	17,10
Slovenia	40,60	2,53	21,50
South Africa	29,80	3,13	14,10
South Korea	57,80	5,28	40,30
Spain	44,60	7,67	27,70
Sweden	61,60	13,14	30,30
Switzerland	64,60	14,95	37,70
Tunisia	27,90	0,81	13,70
Türkiye	38,10	3,64	20,60
United Kingdom	59,70	38,71	41,80
Uruguay	29,20	6,58	16,30
United States	61,80	69,15	100,00
Vietnam	34,30	0,69	18,00

The study analyzes the effects of innovation, AI, and fintech on each other using the k-Means clustering algorithm, focusing on the GII, AI, and fintech indexes in selected countries, based on their total score data and their impact on each other.

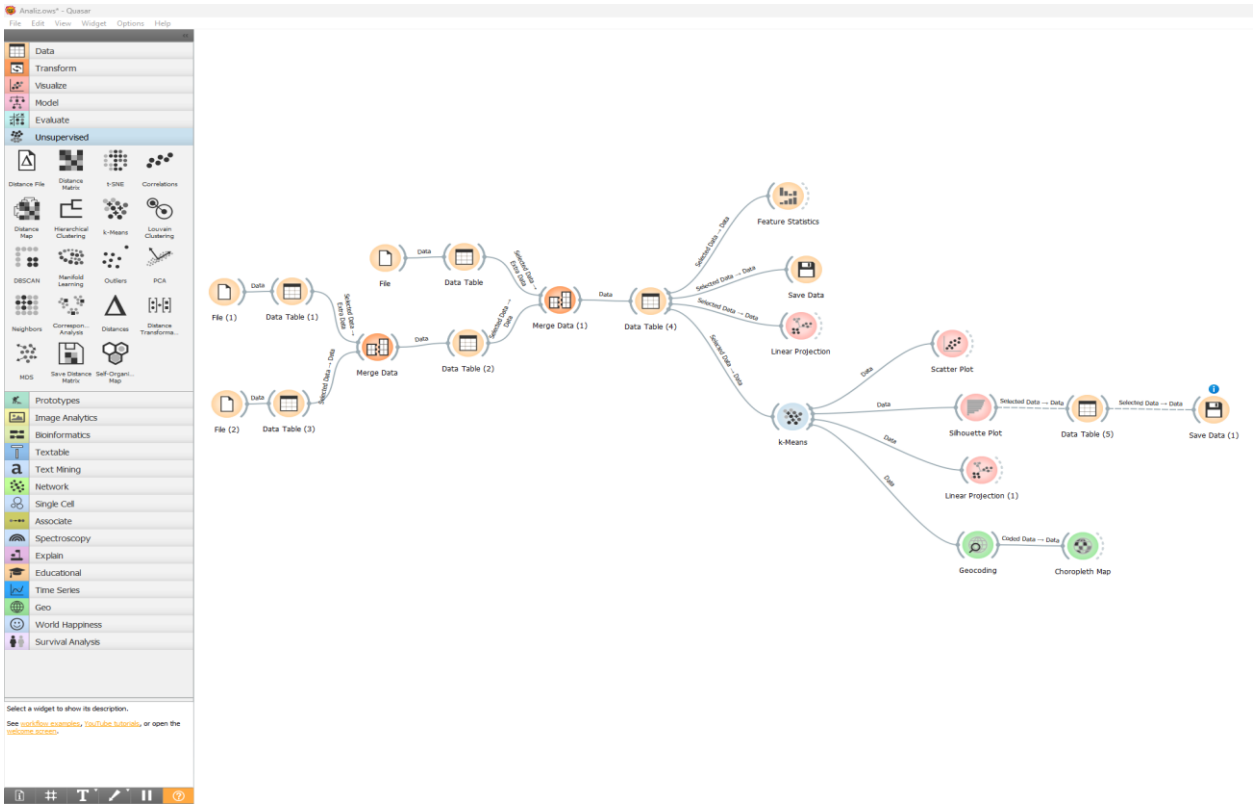

Figure 1: Analysis workflow

The k-Means clustering algorithm is a widely used method for partitioning data into clusters, developed over the past fifty years. It aims to minimize variance within each cluster by assigning data points to the nearest centroid and updating the centroids based on newly assigned points. The algorithm has been extensively studied and has applications in computer science and computer vision. It is an iterative algorithm that repeats steps until it converges to a solution. The best way to choose the number of clusters is experiment with different values (Demšar et al., 2013; Hartigan & Wong, 1979; Lloyd, 1982; Steinley, 2006; Toplak et al., 2017, 2021).

3. FINDINGS

The analysis of index-based data results are detailed below.

Feature Statistics

Feature statistics offer a swift method to analyze and discover intriguing aspects within a particular data set (Demšar et al., 2013; Toplak et al., 2017, 2021).

AJIT-e Academic Journal of Information Technology
2023 Fall/Güz – Cilt/Vol: 14 - Sayı/Issue: 55
10.5824/ajite.2023.04.002.x

Table 2: Feature statistics of the indexes

Index Score	Distribution	Mean	Mode	Median	Dispersion	Min.	Max.	Türkiye
GII Score		42.42	34.3	42.1	0.28	16.9	64.60	38.1
AI Score		27.3	16.9	23.7	0.53	8.3	100.0	20.6
Fintech Score		7.7	0.32	5.25	1.38	0.32	69.15	3.64

According to the GII, Türkiye ranks 37th among 128 countries with a score of 38.1. The highest score in this index is 64.60 for Switzerland and the lowest score is 11.60 for Guinea. According to the Fintech Index, Türkiye ranks 40th among 83 countries with a score of 3.64. The highest score is 69.15 for the United States and the lowest score is 0.12 for Ethiopia. According to the AI index, Türkiye ranks 40th out of 62 countries with a score of 20.6. The highest score is 100 for the United States and the lowest score is 8.3 for Kenya (AI Index Steering Committee, 2023; Hussein Kassim et al., 2021; WIPO, 2022).

k-Means Clustering Algorithm Results

The analysis visualization analysis is based on the three clusters, as the highest cluster analysis score is based on these clusters.

Table 3: k-Means Clustering Algorithm Results Table

Countries	Cluster	Silhouette	Silhouette (Cluster)	Innovation Score	Fintech Score	AI Score
Portugal	C1	0.578926	0.261295	42.1	4.3266	23.7
Slovenia	C1	0.633511	0.457302	40.6	2.5344	21.5
Hungary	C1	0.648972	0.517547	39.8	2.5335	20.7
Malaysia	C1	0.664567	0.580557	38.7	3.0442	19.6
Turkey	C1	0.667312	0.587789	38.1	3.6397	20.6
Poland	C1	0.65017	0.486343	37.5	4.1687	24.8
Lithuania	C1	0.625582	0.4692	37.4	11.1071	19.7
India	C1	0.591907	0.208858	36.6	5.8972	31.4
Greece	C1	0.69367	0.700759	34.5	1.4150	18.3
Russia	C1	0.672419	0.591187	34.3	6.1321	23.7
Slovakia	C1	0.693853	0.701674	34.3	1.2353	17.1
Vietnam	C1	0.692688	0.698004	34.3	0.6931	18.0
Chile	C1	0.694028	0.696908	34.0	2.9256	20.2
Saudi Arabia	C1	0.683041	0.632816	33.4	0.8670	23.3
Brazil	C1	0.673727	0.61618	32.5	8.1635	22.1
Mexico	C1	0.699906	0.728954	31.0	4.4369	16.9
South Africa	C1	0.698583	0.716187	29.8	3.1264	14.1
Colombia	C1	0.701506	0.734159	29.2	3.0666	17.8
Uruguay	C1	0.692769	0.702144	29.2	6.5785	16.3
Argentina	C1	0.700963	0.731648	28.6	2.6924	17.5
Indonesia	C1	0.699269	0.72315	27.9	3.1308	18.2
Tunisia	C1	0.694999	0.701845	27.9	0.8136	13.7
Pakistan	C1	0.681017	0.635856	23.0	0.3242	10.1
Kenya	C1	0.677039	0.615172	22.8	4.4753	8.3
Egypt	C1	0.684894	0.65983	22.7	0.6688	16.9
Nigeria	C1	0.665437	0.573132	16.9	1.4600	9.3
Switzerland	C2	0.656042	0.539717	64.6	14.9513	37.7
Sweden	C2	0.657345	0.534085	61.6	13.1409	30.3
United Kingdom	C2	0.593488	0.335833	59.7	38.7072	41.8
South Korea	C2	0.660449	0.555149	57.8	5.2833	40.3
Singapore	C2	0.646885	0.489107	57.3	15.8284	49.7
Germany	C2	0.669416	0.587541	57.2	11.1183	39.2
Finland	C2	0.671482	0.597261	56.9	8.3042	34.9
Denmark	C2	0.662159	0.554342	55.9	6.0787	30.5
China	C2	0.618092	0.373877	55.3	8.0719	61.5
France	C2	0.665598	0.574335	55.0	5.9266	32.8
Japan	C2	0.664441	0.570863	53.6	6.0547	33.9
Canada	C2	0.655319	0.532557	50.8	10.2642	40.3
Austria	C2	0.631747	0.428918	50.2	5.2474	27.7
Estonia	C2	0.628538	0.397421	50.2	10.4462	26.0
Israel	C2	0.634171	0.470346	50.2	19.4050	40.0
Luxembourg	C2	0.635633	0.452731	49.8	5.3288	29.2
Malta	C2	0.560432	0.138459	49.1	3.3850	22.4
Norway	C2	0.612117	0.347424	48.8	5.6358	26.4
Ireland	C2	0.626066	0.415053	48.5	6.3565	28.8
New Zealand	C2	0.52273	-0.00292644	47.2	4.5163	21.6
Australia	C2	0.617892	0.395545	47.1	13.7292	30.9
Belgium	C2	0.576354	0.238898	46.9	4.6149	26.6
Italy	C2	0.552852	0.168591	46.1	4.1538	26.5
Spain	C2	0.552284	0.168996	44.6	7.6700	27.7
United States	C3	0.5	0	61.8	69.1513	100.0

AJIT-e Academic Journal of Information Technology
2023 Fall/Güz – Cilt/Vol: 14 - Sayı/Issue: 55
10.5824/ajite.2023.04.002.x

The Silhouette Plot widget provides a visual representation of data consistency within clusters, assessing cluster quality using a silhouette score. A score close to 1 indicates the data's center, while scores close to 0 indicate the border between clusters. Euclidean formula was used.

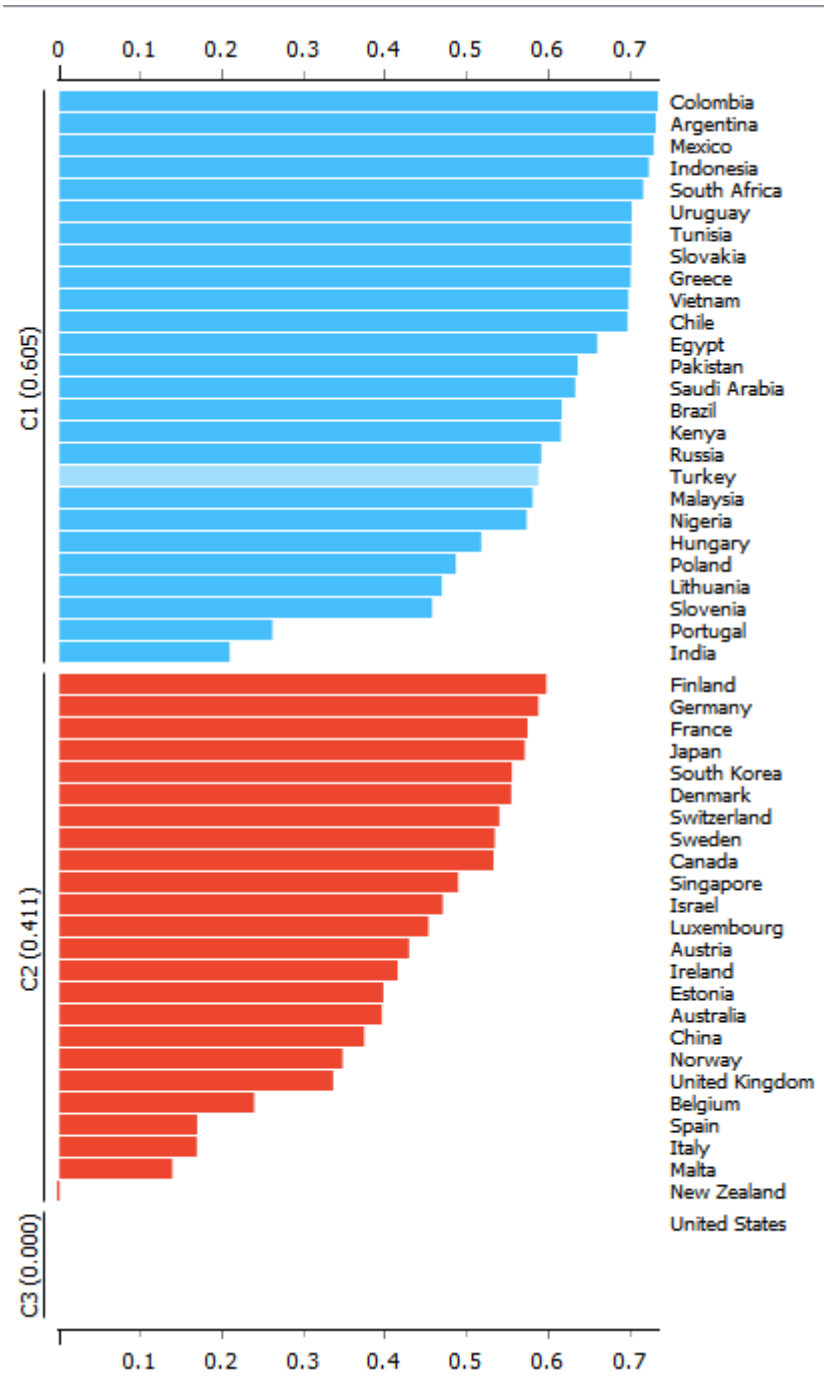

Figure 2: k-Means Clustering Algorithm Results (3 clusters)

According to the k-Means best clustering result, 51 countries are divided into 3 clusters. America is a cluster on its own. The second cluster is dominated by European countries.

Countries such as Türkiye, Russia, Poland, Kenya, Kenya, Malaysia, Nigeria and Hungary form the third cluster group.

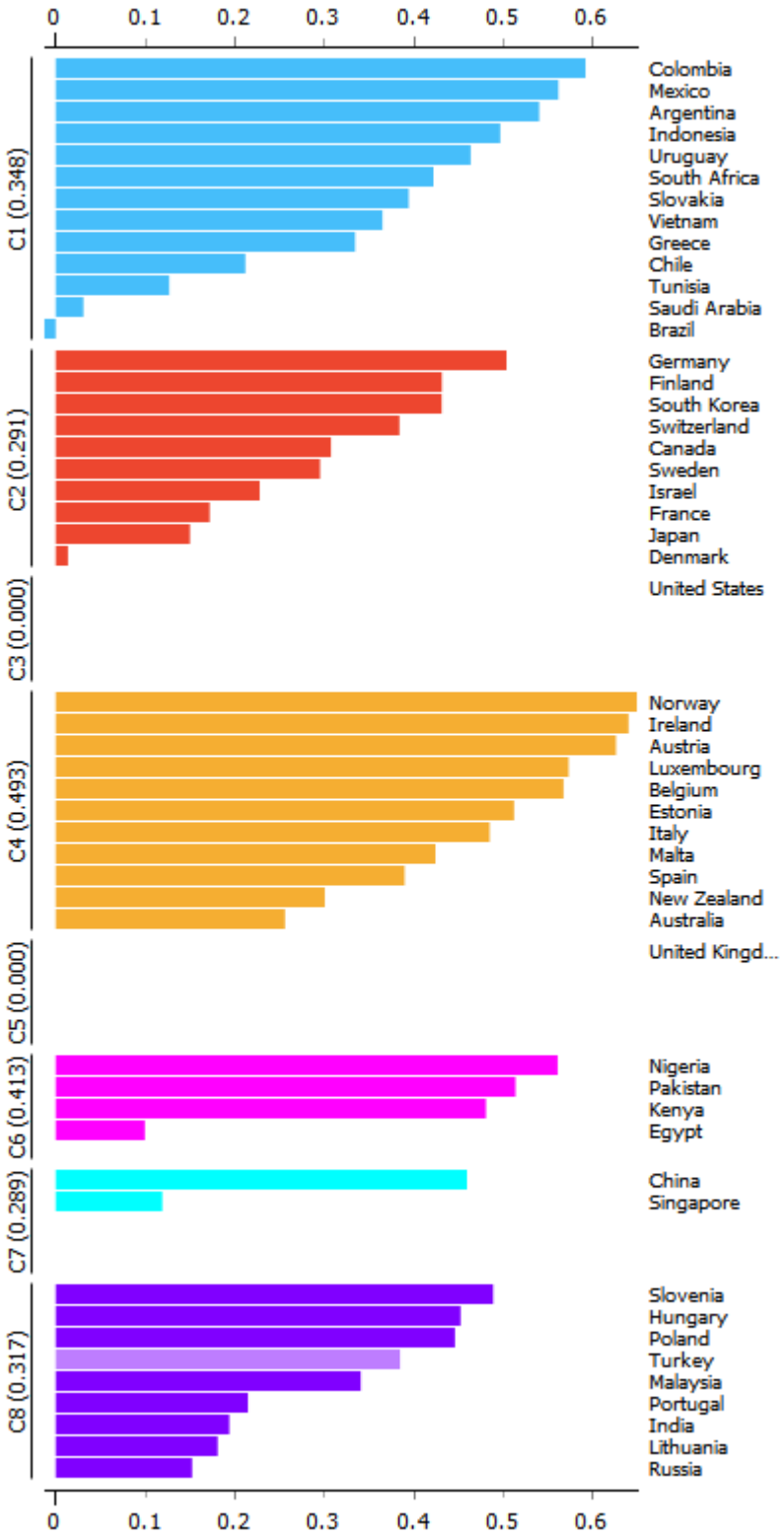

Figure 3: k-Means Clustering Algorithm Results (8 clusters)

10.5824/ajite.2023.04.002.x

8 clusters were formed by manually directing the k-Means clustering algorithm. According to this clustering result, Türkiye is in the same cluster with Slovenia, Hungary, Malaysia, Portugal, India, Lithuania and Russia. Again, America is a cluster on its own. While China and Singapore are separated as another cluster, two different clusters emerge from European countries. South America forms a cluster on its own.

Linear Projection Method

A linear projection method with explorative data analysis. The linear projection method is a technique used for dimensionality reduction, which aims to discover compact representations of high-dimensional data. Unlike clustering methods, the linear projection method maps the input data into a single global coordinate system of lower dimensionality. This method, specifically the locally linear embedding (LLE) algorithm, is able to learn the global structure of nonlinear manifolds by exploiting the local symmetries of linear reconstructions. LLE computes low-dimensional embeddings that preserve the neighborhood relationships of the high-dimensional inputs (Roweis & Saul, 2000). It is capable of discovering the nonlinear degrees of freedom underlying complex observations, such as images of faces or human handwriting. The linear projection method efficiently computes a globally optimal solution and is guaranteed to converge asymptotically to the true structure for certain data manifolds. This technique has applications in various fields, including data analysis, visualization, and perception (Tenenbaum et al., 2000). The linear projection method can be a useful tool for dimensionality reduction, but it is important to note that it can also introduce some bias into the data set. It displays linear projections of class-labeled data. It supports various types of projections such as circular, linear discriminant analysis, and principal component analysis (Boulesteix & Strimmer, 2006; Koren & Carmel, 2003; Leban et al., 2006).

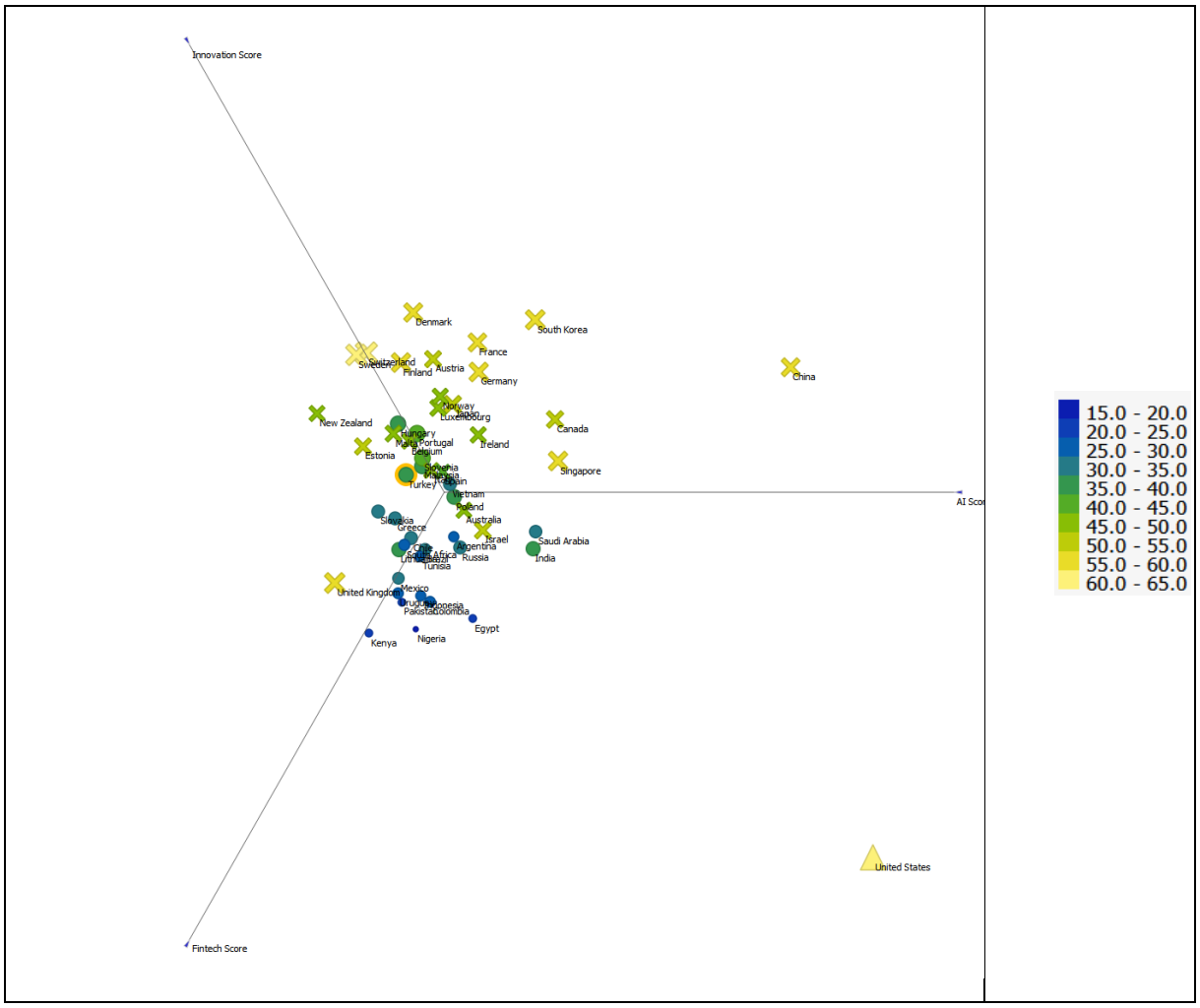

Figure 4: Linear projection of countries clustered according to the GII index

When linear projection analysis is performed according to the GII index, Türkiye is located in the cluster shown in green color and round shape. Türkiye has an average linear projection in this analysis. Countries such as the United States, the United Kingdom, China, Korea, France, Denmark, Singapore and Canada are at important points in this analysis.

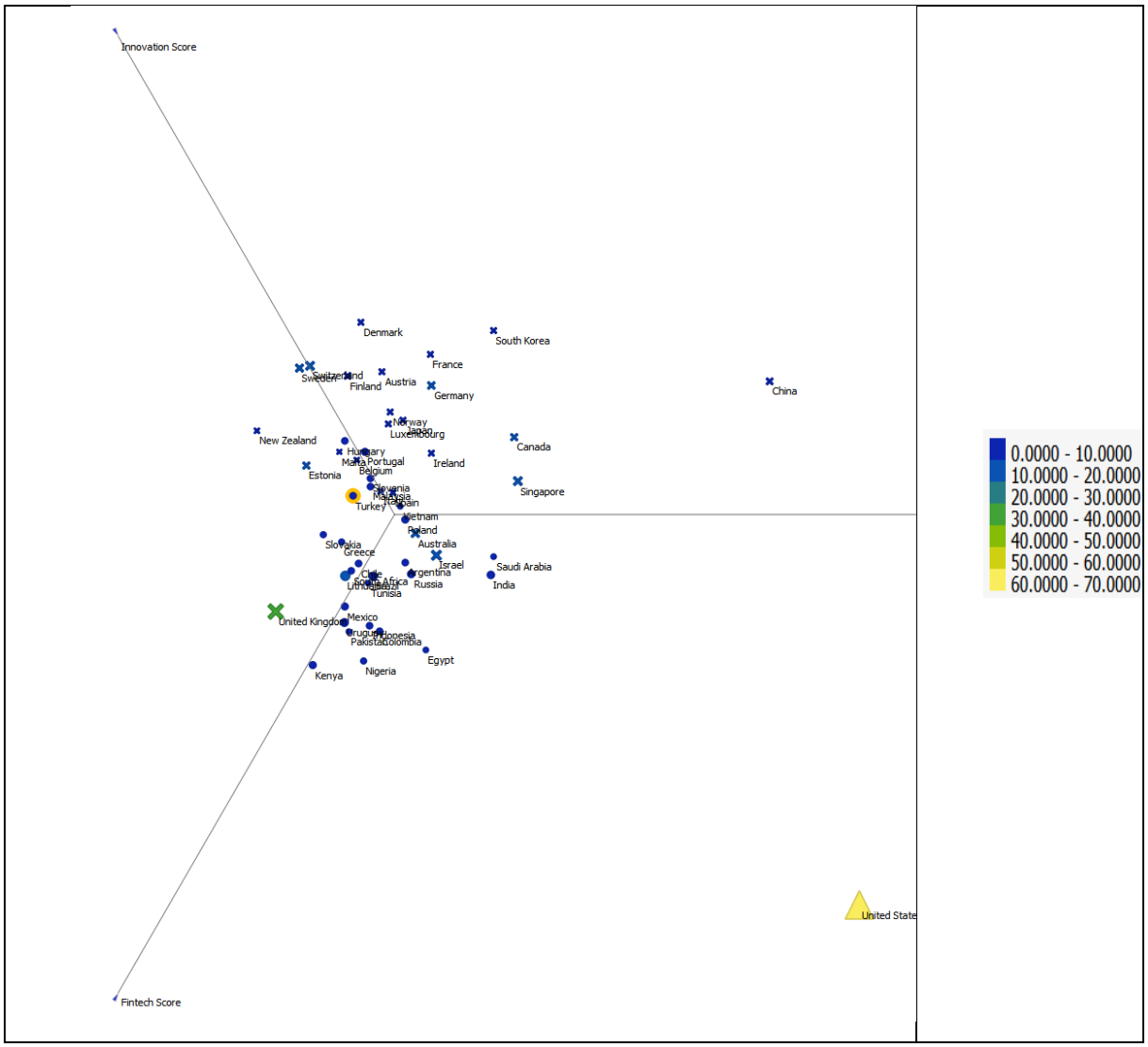

Figure 5: Linear projection of countries clustered according to the Fintech index

When linear projection analysis is performed according to the Fintech index, Türkiye ranks at the lower levels, while the UK and the US are far ahead of other countries in this field.

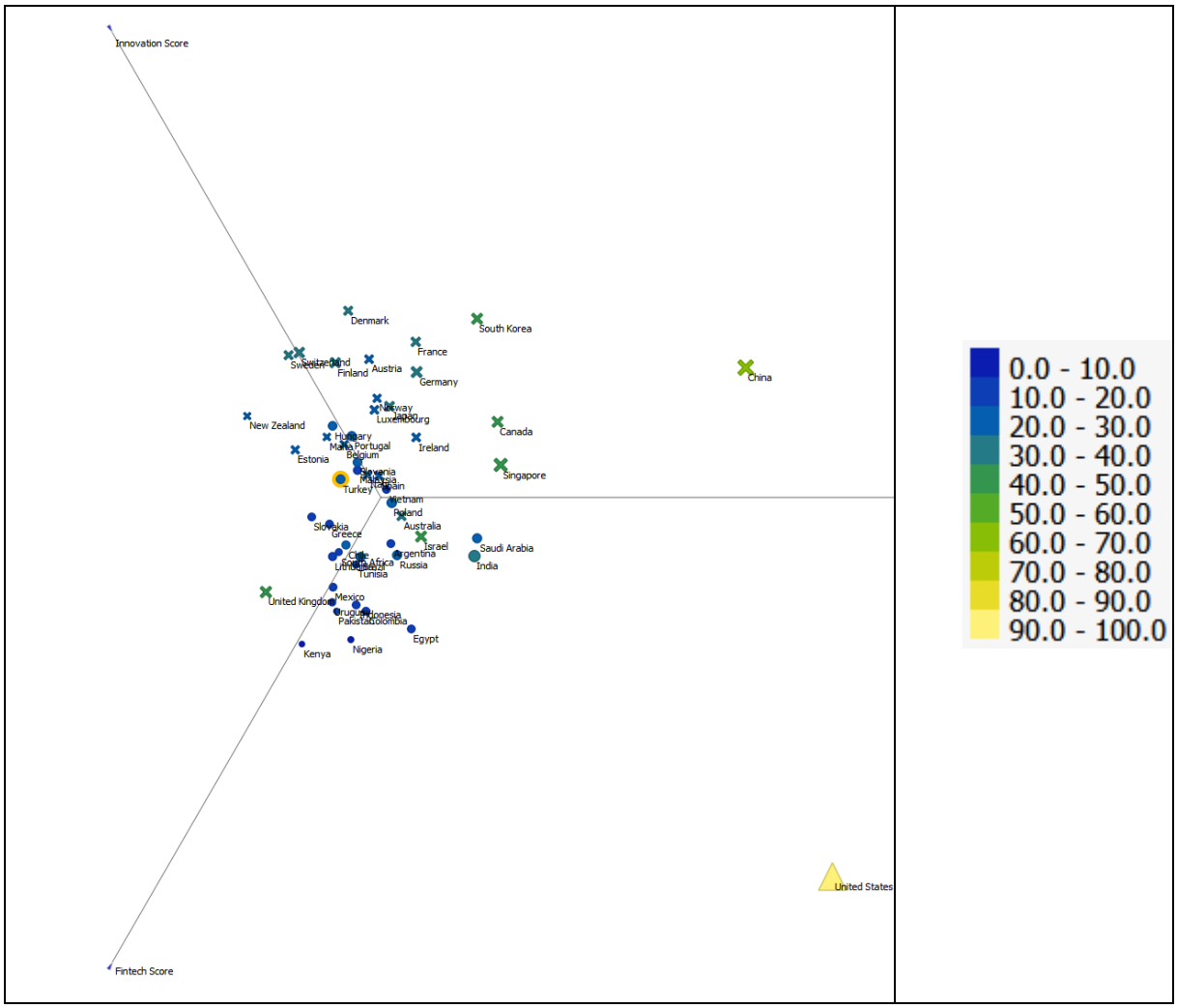

Figure 6: Linear projection of countries clustered according to the AI index

When linear projection analysis is made according to the AI index, Türkiye is at the lower levels, while China and the United States are ahead of other countries in this field. These countries are followed by Singapore, Canada, the UK, and Korea.

10.5824/ajite.2023.04.002.x

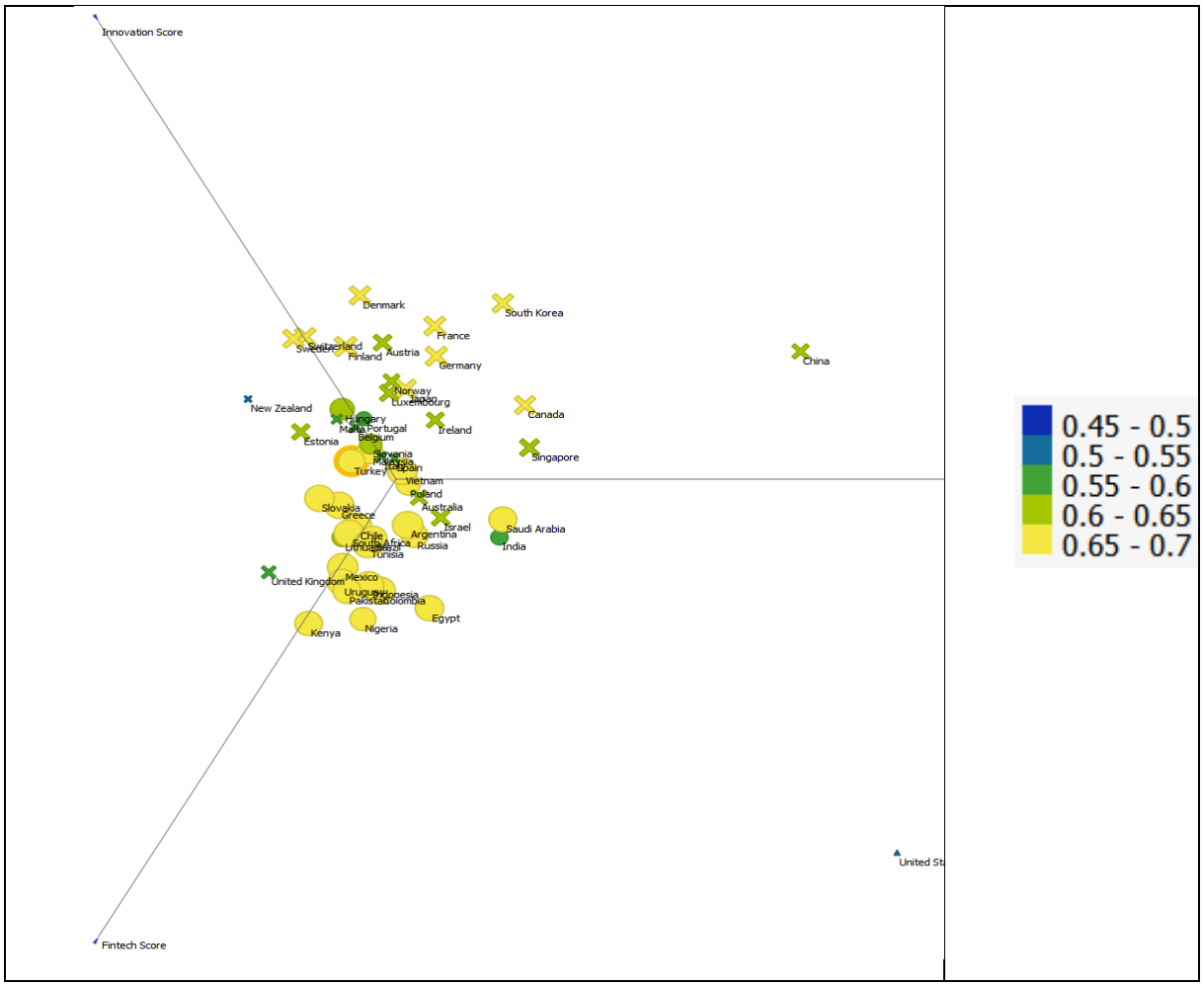

Figure 7: Linear projection of countries clustered according to three indexes

According to the 3 indexes, when linear projection analysis is performed, Türkiye is located in the middle and in the fintech and innovation zone. New Zealand, the UK, and Estonia stand out in this region. America is a cluster that differs from all other countries by being in the AI and fintech region. In the AI and innovation region, countries such as China, Singapore, Korea, Canada, Germany, Denmark, and France stand out.

Geocoding and Choropleth Visualization

The study utilized two geographic information systems from orange data mining tools: Geocoding and Choropleth. Geocoding extracts latitude/longitude pairs from region names or synthesizes them to return region names. Choropleth visualizes measurement variability across a geographic area or within a region, with various levels of granularity available. These tools classify and display color-coded clusters of countries compared in indexes, allowing for better understanding and comparison of different regions (Demšar et al., 2013; Toplak et al., 2017, 2021).

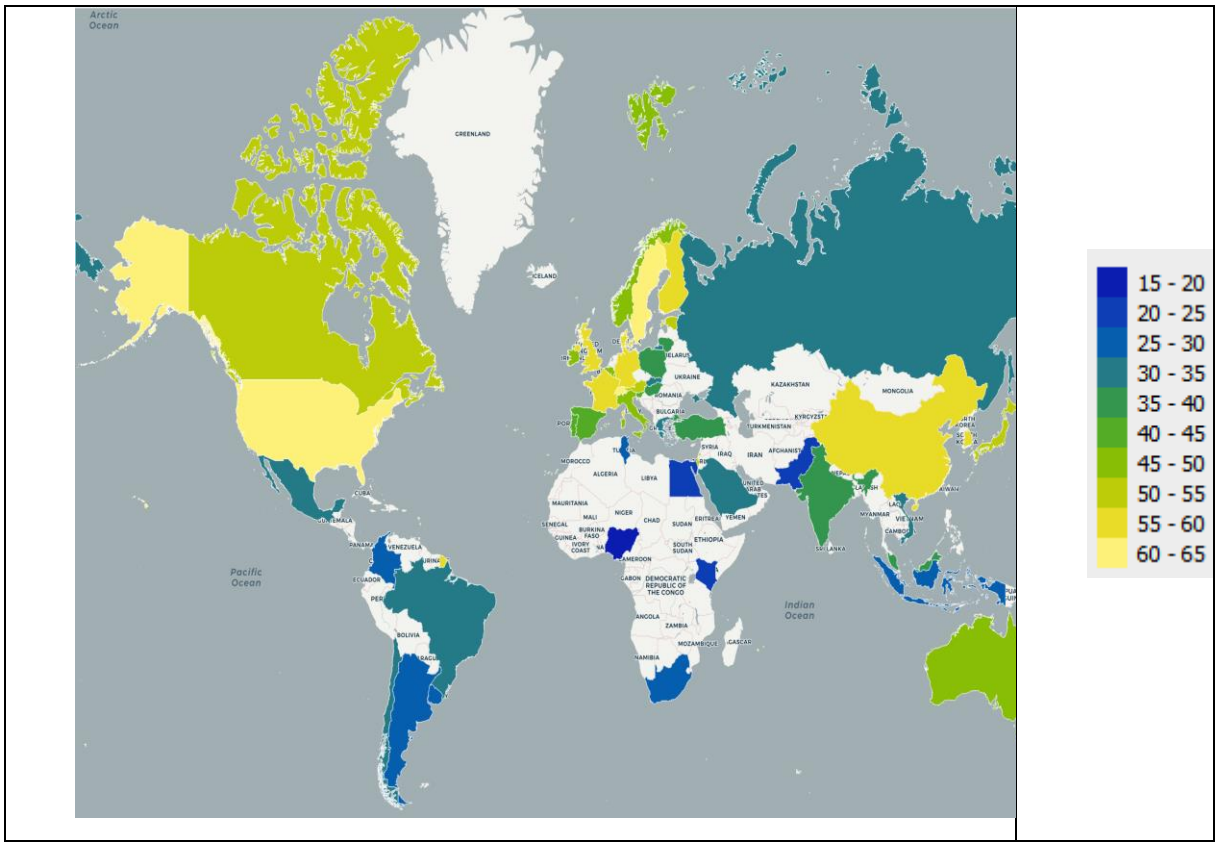

Figure 8: Clustered countries on a world map according to the GII index

The map displays countries grouped by the GII index, with Türkiye being among the dark green clusters, ranging from 35-40 points.

Türkiye's place in the GII is a topic of interest in academic research. Several studies have examined the innovation performance of Türkiye in comparison to other countries. (Kaynak et al., 2017) compared the innovation performance of four EU candidate countries, including Türkiye, using the entropy-based Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) approach. They found that Türkiye's innovation performance was comparable to other candidate countries (Kaynak et al., 2017). Additionally, (Çınar et al., 2020) conducted empirical research on Turkish export companies and found that innovation activities had a positive effect on firm performance (Çınar et al., 2020). These studies suggest that Türkiye has made efforts to improve its innovation performance and that innovation activities have a positive impact on the country's firms. However, further research is needed to provide a comprehensive ranking of Türkiye's place in the GII. Türkiye's ranking in the GII has improved significantly in recent years. In 2022, Türkiye ranked 37th out of 132 countries, up from 49th in 2016. This is the highest-ranking Türkiye has ever achieved in the GII.

Türkiye's innovation ranking improved in 2022 due to increased government investment in R&D, a growing number of startups, a strong education system, a favorable business environment, low taxes, and a supportive government. However, challenges include a high brain drain, lack of access to finance, and weak intellectual property protection. Despite these obstacles, Türkiye is well-positioned to continue improving its ranking in the GII, with continued investment, strong startup ecosystem, and supportive government.

AJIT-e Academic Journal of Information Technology
2023 Fall/Güz – Cilt/Vol: 14 - Sayı/Issue: 55
10.5824/ajite.2023.04.002.x

Figure 9: Clustered countries on a world map according to the fintech index

The Fintech index shows Türkiye in a dark blue country cluster, with America at the top and the UK in a remarkable position.

Türkiye holds a significant position in the fintech index due to its strong banking system and high adoption of technology. The country has made remarkable progress in increasing financial inclusivity through fintech solutions, particularly in providing contactless payment and contract systems, microfinance, and improving payment systems with educational content on responsible consumption (Bayram et al., 2022). Türkiye's potential for fintech growth is further highlighted by its role as a hub for Islamic fintech (Ahmad & Mamun, 2020) The country's collaboration between the banking and fintech sectors, as well as regulatory institutions, has facilitated the emergence of fintech solutions utilizing technologies such as Big Data, AI, and blockchain. With upcoming developments like the sandbox environment in Istanbul Financial Center, Türkiye is poised to further accelerate fintech innovation and address climate-related financial risks (Bayram et al., 2022). Overall, Türkiye's position in the fintech index is characterized by its potential for sustainable finance, financial inclusivity, and Islamic fintech growth.

Türkiye has been ranked 16th in the 2023 Global Fintech Index, up from 20th in 2022. The index is compiled by the Global Fintech Index Foundation and ranks countries on a number of factors, including the size of their fintech ecosystem, the number of fintech startups, the level of government support for fintech, and the regulatory environment for fintech. Türkiye's improved ranking is a reflection of the growing importance of fintech in the Turkish economy.

The Turkish fintech ecosystem is home to over 1,000 startups, and the government has been supportive of fintech development, providing tax breaks and other incentives to startups. The regulatory environment for fintech in Türkiye is also becoming more favorable, with the government recently passing legislation that is designed to make it easier for fintech companies to operate in the country (Hussein Kassim et al., 2021).

The growth of fintech in Türkiye is being driven by a number of factors, including the country's young and tech-savvy population, its growing middle class, and its high demand for financial services. Fintech companies in Türkiye are developing a variety of innovative products and services that are tailored to the needs of Turkish consumers, such as mobile payment apps, peer-to-peer lending platforms, and online investment platforms. The growth of fintech in Türkiye is expected to continue in the coming years. The Turkish government has set a goal of becoming a regional fintech hub, and the country has the potential to become a major player in the global fintech industry.

Türkiye's young, tech-savvy population and growing middle class make it an ideal market for fintech innovation. The government supports fintech development with tax breaks and incentives. The favorable regulatory environment is making it easier for fintech companies to operate. This growth positively impacts the Turkish economy, creating jobs, driving innovation, and positioning Türkiye as a regional fintech hub.

Figure 10: Clustered countries on a world map according to the AI index

The AI index shows Türkiye among light blue countries with scores 20-30, with the United States and China at the top.

AJIT-e Academic Journal of Information Technology
2023 Fall/Güz – Cilt/Vol: 14 - Sayı/Issue: 55
10.5824/ajite.2023.04.002.x

Türkiye ranked 43rd in the 2023 Global AI Index, which is a ranking of 62 countries based on their investment, innovation, and implementation of AI. Türkiye's ranking improved from 48th in 2022, which is a sign that the country is making progress in the field of AI (AI Index Steering Committee, 2023).

Türkiye's strengths in AI include a strong academic base, growing AI startups, a supportive government policy environment, a shortage of skilled AI talent, lack of large datasets, and a regulatory environment that is not yet fully supportive. However, challenges such as a lack of skilled talent, data, and a regulatory framework need to be addressed to become a leading AI hub in the region.

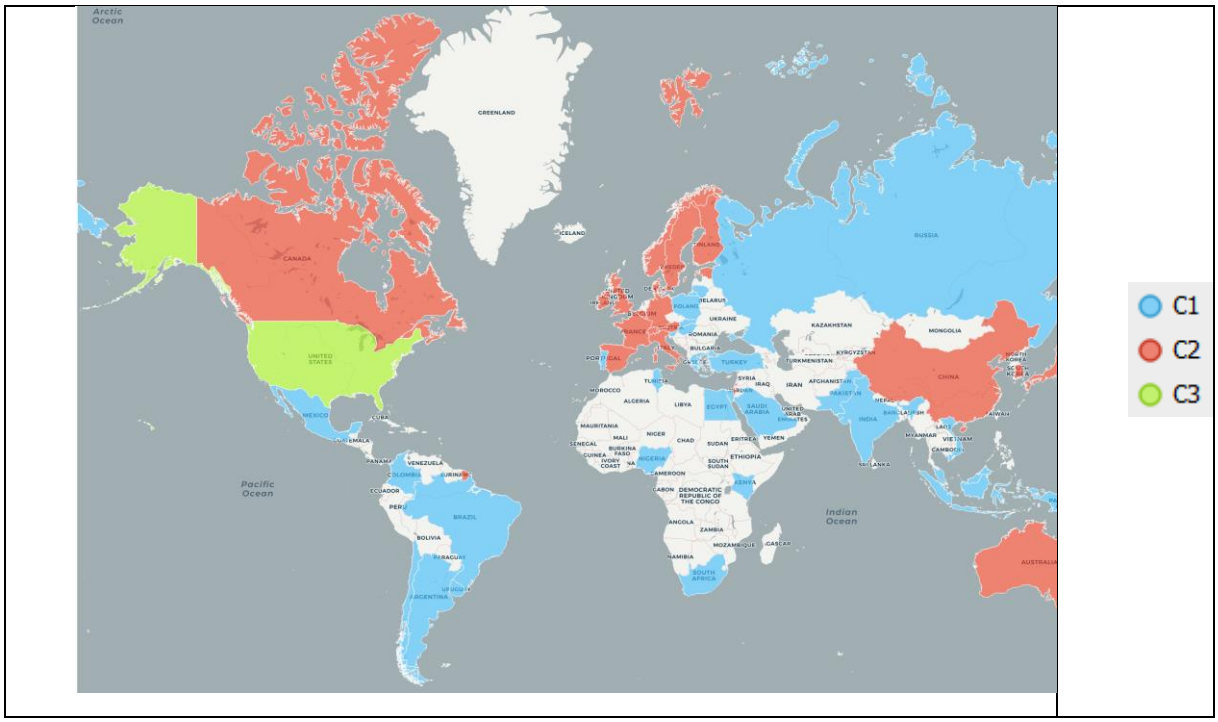

Figure 11: Clustered countries on a world map according to three indexes

As a result of the clustering analysis, the group of countries including Türkiye is shown in the same color in the map above. Türkiye is in the light blue cluster group, followed by America in the green group, followed by European countries, Japan, and China in the red group.

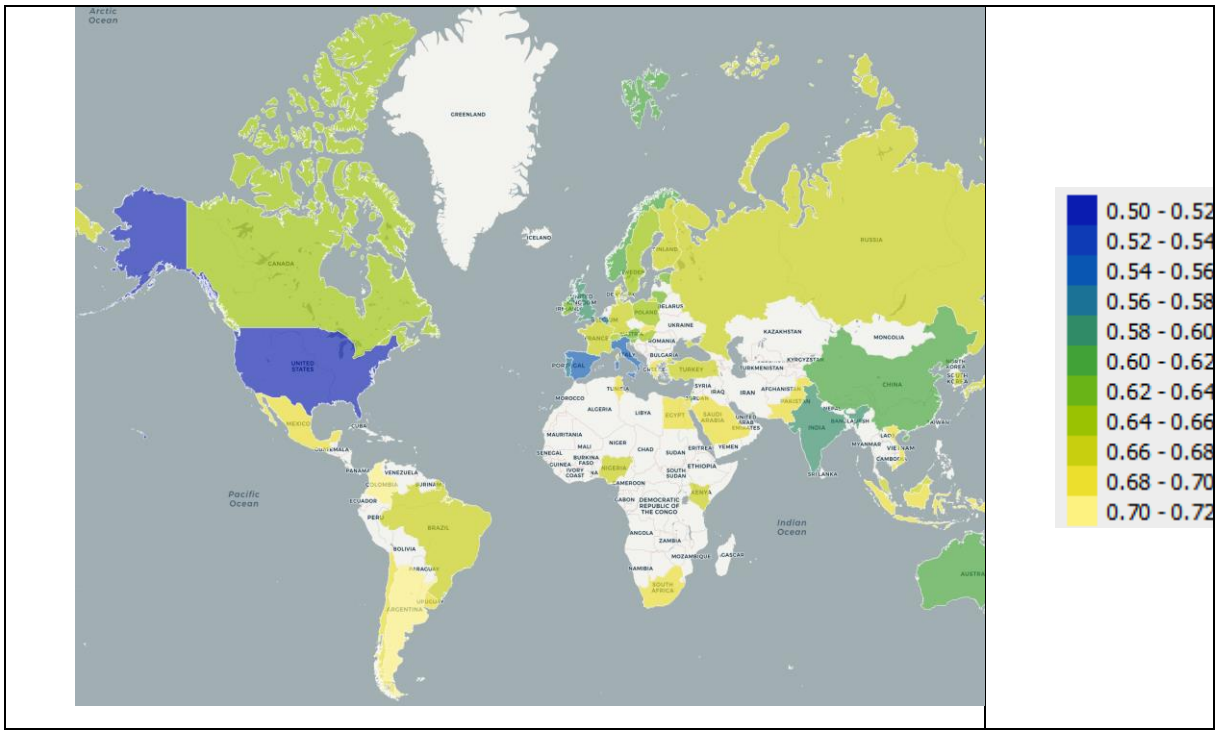

Figure 12: Clustered countries on a world map according to three indexes (Silhouette)

As a result of the clustering analysis, the group of countries including Türkiye is shown in the same color in the map above. The map displays countries clustered based on silhouette clustering scores, with Türkiye, in the 0.66- 0.70. range, America is in the range of 0.50-0.52 and Portugal, Spain and Italy are in the range of 0.56-0.58.

10.5824/ajite.2023.04.002.x

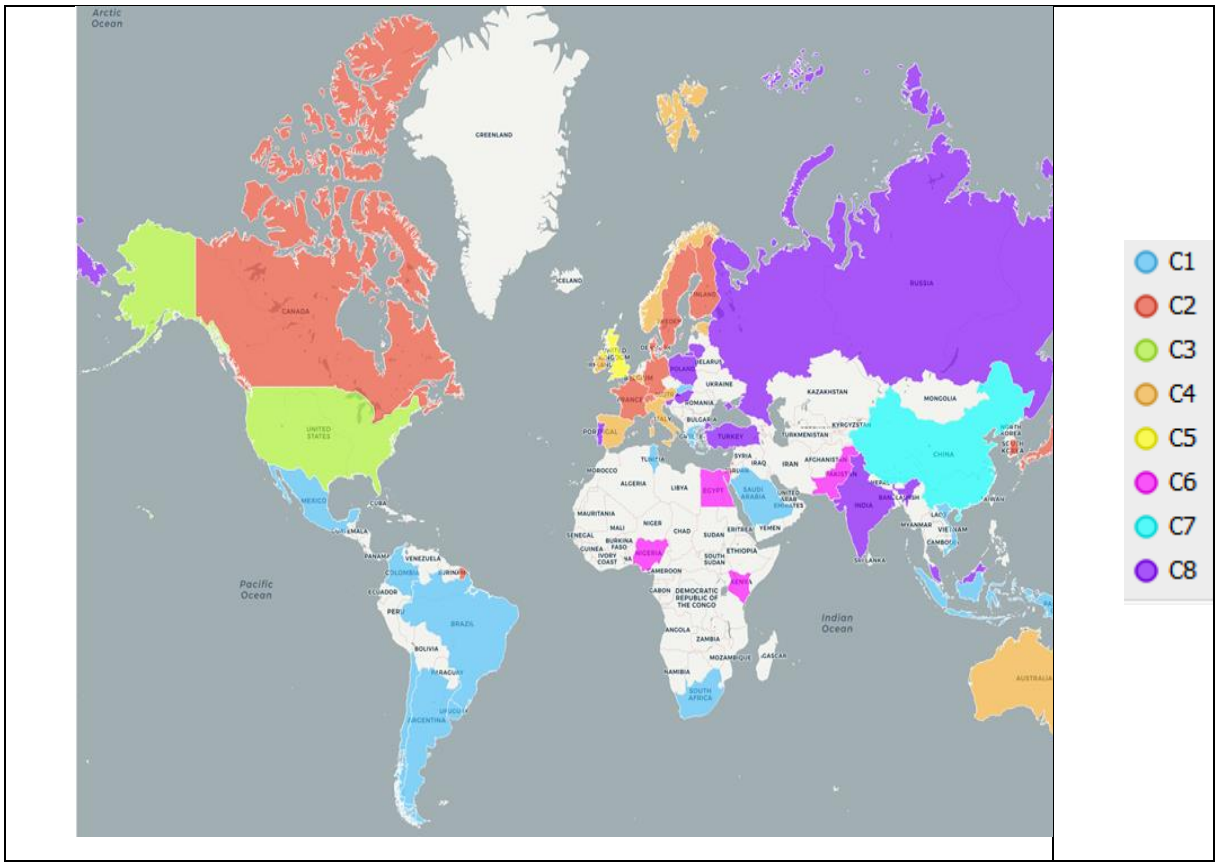

Figure 13: Clustered countries on a world map according to eight indexes

As a result of the clustering analysis, the group of countries including Türkiye is shown in the same color in the map above. The map displays countries grouped by eight indexes, with Türkiye in the purple cluster alongside Poland, Russia, Hungary, and India.

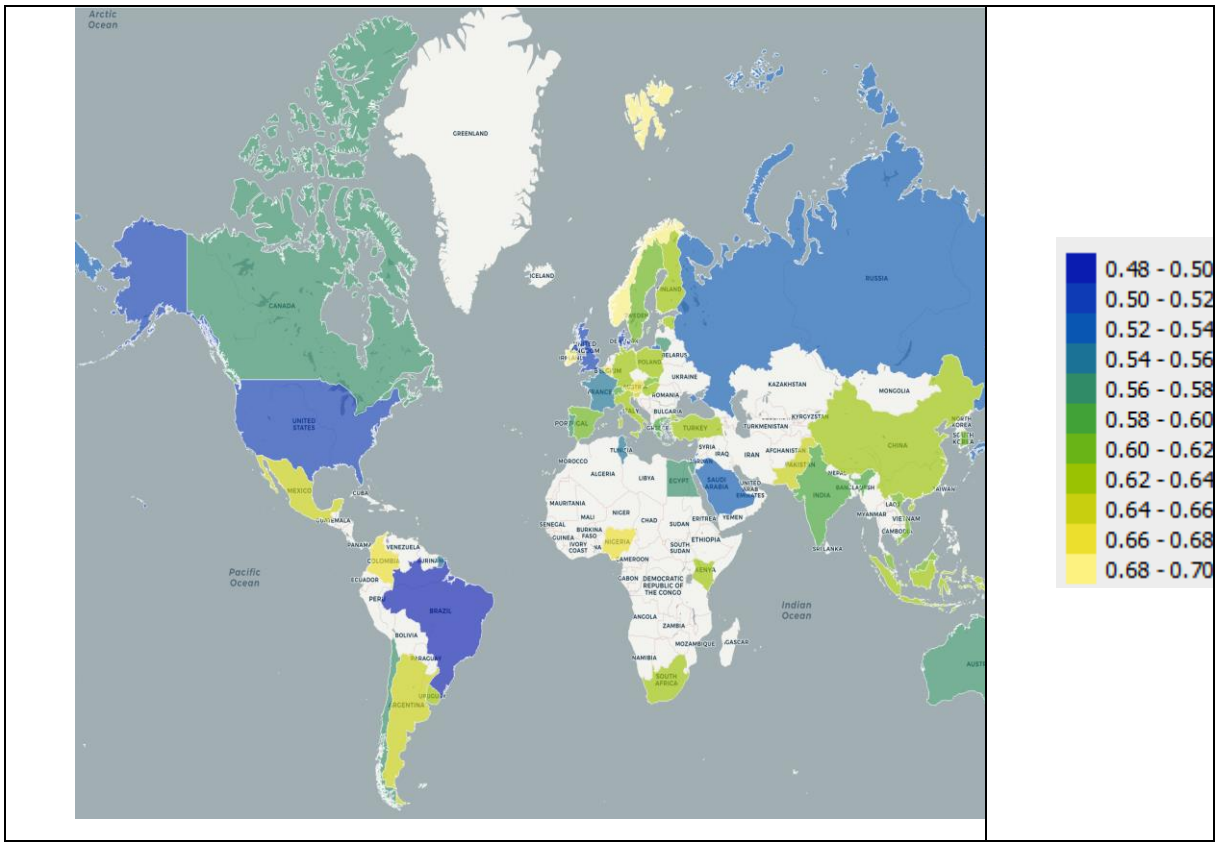

Figure 14: Clustered countries on a world map according to eight indexes (Silhouette)

As a result of the clustering analysis, the group of countries including Türkiye is shown in the same color in the map above. Türkiye is part of a cluster with countries like Poland, Finland, Spain, Italy, and the Philippines, based on silhouette clustering scores ranging from 0.62 to 0.64.

CONCLUSION AND DISCUSSION

To enhance productivity for innovation in Türkiye, several factors can be considered. Firstly, fostering a learning orientation within companies can have a positive impact on product innovation performance (Calisir et al., 2013). This includes promoting commitment to learning, shared vision, and open-mindedness. Secondly, the effects of social ties on innovation behavior and new product performance should be taken into account (Yeniaras et al., 2020). Building strong interpersonal ties and leveraging political ties can influence the direction and success of innovation efforts. Additionally, organizational culture plays a crucial role in facilitating radical product innovation (Naranjo-Valencia et al., 2017). Cultivating an adhocracy culture, characterized by flexibility, risk-taking, creativity, and external orientation, can foster innovation. These factors should be considered in the context of Türkiye's emerging economy and the unique challenges it presents (Yeniaras et al., 2020). By addressing these aspects, Türkiye can create an environment conducive to productivity and innovation. To harness the power of innovation, Türkiye can focus on several key strategies. Firstly, fostering a culture of innovation within small and medium-sized enterprises (SMEs) is crucial. Research has shown that organizational culture and empowerment positively impact innovation capability. By promoting collectivism and uncertainty avoidance while reducing power

distance, SMEs can create an empowering work environment that encourages innovation. Secondly, Türkiye should prioritize investment in research, technological development, and innovation in SMEs. The SME Strategy and Action Plan of Türkiye emphasizes the importance of raising awareness about these areas and encouraging SMEs to invest in technology for a sustainable competitive edge. Furthermore, Türkiye can play a central role in the entrepreneurship ecosystem of the Balkan countries, particularly in terms of product innovation, risk capital, and high-growth enterprises. By fostering collaboration and cooperation with other Balkan countries, Türkiye can create opportunities for mutual growth and innovation. In summary, Türkiye can harness the power of innovation by promoting a culture of innovation within SMEs, investing in research and technology, and fostering collaboration with other countries in the region (Çakar & Ertürk, 2010; Tekin et al., 2021).

Türkiye, a country with a rich history of innovation dating back to the Ottoman Empire, has been falling behind in innovation in recent years. To catch up, Türkiye needs to harness the power of innovation in several ways. Firstly, it should increase its investment in R&D to attract and retain talented scientists and engineers. Secondly, it should create a supportive environment for startups, offering tax breaks and incentives to encourage entrepreneurs to start new businesses and develop innovative products and services. Thirdly, Türkiye should promote entrepreneurship in schools and universities to foster a culture of innovation and risk-taking. Lastly, Türkiye should open up to foreign investment, which can bring new ideas and technologies to the country. Lastly, the country should improve its education system to produce a more skilled workforce. Lastly, Türkiye should create a culture of innovation that encourages creativity and risk-taking, ensuring that the country remains a leader in the global economy. Türkiye can boost its technology sector by developing AI, robotics, and the Internet of Things, attracting foreign investment through a favorable regulatory environment and tax breaks. In the agriculture sector, Türkiye can improve crop yields and reduce water consumption by promoting sustainable practices. The tourism sector can also be improved by creating new products and services, improving infrastructure, and building new airports and hotels. To foster innovation, Türkiye should create a favorable regulatory environment by providing tax breaks and incentives to startups and businesses. Additionally, Türkiye can support innovation clusters by providing funding and resources to groups of businesses and organizations working together to develop new technologies. Türkiye can boost its technology sector by developing AI, robotics, and the Internet of Things, attracting foreign investment through a favorable regulatory environment and tax breaks. In the agriculture sector, Türkiye can improve crop yields and reduce water consumption by promoting sustainable practices. The tourism sector can also be improved by creating new products and services, improving infrastructure, and building new airports and hotels. To foster innovation, Türkiye should create a favorable regulatory environment by providing tax breaks and incentives to startups and businesses. Additionally, Türkiye can support innovation clusters by providing funding and resources to groups of businesses and organizations working together to develop new technologies.

Türkiye has the potential to harness the power of fintech to promote sustainable finance and financial inclusivity. According to (Bayram et al., 2022) Türkiye, as one of the largest emerging market economies with a strong banking system and high technology adoption, can

benefit from fintech solutions to boost sustainable finance. The country has made progress in increasing financial inclusivity through contactless payment systems, microfinance, and educational content on responsible consumption (Bayram et al., 2022).Additionally, Türkiye has emerged as a hub for Islamic fintech, with the rise of shariah-compliant Islamic fintech applications. The use of fintech has significantly benefited Islamic finance based on Islamic Shariah (Ahmad & Mamun, 2020).To further harness the power of fintech, a collaboration between the banking and fintech sectors, regulatory institutions, and the development of a sandbox environment can facilitate the emergence of fintech solutions using technologies like Big Data, AI, and blockchain (Bayram et al., 2022). Türkiye has the potential to leverage fintech to boost productivity and economic growth. With a young, growing population, high education level, a large middle class, and a supportive government, Türkiye can invest in infrastructure to support fintech development. This will make it easier for fintech companies to operate and consumers to access fintech products and services. A favorable regulatory environment is also crucial, ensuring clear, predictable, and easy-to-come-by regulations. Supporting fintech education and training will create a skilled workforce and raise awareness of fintech among consumers and businesses. Türkiye can promote fintech innovation by providing funding for startups, hosting fintech events, and connecting fintech companies with potential partners and investors. By implementing these strategies, Türkiye can harness the power of fintech to boost productivity and economic growth. The Turkish government can collaborate with fintech companies to create tailored financial products and services for Turkish businesses and consumers. For instance, a mobile payment app could be developed for all merchants in Türkiye. Tax breaks and incentives for fintech startups can attract investment and create jobs. A regulatory sandbox could be created for fintech companies to test new products in a controlled environment, reducing risk and speeding up development. This move could position Türkiye as a leader in fintech and reap the benefits of innovative technology.

Türkiye has the potential to harness the power of AI by adopting and implementing AI technologies in various sectors. The banking sector in Türkiye has effectively utilized AI to improve their overall services. Additionally, AI has been successfully applied in fields such as neuropsychiatry, ophthalmology, dairy farming, furniture design retailing and water quality assessment (Öztürk & Kula, 2021)in Türkiye. By embracing AI, Türkiye can benefit from increased productivity and efficiency in these sectors. Furthermore, the displacement effect caused by automation and AI can be counteracted by the productivity effect, which increases the demand for labor in non-automated tasks. This suggests that while AI may replace certain tasks, it can also create new labor-intensive tasks, thereby increasing the labor share and countering the impact of automation (Acemoglu & Restrepo, 2019).In conclusion, Türkiye can harness the power of AI by adopting AI technologies in various sectors, such as banking, healthcare, agriculture, and retail. This can lead to improved services, increased productivity, and the creation of new labor-intensive tasks.

Türkiye can leverage AI to boost its economy, enhance productivity, and create new jobs. To achieve this, the country should invest in R&D, including funding universities and research institutions, and provide incentives for businesses developing AI products and services. Educating the workforce in AI is crucial for creating a skilled workforce capable of working in AI-related jobs. This can be achieved through teaching AI in schools and universities, as well

as providing training programs for businesses and individuals. Creating a favorable regulatory environment, including laws protecting privacy and data security, and promoting innovation, is also essential. Partnering with AI-leading foreign companies can help Türkiye learn from their expertise and access their technology, accelerating the development of its own AI capabilities. AI can revolutionize various industries, including agriculture, healthcare, education, and manufacturing. It can automate tasks like planting, harvesting, and pest control, allowing farmers to focus on strategic work like marketing and sales. AI can also analyze data to improve crop yields and reduce costs. In healthcare, AI can diagnose diseases, develop new treatments, and provide personalized care. It can also schedule appointments and manage medical records, freeing doctors and nurses to focus on patient-facing tasks. In education, AI can personalize learning, provide feedback, and automate tasks, enhancing efficiency and effectiveness. In manufacturing, AI can automate tasks like quality control and assembly, allowing workers to focus on complex tasks like problem-solving and innovation. It can also optimize production processes and reduce costs. AI can revolutionize various industries, including agriculture, healthcare, education, and manufacturing. It can automate tasks like planting, harvesting, and pest control, allowing farmers to focus on strategic work like marketing and sales. AI can also analyze data to improve crop yields and reduce costs. In healthcare, AI can diagnose diseases, develop new treatments, and provide personalized care. It can also schedule appointments and manage medical records, freeing doctors and nurses to focus on patient-facing tasks. In education, AI can personalize learning, provide feedback, and automate tasks, enhancing efficiency and effectiveness. In manufacturing, AI can automate tasks like quality control and assembly, allowing workers to focus on more complex tasks like problem-solving and innovation. It can also optimize production processes and reduce costs.

Türkiye can leverage AI to enhance its economy, boost productivity, and create new jobs. By synchronizing innovation, fintech, and AI, the Turkish economy can adapt to the digital age effectively. Financial assets are more valuable than real assets, and fintech can help Türkiye access these assets. AI is a highly effective technology, and focusing on these areas will enable rapid progress in social and economic areas. To become a global power, Türkiye must focus on fintech, AI, and strong innovation. Effective innovation, strong financial markets, and a strong technological infrastructure are essential. China's transition from an imitation economy to an innovation economy has made it a world giant. Türkiye should imitate and then innovate, particularly in fintech and AI, while synchronizing these sectors. This will increase economic and social productivity, leading to Türkiye becoming a global power.

REFERENCES

Acemoglu, D., & Restrepo, P. (2019). *Automation and new tasks: How technology displaces and reinstates labor* (w25684; s. w25684). National Bureau of Economic Research. https://doi.org/10.3386/w25684

Aghion, P., Bloom, N., Blundell, R., Griffith, R., & Howitt, P. (2002). *Competition and innovation: An inverted u relationship* (w9269; s. w9269). National Bureau of Economic Research. https://doi.org/10.3386/w9269

Ahmad, S. A., & Mamun, A. A. (2020). Opportunities of Islamic FinTech: The Case of Bangladesh and Türkiye. *Cenraps Journal of Social Sciences*. https://doi.org/10.46291/cenraps.v2i3.39

AI Index Steering Committee. (2023). *Artificial Intelligence Index Report 2023 Introduction to the AI Index Report 2023*.

Anagnostopoulos, I. (2018). Fintech and Regtech: Impact on Regulators and Banks. *Journal of Economics and Business.* https://doi.org/10.1016/j.jeconbus.2018.07.003

Arner, D. W., Barberis, J., & Buckley, R. P. (2015). The Evolution of Fintech: A New Post-Crisis Paradigm? *SSRN Electronic Journal.* https://doi.org/10.2139/ssrn.2676553

Autor, D. H. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation. *Journal of Economic Perspectives*. https://doi.org/10.1257/jep.29.3.3

Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management Decision*, *47*(8), 1323-1339. https://doi.org/10.1108/00251740910984578

Bayram, O., Talay, I., & Feridun, M. (2022). Can Fintech Promote Sustainable Finance? Policy Lessons From the Case of Türkiye. *Sustainability*. https://doi.org/10.3390/su141912414

Bessen, J. (2018). *AI and Jobs: The role of demand*. National Bureau of Economic Research. https://doi.org/10.3386/w24235

Bloom, N., Garicano, L., Sadun, R., & Reenen, J. V. (2014). The Distinct Effects of Information Technology and Communication Technology on Firm Organization. *Management Science*. https://doi.org/10.1287/mnsc.2014.2013

Bloom, N., Jones, C., Van Reenen, J., & Webb, M. (2017). *Are ideas getting harder to find?* (w23782; s. w23782). National Bureau of Economic Research. https://doi.org/10.3386/w23782

Boulesteix, A.-L., & Strimmer, K. (2006). Partial least squares: A versatile tool for the analysis of high-dimensional genomic data. *Briefings in Bioinformatics*, *8*(1), 32-44. https://doi.org/10.1093/bib/bbl016

Çakar, N. D., & Ertürk, A. (2010). Comparing Innovation Capability of Small and Medium-Sized Enterprises: Examining the Effects of Organizational Culture and Empowerment. *Journal of Small Business Management*. https://doi.org/10.1111/j.1540-627x.2010.00297.x

Calisir, F., Gumussoy, C. A., & Guzelsoy, E. (2013). Impacts of Learning Orientation on Product Innovation Performance. *The Learning Organization*. https://doi.org/10.1108/09696471311328442

Cao, L., Yang, Q., & Yu, P. S. (2021). Data Science and AI in FinTech: An Overview. *International Journal of Data Science and Analytics*. https://doi.org/10.1007/s41060-021-00278-w

Çınar, Ö., Altuntas, S., & Alan, M. A. (2020). Technology Transfer and Its Impact on Innovation and Firm Performance: Empirical Evidence from Turkish Export Companies. *Kybernetes*. https://doi.org/10.1108/k-12-2019-0828

Demšar, J., Curk, T., Erjavec, A., Gorup, Č., Hočevar, T., Milutinovič, M., Možina, M., Polajnar, M., Toplak, M., Starič, A., Štajdohar, M., Umek, L., Žagar, L., Žbontar, J., Žitnik, M., & Zupan, B. (2013). Orange: Data mining toolbox in python. *Journal of Machine Learning Research*, *14*(71), 2349-2353. http://jmlr.org/papers/v14/demsar13a.html

UST-Global, Inc., & Donepudi, P. K. (2017). Machine learning and artificial intelligence in banking. *Engineering International*, *5*(2), 83-86. https://doi.org/10.18034/ei.v5i2.490

Dubé, A. K., & Wen, R. (2021). Identification and Evaluation of Technology Trends in K-12 Education From 2011 to 2021. *Education and Information Technologies*. https://doi.org/10.1007/s10639-021-10689-8

Dwivedi, P., Alabdooli, J. I., & Dwivedi, R. (2021). Role of FinTech Adoption for Competitiveness and Performance of the Bank: A Study of Banking Industry in UAE. *International Journal of Global Business and Competitiveness*. https://doi.org/10.1007/s42943-021-00033-9

Farahani, M. S., Esfahani, A., Falatouri Moghaddam, M. N., & Ramezani, A. (2022). The Impact of Fintech and Artificial Intelligence on COVID 19 and Sustainable Development Goals. *International Journal of Innovation in Management Economics and Social Sciences*. https://doi.org/10.52547/ijimes.2.3.14

Hartigan, J. A., & Wong, M. A. (1979). Algorithm AS 136: A K-Means Clustering Algorithm. *Journal of the Royal Statistical Society Series C (Applied Statistics)*. https://doi.org/10.2307/2346830

Hussein Kassim, A., McGuire MyMy, J., Lyons, A., Puah, K. S., Bhaskar, S., Chivunga, M. N., Arieli, I., More, N., Biedermann, J., & Olivera, S. (2021). *Global Fintech Rankings Report Bridging the Gap*.

Jiang, S., Tang, Y., & Lee, J. C. (2022). A preliminary study exploring the effects of artificial intelligence on fintech innovation resistance. Içinde Y. Jiang, Y. Shvets, & H. Mallick (Ed.), *Proceedings of the 2022 2nd International Conference on Economic Development and Business Culture (ICEDBC 2022)* (C. 225, ss. 923-927). Atlantis Press International BV. https://doi.org/10.2991/978-94-6463-036-7_136

Kaynak, S., Altuntas, S., & Dereli, T. (2017). Comparing the innovation performance of EU candidate countries: An entropy-based TOPSIS approach. *Economic Research-Ekonomska Istraživanja*, *30*(1), 31-54. https://doi.org/10.1080/1331677X.2016.1265895

Kazachenok, O. P., Stankevich, G. V., Chubaeva, N. N., & Tyurina, Y. G. (2023). Economic and legal approaches to the humanization of FinTech in the economy of artificial intelligence through the integration of blockchain into ESG Finance. *Humanities and Social Sciences Communications*, *10*(1), 167. https://doi.org/10.1057/s41599-023-01652-8

Koren, Y., & Carmel, L. (2003). Visualization of labeled data using linear transformations. *IEEE Symposium on Information Visualization 2003 (IEEE Cat. No.03TH8714)*, 121-128. https://doi.org/10.1109/INFVIS.2003.1249017

Leban, G., Zupan, B., Vidmar, G., & Bratko, I. (2006). Vizrank: Data visualization guided by machine learning. *Data Mining and Knowledge Discovery*, *13*(2), 119-136. https://doi.org/10.1007/s10618-005-0031-5

Li, J., Li, N., & Cheng, X. (2021). The impact of fintech on corporate technology innovation based on driving effects, mechanism identification, and heterogeneity analysis. *Discrete Dynamics in Nature and Society*, *2021*, 1-12. https://doi.org/10.1155/2021/7825120

Lloyd, S. (1982). Least squares quantization in PCM. *IEEE Transactions on Information Theory*, *28*(2), 129-137. https://doi.org/10.1109/TIT.1982.1056489

Mnih, V., Kavukcuoglu, K., Silver, D., Rusu, A. A., Veness, J., Bellemare, M. G., Graves, A., Riedmiller, M., Fidjeland, A. K., Ostrovski, G., Petersen, S., Beattie, C., Sadik, A., Antonoglou, I., King, H., Kumaran, D., Wierstra, D., Legg, S., & Hassabis, D. (2015). Human-level control through deep reinforcement learning. *Nature*, *518*(7540), 529-533. https://doi.org/10.1038/nature14236

Naranjo-Valencia, J. C., Jimenez-Jimenez, D., & Sanz-Valle, R. (2017). Organizational culture and radical innovation: Does innovative behavior mediate this relationship? *Creativity and Innovation Management*, *26*(4), 407-417. https://doi.org/10.1111/caim.12236

Onderco, M., & Zutt, M. (2021). Emerging technology and nuclear security: What does the wisdom of the crowd tell us? *Contemporary Security Policy*, *42*(3), 286-311. https://doi.org/10.1080/13523260.2021.1928963

Öztürk, R., & Kula, V. (2021). A general profile of artificial intelligence adoption in banking sector: A survey of banks in afyonkarahisar province of turkey. *Journal of corporate governance, insurance and risk management*, *8*(2), 146-157. https://doi.org/10.51410/jcgirm.8.2.10

Pătraşcu, P. (2021). Emerging technologies and national security: The impact of iot in critical infrastructures protection and defence sector. *Land Forces Academy Review*, *26*(4), 423-429. https://doi.org/10.2478/raft-2021-0055

Prabhaker, P. R., Goldhar, J. D., & Lei, D. (1995). Marketing implications of newer manufacturing technologies. *Journal of Business & Industrial Marketing*, *10*(2), 48-58. https://doi.org/10.1108/08858629510087373

Quintane, E., Mitch Casselman, R., Sebastian Reiche, B., & Nylund, P. A. (2011). Innovation as a knowledge-based outcome. *Journal of Knowledge Management*, *15*(6), 928-947. https://doi.org/10.1108/13673271111179299

Raban, Y., & Hauptman, A. (2018). Foresight of cyber security threat drivers and affecting technologies. *Foresight*, *20*(4), 353-363. https://doi.org/10.1108/FS-02-2018-0020

Roweis, S. T., & Saul, L. K. (2000). Nonlinear dimensionality reduction by locally linear embedding. *Science*, *290*(5500), 2323-2326. https://doi.org/10.1126/science.290.5500.2323

Shin, Y. J., & Choi, Y. (2019). Feasibility of the fintech industry as an innovation platform for sustainable economic growth in korea. *Sustainability*, *11*(19), 5351. https://doi.org/10.3390/su11195351

Silver, D., Huang, A., Maddison, C. J., Guez, A., Sifre, L., Van Den Driessche, G., Schrittwieser, J., Antonoglou, I., Panneershelvam, V., Lanctot, M., Dieleman, S., Grewe, D., Nham, J., Kalchbrenner, N., Sutskever, I., Lillicrap, T., Leach, M., Kavukcuoglu, K., Graepel, T., & Hassabis, D. (2016). Mastering the game of Go with deep neural networks and tree search. *Nature*, *529*(7587), 484-489. https://doi.org/10.1038/nature16961

Steinley, Douglas. (2006). K-means clustering: A half-century synthesis. *British Journal of Mathematical and Statistical Psychology*, *59*(1), 1-34. https://doi.org/10.1348/000711005X48266

Sun, Y., Ying, L., & Zhang, J. (2022). *Analysis of the impact of fintech on small and medium-sized enterprises:* 2022 7th International Conference on Financial Innovation and Economic Development (ICFIED 2022), Zhuhai, China. https://doi.org/10.2991/aebmr.k.220307.132

Tekin, E., Ramadani, V., & Dana, L.-P. (2021). Entrepreneurship in Turkey and other Balkan countries: Are there opportunities for mutual co-operation through internationalisation? *Review of International Business and Strategy*, *31*(2), 297-314. https://doi.org/10.1108/RIBS-10-2020-0133

Tenenbaum, J. B., Silva, V. D., & Langford, J. C. (2000). A global geometric framework for nonlinear dimensionality reduction. *Science*, *290*(5500), 2319-2323. https://doi.org/10.1126/science.290.5500.2319

T., G., & C., A. (2015). Futuristic computational technologies: A scenario analysis. *International Journal of Computer Applications*, *127*(16), 15-21. https://doi.org/10.5120/ijca2015906687

Toplak, M., Birarda, G., Read, S., Sandt, C., Rosendahl, S. M., Vaccari, L., Demšar, J., & Borondics, F. (2017). Infrared orange: Connecting hyperspectral data with machine learning. *Synchrotron Radiation News*, *30*(4), 40-45. https://doi.org/10.1080/08940886.2017.1338424

Toplak, M., Read, S. T., Sandt, C., & Borondics, F. (2021). Quasar: Easy machine learning for biospectroscopy. *Cells*, *10*(9), 2300. https://doi.org/10.3390/cells10092300

Wali, A. Z., & Popal, A. W. (2020). The emerging issues and impacts of technology in classroom learning. *International Journal of Emerging Technologies in Learning (iJET)*, *15*(15), 237. https://doi.org/10.3991/ijet.v15i15.14175

Dutta, S., Lanvin, B., Wunsch-Vincent, S., León, L. R., & World Intellectual Property Organization. (t.y.). *Global innovation index 2022: (Subtitle)* /. Unknown. https://doi.org/10.34667/TIND.46596

Yeniaras, V., Kaya, I., & Ashill, N. (2020). The effects of social ties on innovation behavior and new product performance in emerging economies: Evidence from Turkey. *Journal of Business & Industrial Marketing*, *35*(4), 699-719. https://doi.org/10.1108/JBIM-12-2018-0371

AJIT-e Academic Journal of Information Technology
10.5824/ajite.2023.04.003.x

2023 . Fall - Güz . Volume – Cilt: 14 . Issue – Sayı: 55

Regulatory Recommendations for Fraud Problem in The Turkish Telecommunication Sector*

Süleyman BAYRAM, *Başkent University, Department of Management Information Systems, sbayram12@gmail.com, 0000-0002-0969-3718*

Esma ERGÜNER ÖZKOÇ, *Başkent University, Department of Management Information Systems, Assoc. Prof., eeozkoc@baskent.edu.tr, 0000-0003-1728-5930*

ABSTRACT

Fraud has been a persistent issue throughout human history. As technology continues to advance in various fields, fraudulent activities adapt and evolve accordingly. The telecommunication industry, in particular, has undergone significant transformations since the early 2000s with the advent of mobile technologies. It is evident that telecommunication fraud has seen a substantial increase during this time, leading to serious financial and reputational damage. Therefore, combating and preventing fraud has become a crucial task in the telecommunication sector, as it is in all industries. This study delves into the topic of fraud, with a particular emphasis on telecommunication fraud. It investigates the experiences and efforts made to minimize and prevent fraud globally. Additionally, the study includes a focus group analysis involving two mobile operators in Turkey, aiming to understand the current situation and industry expectations concerning telecommunication fraud within the country. After evaluating the information gathered and examining the existing efforts, the study offers a series of regulatory recommendations for reducing and preventing fraud in the Turkish telecommunication sector.

Keywords **:** Fraud, Telecommunication, Regulation, CLI Spoofing

Türkiye Telekomünikasyon Sektöründe Sahtecilik Sorunu için Düzenleyici Öneriler

ÖZ

İnsanlık tarihinde süregelen sahtecilik sorunu, teknolojik alanlarda yaşanan önemli gelişmelerle birlikte farklı şekillerde karşımıza çıkmaktadır. Telekomünikasyon sektörü, 2000'li yılların başında mobil teknolojilerin yaygınlaşmasıyla büyük dönüşümler yaşamıştır. Bu süreçte telekomünikasyon sahteciliğinde de önemli artışlar yaşanmış ve ciddi maddi ve itibar kayıplarına neden olmuştur. Dolayısıyla tüm sektörlerde olduğu

* *This article is derived from Süleyman Bayram's master's thesis entitled " Türkiye Telekomünikasyon Sektöründe Sahtecilik Sorunu için Düzenleyici Öneriler", conducted under the supervision of Assoc. Prof. Esma ERGÜNER ÖZKOÇ.*

Araştırma Makalesi / Research Article
Date Received: 9.05.2023
Publishing Date: 22.11.2023

10.5824/ajite.2023.04.003.x

gibi telekomünikasyon alanında da sahtecilikle mücadele ve önleme çalışmaları büyük önem taşımaktadır. Bu çalışma, sahtecilik konusuna ve özellikle telekomünikasyon sahteciliğine odaklanarak, bu alandaki dünya genelinde yaşanan deneyimleri ve önleme çalışmalarını incelemektedir. Ayrıca, Türkiye'deki telekomünikasyon sahteciliği konusundaki mevcut durumu ve beklentileri anlamak amacıyla iki mobil operatörle yapılan odak grup çalışması da bu çalışmaya dahil edilmiştir. Toplanan bilgiler ve mevcut çalışmaların değerlendirmesi sonucunda, Türkiye telekomünikasyon sektöründe sahteciliği azaltmak ve önlemek için düzenleyici öneriler sunulmaktadır.

Anahtar Kelimeler **:** Sahtecilik, Telekomünikasyon, Düzenleme, CLI Manipülasyonu

INTRODUCTION

The fraud which comes from the Latin word "fraudem" meaning tendency to deceive, is defined by the Oxford Dictionary of Concise as criminal deception that uses false representations for unfair personal gain (Bolton & Hand, 2002; Becker et al., 2010). Fraud is a phenomenon that has always been experienced since the existence of humanity. Fraud gains new forms with every new technological step (Alraouji & Bramantoro, 2014). Fraud, which is usually carried out for financial gain, can sometimes serve for personal gains, political goals, or other objectives (Becker et al., 2010). Although it is known that fraud is used in many areas such as banking, telecommunications, finance, health, and academic processes, within the scope of this study, the problem of telecommunications fraud will be investigated, and various evaluations and suggestions will be given for Turkey.

About 5% of the annual revenue of telecommunications operators is lost due to fraud and this rate is increasing every passing year (Rebahi et al., 2014). In 2019, it was measured that there was approximately $ 28.3 billion in lost revenue due to fraud cases in the telecommunications industry worldwide (Communications Fraud Control Association, 2019). Telecommunication fraud is experienced in Turkey as well as all over the world and causes various losses. The total number of subscribers of mobile operators, which are the most important actors and major stakeholders of the Turkish telecommunications sector, is approximately 87 million and their annual net sales revenue is approximately $ 2,7 billion [6]. With fraud, not only loss of income, but also loss of reputation, customer satisfaction, number of subscribers, and various other losses can be experienced. Telecommunication is considered one of the most important sectors in terms of fraud as both operators and individual users are directly targeted (Alraouji & Bramantoro, 2014; Brown, 2005; Weiss, 2005; Abdallah et al., 2016).

1. LITERATURE RESEARCH

1.1. General Fraud Approach

It is possible to divide fraud into two types: internal and external. Internal fraud occurs when an employee makes an attempt against his company, which can be defind as either low

or high based on the employee's authority (Green & Choi, 1997; Beneish, 1997; Summers & Sweeney, 1998; Phua et al., 2010). External fraud, on the other hand, can occur in a broader spectrum, which can include customers, manufacturers, third-party thieves, and more.

In the twentieth century, fraud has increased considerably in sectors that require transactions and interactions. In many technological systems such as telecommunication networks, mobile communication, banking, and e-commerce, fraudulent activities cause significant losses. In the context of fraud, sometimes a method can be used only as a tool, and the main target can be a different sector. In other words, there may be cases of fraud intricately intertwined with each other. For example, fraudsters who want to commit credit card or banking fraud can send a text message or make a call to the person concerned. In this case, it can be said that both telecommunication fraud and banking fraud are present here since telecommunication tools are used. The fight between scammers and affected companies continues on an ongoing basis (Alraouji & Bramantoro, 2014). Various fraud management systems are available to detect, intercept and prevent fraud (Kou et al., 2004). Since fraud prevention describes stopping fraud before it happens, this is unlikely to be 100% achieved in real life (Bolton & Hand, 2022). Fraud detection, on the other hand, refers to the detection after the incident occurs. It is important to consider fraud detection as constantly evolving.

1.2. Telecommunications Fraud

When analog telecommunications networks were first used, there were various security vulnerabilities, and these led to simple fraudulent methods. Beginning with Joe Engressia, one of the famous fraudsters of the early period, realizing that he could control automatic call forwarding when he whistled at certain frequencies in 1957, and later with other methods developed, the fraudsters created devices to penetrate telephone systems and were able to provide free service for users by charging the operators completely (Becker et al., 2010). Later on, analog technologies left their place for digital technologies and so, did the nature of fraud (Pourhabibi et al., 2020). Even though it is possible to talk about many fraud methods and scenarios, telecommunication fraud can be grouped into 4 categories. Contractual fraud; aims to benefit from the services without paying a fee, hacking; aims illegal takeover of telecommunications networks and services, technical; aims to exploit weaknesses in mobile system technologies and requires high technical capacity and procedural fraud; illegal attempt against procedures implemented in systems to reduce the risks of fraudulent activities (Gosset & Hyland, 1999; Sahin, 2007). More than 200 types of fraud fall under these classifications in the telecommunications industry. The most important of them are subscription, superimposed, premium rate, roaming, and simbox fraud (Cortesão et al., n.d.; Kuşaksızoğlu, 2006; Farvaresh & Sepehri, 2011; Mohd Yusoff et al., 2013; Abdallah et al., 2016). The most common fraud methods among European Conference of Postal and Telecommunications Administrations (CEPT) countries are; CLI spoofing, PBX hacking, wangiri fraud, roaming fraud, call hijacking, and subscription fraud (Electronic Communications Services, 2018). CLI spoofing, one of the fraud types mentioned above, is encountered very seriously, can cause serious problems and income losses. The origin of the call is shown differently by manipulating the CLI to avoid high termination fees. In this way, much lower termination fees can be paid. This situation causes significant revenue losses for many operators. Regulatory institutions in the United States of America (USA) and Europe make many regulations and impose various sanctions on this issue. The interoperability of these different solutions in

10.5824/ajite.2023.04.003.x

terms of international traffic also poses a significant challenge, as these regulations differ significantly among countries. In this regard, the cooperation of all stakeholders, especially in the international sense, is extremely important (i3Forum, 2020).

1.3. Fraud Problem in Turkey

As in the rest of the world, the telecommunication sector in Turkey is developing rapidly and is opening up to new areas every day. However, some revenue and prestige losses can occur due to fraud, and this causes severe problems. Many of the problems and losses in the world related to fraud methods are also experienced in Turkey in the same and/or similar forms.

Information and Communication Technologies Authority (BTK) is the authorized body for regulation and supervision of the electronic communication sector in Turkey. Operators serving in the sector are authorized by BTK. Operators are responsible to the BTK and related regulations for issues such as service delivery and problems encountered during service delivery. In this respect, it is obvious that it would not be reasonable in today's technology and conditions to leave the solution to fraud problems in the telecommunications sector only to the public authority and regulations. Considering that every stakeholder in the sector may be a part of the fraud, as stated above, it is considered that all stakeholders should take their share of responsibilities for a solution. With various regulations prepared by BTK, it is aimed to prevent fraud scenarios within the scope of CLI manipulation within the framework of the legislation, and applications for these regulations are continuing actively. However, fraud problems continue to occur. At this point, in the examination carried out within the scope of Turkey's legislation, it has been observed that there is no special regulation regarding the precautions that operators should take against fraud and how the issue is generally approached. Thus, it is thought that there is a regulation gap in this area.

Subscription frauds, CLI spoofing, international call fraud, value-added service fraud, spam messages, and artificial traffic generation are the most common fraud types in Turkey. However, in this study, although telecommunication fraud and many scenarios are discussed in general, problems and solutions within the scope of CLI spoofing will be mainly examined. Because this problem has been increasing both in the world and in Turkey recently and causes significant revenue losses. There are disagreements in this context, particularly among operators in Turkey, and there is no useful solution currently implemented.

CLI spoofing scenarios in Turkey are generally realized by changing the CLI of calls originating from abroad and showing them as domestic calls. At this point, the main problem is that it cannot be determined precisely on the legal basis of who committed the fraud. When mobile operators detect a CLI spoofing case with their technical means, they first send requests such as closing the number to the fixed operators who delivered the call. These numbers are closed to services from time to time by fixed operators. Sometimes it is stated that even if fraud has been done, they are not aware of it and there is no action they can take at that point. In addition, since there is no distinction between operators in the sector according to the relevant legislation, it is stated that the requests within the scope of fraud should be delivered by the public authority, not by another operator.

There are some methods for detecting CLI spoofing. It is also known that these methods are used by mobile operators in Turkey. However, fraud detections made by the operators in the sector do not make much legal sense and it does not seem possible to impose sanctions within the scope of these detections. For this reason, the assembly of the experience of the actors in the sector and the administrative, technical, and legal power of the public authority seems to be essential for the solution of the problem.

1.4. Fraud Problem in World

According to the global telecommunications survey released in 2019 by the Communications Fraud Control Association (CFCA), the worldwide telecommunications industry revenue lost due to fraud at $28.3 billion in 2019 (Communications Fraud Control Association, 2019). The Global Leaders Forum's (GLF) report on actions to be taken against fraud in 2018 stated that fraudulent call traffic costs the international wholesale transit call industry approximately $17 billion annually (GLF, 2018).

A study was conducted by BEREC (The Body of European Regulators for Electronic Communications) in 2019 within the scope of fraud (CLI manipulation, Simbox, Wangiri, etc.) and misuse of E.164 numbers and the results were published in a report (BEREC, 2019). The survey was conducted with the public authorities of the countries in the telecommunications sector and 15 countries, not including Turkey, participated in the survey. As a result of this survey; it has been stated that there is a significant increase in fraud cases in countries recently, it is very important to act together as the whole sector for a solution, it would be beneficial to create a common fraud database and to publish this database and to prevent calls accordingly.

In 2022, a report was published by the ECC (Electronic Communications Committee) to review current regulatory practices from the perspective of various regulatory authorities to combat CLI spoofing (Electronic Communications Services, 2022). It was stated that some short-term solutions are already in use, but they are not usually real-time solutions. It has been argued that the regulatory authorities of CEPT countries, as well as organizations such as ITU (International Telecommunication Union) and BEREC, at both national and international levels, should encourage industry groups in the fight against CLI manipulation, such as information sharing and traffic analysis. In addition, it is stated that the use of proven techniques such as STIR (Secure Telephony Identity Revisited)/SHAKEN (Signature-based Handling of Asserted Information Using Tokens), which will be detailed later, maybe one of the long-term solutions in this context. However, it has been stated that it may be difficult to implement such techniques in the short term since they require a purely IP environment. In addition, it was stated that in the relevant countries, there is a blacklist of fraudulent numbers, operators are allowed to block calls if fraud is detected as technically possible, and procedures are developed to increase the accuracy and reliability of CLI, and cooperation studies were carried out between sector representatives and public authorities (Electronic Communications Services, 2022).

1.5. Preventive Measures Against Telecommunication Fraud

Many artificial intelligence solutions are offered against fraud as mentioned above. Most of these methods are carried out with the analyzes made on the call detail records (CDR).

10.5824/ajite.2023.04.003.x

However, there are some other long-term solutions to fight CLI spoofing (Electronic Communications Services, 2022). Some of them will be included in this section.

STIR/SHAKEN: It is based on the verified creation of all call ecosystem components. It consists of a centralized architecture that enables the parties initiating and ending the call to agree on verified information. It is currently implemented in the USA and Canada. It is expected that this method will evolve into a European-wide model shortly (i3Forum, 2019).

SOLID: SOLID (Social Linked Data) is a proposed set of contracts and tools for building decentralized applications based on linked data principles. This standard is built on HTTP (Hyper Text Transfer Protocol). With the authorization and encryption provided by the decentralized structure of SOLID, it is evaluated that it can be used for the verification of the caller number in the telecommunications ecosystem. SOLID has been evaluated together with STIR in terms of reducing international call fraud and it is thought that it can be used for flexible and secure communication between the same people. With this theoretical approach, fraud can be handled without any interruption to all stakeholders in the call flow. Although it has not been implemented by any operator yet, it is thought to be useful in theory (i3Forum, 2019; Sambra et al., 2016).

Blockchain: DLT (Distributed Ledger Technology) is a protocol that enables decentralized database management by multiple participants at multiple points (Yli-Huumo et al., 2016; Yaga et al., 2018). If implemented for numbering management, phone numbers can be used as digital assets. In addition, it will be possible for only certain actions to be performed by authorized participants and data to be exchanged securely and transparently (Electronic Communications Services, 2022). The use case where operators share information about subscribers' identity and certificates, the blockchain ecosystem that can be created between domestic and international operators, and the sharing of public key certificates to verify user identity are important features for the application of blockchain in this sector. In addition, various studies are carried out by organizations such as ITU on the use of DLT in telecommunication applications (International Telecommunication Union, 2019).

AB Handshake: AB Handshake is a method used to detect fraud in real-time based on cooperation between operators and to eliminate fraud within the group of operators by verifying traffic between networks. It has no direct link to a specific country or regulation and has emerged as a standalone solution. It is used for live traffic verification by operators located in different geographical areas. This method is offered by a private business initiative. It can be implemented in both IP-based and traditional systems and can be used without affecting networks and call flows. Since the numbering plans need to be shared to implement this method, integration, and coordination with the relevant regulatory authorities are required (GSMA, 2022).

2. RESEARCH METHOD

2.1. The Data Collection Method

The interview is one of the data collection techniques that allow understanding of people and relationships through verbal communication tools. In this study, a semi-structured

interview technique was used, and interviews were carried out with 2 of 3 mobile operators in Turkey. The relevant representatives of the operator who could not be interviewed were contacted and interview questions were conveyed to them. However, due to the privacy policies of the relevant operator, they abstained from participating in the interview.

The interviewed operators will hereinafter be referred to as the "X" and "Y" operators. Both operators have been serving in the sector since the early 2000s and they have significant experience in terms of both Turkey and the world telecommunication sector. According to the latest market data published by BTK, operators X and Y represent approximately 70% of the mobile market. An interview was held with operator X on 16.06.2021 and with operator Y on 30.06.2021. Interviews were held online with the participation of the operators' fraud team manager and experienced personnel, and with focus groups consisting of three-person teams. All the participants are highly competent and highly experienced people who have been working in this sector and in fraud issues for at least 10 years (Bilgi Teknolojileri ve İletişim Kurumu, 2022).

2.2. Interview Notes and Analyses

Apart from the questions prepared before, other issues were also discussed from time to time during the interviews. For the interview questions, both operators also responded in writing. In addition to these written texts, the notes taken during the interview and interview records were also used for analysis and evaluation through the Nvivo program, which is used in qualitative research analysis. The codes generated as a result of the evaluations are as follows; *"CLI spoofing, simbox, fixed operator, international call, national call, CDR analysis, test calls, legislation, wangiri, IRSF, A number, B number, machine learning, fraud systems, big data, AI, automation, manpower, dealer fraud, subscriber, false documents, SMS, M2M, bypass fraud, high income, artificial traffic, interoperability, audit, legislative regulation, common ground, revenue loss, social engineering, roaming fraud, simswap fraud"*.

In response to questions about which types of fraud are encountered in the sector and which types of fraud have been seen more frequently in the last 5 years; it was stated that CLI manipulation, simbox, wangiri, IRSF, and subscriber frauds were prominent, and it was also stated that fraudulent activities, although not very intense, occurred in value-added services, M2M (machine-to-machine) and social engineering.

In response to questions about what kind of fraud is experienced in voice traffic, what measures are taken for this, and how the CLI spoofing is detected; they noted that wangiri, bypass (simbox and CLI spoofing), and IRSF fraud. In addition, it is stated that CDR analysis and test call methods are used extensively for the detection and prevention of CLI spoofing. In addition, it was overemphasized that the problem is a situation between the actors in the operator ecosystem, and in this sense, the role of the BTK in terms of solution will be important. It was stated that it would be beneficial to carry out detailed inspections and investigations specific to the operators experiencing the problem and to use detection and analysis methods within the body of the BTK or through a mechanism that would involve the BTK and be equidistant to everyone.

In response to questions about systems used to prevent fraud and lost revenue in the last 5 years; the X operator said that the work continues on the transition to a new system

originating abroad and on the other hand, the Y operator indicated that the majority of the systems are provided by internal resources and also differentiated and customized systems are used for various methods such as CLI manipulation and simbox. It was remarked by both operators that the systems are significantly reliable thanks to intelligent systems such as artificial intelligence. X operator said that the cost of the fraud system to be established by an operator with 20-30 million subscribers is approximately $ 2-3 million, although it is not an official value. In addition, X operator stated that annual revenue losses due to fraud will not be less than $ one million. On the other hand, Y operator remarked that the loss of revenue due to fraud, which may occur in the range of $ 3-5 million per year, is prevented by their companies, and that annual revenue loss due to subscription and fake documents are estimated to be around $ 1,5-2 million.

In response to questions about which fraud scenarios are predicted to be encountered more in the future and whether they plan to reduce the impact of the human factor by using tools such as artificial intelligence and machine learning to prevent fraud, both operators stated that social engineering-related fraud cases are expected to increase further in the future. In addition, X operator said that SMS phishing methods and Y operator said that CLI manipulation and malware attacks carried out over smartphones and simbox may increase in the coming period. However, it was stated by both operators that methods such as artificial intelligence and machine learning were used significantly to prevent fraud. In addition, it was stated that robotic automation processes are increased, and maximum efficiency is tried to be obtained from human power. X operator indicated that the use of artificial intelligence is currently around 5% and it is planned to increase this to around 20% in the future. Y operator said that special artificial intelligence solutions have been developed for some types of fraud and it is planned to increase the use of artificial intelligence in the future.

In response to questions about what kind of losses are experienced after fraud and what are the technical, administrative, and legal expectations from the BTK in terms of preventing fraud, it was stated that the most significant loss was in revenue, and it is planned to increase the use of automation and artificial intelligence systems to reduce this. In addition, the issues shared by both operators are increasing the controls on fixed operators especially for CLI spoofing, imposing heavy sanctions against fixed operators who cause or commit fraud, and creating a common ground where operators and BTK can act together, it is necessary to making legal regulations and fighting against fraud together in this way. In addition, both operators stated that although they take many precautions against fraud, it is not possible to completely prevent it, but if they act together as an ecosystem, it can be prevented significantly. Lastly, in response to the question about whether there are reports or publications on fraud, both operators replied that there was no such report or publication officially.

2.3. Summary of Interviews

In the interviews, the perspectives of the sector representatives were seen in detail, both within the framework of the questions asked and in general on issues related to fraud. It is thought that there is an important solution expectation for the problem experienced

particularly in CLI spoofing. At this point, a common solution involving all the stakeholders of the sector is considered vital.

3. ASSESSMENT AND RECOMMENDATIONS

3.1. Model Proposal

The problems experienced in Turkey regarding CLI spoofing have been given in detail in the previous sections. Considering in light of the determinations and precautions made by the interviewed operators in their systems, it would be beneficial to look at this issue first at the solution point, since the main problem at this point is that the operators try to solve the problem among themselves. In this respect, the establishment of a fraud management system within the regulatory public authority of the sector, specific to CLI spoofing and other possible frauds will be beneficial. Operators should also be involved in this system. Some framework issues regarding how this system should be are as follows; call data of all operators will be continuously transferred to this system and as a result of detailed analyzes performed here, fraudulent calls and numbers will be detected. It should be ensured that the test call method, which is currently implemented by the operators, is also automated with the structures established on this system, and thus, the manipulation of calls, numbers, and operator flows should be determined. After the determinations are made, the data will be shared with the relevant stakeholders and sanctions may be applied to the operators who are found to be fraudulent. At this point, it is important that the system is transparent to each stakeholder and that the findings are presented to all stakeholders. Operators will both transfer data to the system and benefit from the outputs of this system. As a result of the activities carried out in the system, various administrative sanctions should be applied to the operators who are understood to have committed fraud, as specified in the relevant legislation, and measures should be taken up to the cancellation of the authorization of the relevant operator in case of the size or repetition of the fraud. Confidentiality of communication is essential in laws and regulations in Turkey. To avoid a process contrary to this principle, all information and data transmitted to the system must be anonymized. Moreover, to provide the legal infrastructure of the system, it is considered that a regulation that will include all the above-mentioned issues and that will specify the system architecture and the roles of all stakeholders should be implemented by the BTK Board. Thanks to this structure to be established, a collaborative ecosystem, as emphasized in the information obtained in the study, will be realized in real terms. The architectural structure that summarizes this system is given in Figure 1.

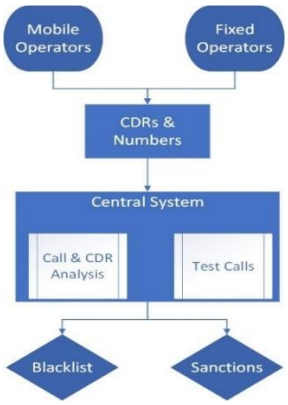

Figure 1: Central Fraud Detection System Architecture

10.5824/ajite.2023.04.003.x

3.2. Legislative/Regulative Proposals

It is thought that all transactions (subscription, number porting) involving physical document processes should also be carried out in digital environments, and thus, issues such as identity fraud will be prevented to a great extent.

While there are certain precautions and obligations regarding fraud in current regulations and practices, there is no special regulation directly targeting fraud in general. In this context, it is considered important that a Procedure and Principles titled "Measures to be Taken Against Fraud" is implemented by the BTK Board. The main issues that are considered to be included in these Procedures and Principles are as follows:

- All operators providing electronic communication services should take necessary measures against fraud in their networks and protect the subscriber.
- Operators should provide all the facilities for their subscribers to reach them and show maximum sensitivity to eliminate grievances.
- Operators should inspect their dealers regularly against fraudulent activities and must train dealers on countermeasures.
- Operators with more than ten thousand subscribers should establish a fraud team consisting of at least 3 experts in their field.
- Operators providing voice call services should take the necessary precautions in their network and prevent such calls within the framework of issues such as making too many simultaneous calls to a single number, simultaneous calls from a single number to many directions, and heavy traffic at certain numbers.

CONCLUSION

The main purpose of this study is to examine the cases of fraud in the Turkish telecommunication sector and to contribute to the measures that can be taken to reduce fraud. For this purpose, many important aspects of the subject have been revealed by conducting a literature review. Interviews were held with two mobile operators in Turkey with a market share of approximately 70% in total in the sector. The practices and measures taken within the scope of fraud in the world are included. Finally, in light of all this information, necessary discussions and evaluations were made and various suggestions were presented in terms of reducing telecommunication fraud in Turkey.

As a result of all the examinations and evaluations, a central fraud management system proposal, in which all stakeholders in the sector will participate, has been developed to prevent CLI spoofing. In this way, it is thought that the cases of fraud in this area will diminish significantly. In addition, it was stated that a regulation specific to fraud should be prepared and the basic framework of the said regulation was drawn. In this way, it is thought that a protective general framework will be drawn at both the operator and subscriber side and it will contribute to the reduction of fraud cases.

REFERENCES

Abdallah, A., Maarof, M. A., & Zainal, A. (2016). Fraud detection system: A survey. *Journal of Network and Computer Applications*, *68*, 90-113. https://doi.org/10.1016/j.jnca.2016.04.007

Alraouji, Y., & Bramantoro, A. (2014). International call fraud detection systems and techniques. *Proceedings of the 6th International Conference on Management of Emergent Digital EcoSystems*, 159-166. https://doi.org/10.1145/2668260.2668272

Becker, R. A., Volinsky, C., & Wilks, A. R. (2010). Fraud detection in telecommunications: History and lessons learned. *Technometrics*, *52*(1), 20-33. https://www.jstor.org/stable/40586677

Beneish, M. D. (1997). Detecting GAAP violation: Implications for assessing earnings management among firms with extreme financial performance. *Journal of Accounting and Public Policy*, *16*(3), 271-309. https://doi.org/10.1016/S0278-4254(97)00023-9

Bilgi Teknolojileri ve İletişim Kurumu. (2022). *Elektronik Haberleşme Sektörü 3 Aylık Veriler Raporu 2022 – 1. Çeyrek*. https://www.btk.gov.tr/uploads/pages/pazar-verileri/uc-aylik-pazar-verileri-raporu-2022-1.pdf

Bolton, R. J., & Hand, D. J. (2002). Statistical fraud detection: A review. *Statistical Science*, *17*(3), 235-249. https://www.jstor.org/stable/3182781

Brown, S. (2005). *White Paper Telecommunication Fraud and Management.* Waveroad SecurIT,

Communications Fraud Control Association. (2019). *Communications Fraud Control Association Announces Results of 2019 Global Telecom Fraud Survey*. https://cfca.org/document/cfca-2019-fraud-loss-survey-pdf/

Cortesão, L., Martins , F., Rosa , A., & Carvalho , P. (n.d.). *Fraud Management Systems in Telecommunications: A practical approach*. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.553.9706&rep=rep1&type=pdf

Electronic Communications Services. (2018). *The role of E.164 numbers in international fraud and misuse of electronic communications services*. 2018. https://docdb.cept.org/download/1322

Electronic Communications Services. (2022). *CLI Spoofing. https://nkom.no/telefoni-og-telefonnummer/telefonsvindel/_/attachment/download/34a76b0e-011b-4bc0-b060-cc7761c0ffef:7b521945f6d348bd22fd3569e53458c8347fa51d/ECC%20Report%20338.pdf*

Farvaresh, H., & Sepehri, M. M. (2011). A data mining framework for detecting subscription fraud in telecommunication. *Engineering Applications of Artificial Intelligence*, *24*(1), 182-194. https://doi.org/10.1016/j.engappai.2010.05.009

GLF. (2018). *Taking action against fraud*.

Gosset, P., & Hyland, M. (1999). *Classification, Detection and Prosecution of Fraud on Mobile Networks*. http://www.chrismitchell.net/ASPeCT/CD%20Data/Papers/P31.PDF

Green, B. P., & Choi, J. H. (1997). Assessing the risk of management fraud through neural network technology. *Auditing : A Journal of Practice & Theory*, *16*(1), 14-28.

GSMA. (2021). *AB handshake global solution for call validation*. https://www.gsma.com/get-involved/gsma-membership/wp-content/uploads/2021/04/AB-Handshake_whitepaper.pdf

International Telecommunication Union. (2019). *Technical Specification FG DLT D1.1: Distributed ledger technology terms and definitions*. https://www.itu.int/en/ITU-T/focusgroups/dlt/Documents/d11.pdf

i3Forum. (2019). *Calling line ıdentification (clı) management (release 1.0) june 2019*. https://i3forum.org/blog/2019/06/18/calling-line-identification-cli/

BEREC. (2019). *BEREC summary report on the Workshop on Fraud & Misuse of the E . 164 number range. https*://www.berec.europa.eu/sites/default/files/files/document_register_store/2019/12/BoR_%2819%29_241_-_Report_Fraud_Misuse_of_Numbers.pdf

i3Forum. (2020). *I3forum "calling line identification (Cli) spoofing" report*. https://i3forum.org/blog/2020/11/04/i3forum-calling-line-identification-cli-spoofing-report/

Kuşaksızoğlu, B. (2006). *Fraud detection in mobile communication networks using data mining* [Unpublished Master's Thesis]. The University of Bahçeşehir.

Mohd Yusoff, M. I., Mohamed, I., & Abu Bakar, M. R. (2013). Improved expectation maximization algorithm for gaussian mixed model using the kernel method. *Mathematical Problems in Engineering*, *2013*, 1-9. https://doi.org/10.1155/2013/757240

Phua, C., Lee, V., Smith, K., & Gayler, R. (2010). *A comprehensive survey of data mining-based fraud detection research*. https://doi.org/10.48550/ARXIV.1009.6119

Pourhabibi, T., Ong, K.-L., Kam, B. H., & Boo, Y. L. (2020). Fraud detection: A systematic literature review of graph-based anomaly detection approaches. *Decision Support Systems*, *133*, 113303. https://doi.org/10.1016/j.dss.2020.113303

Rebahi, Y., Thanh, T. Q., Busse, R., & Lorenz, P. (2014). On the use of unsupervised techniques for fraud detection in voip networks. In *Emerging Trends in ICT Security* (ss. 359-373). Elsevier. https://doi.org/10.1016/B978-0-12-411474-6.00022-0

Sahin, M. (2017). *Understanding Telephony Fraud as an Essential Step to Better Fight it* [Thesis]. École Doctorale Informatique, Télécommunication et Électronique, Paris.

Sambra, A.V., Mansour, E., Hawke, S., Zereba, M., Greco, N., Ghanem, A., Zagidulin, D., Aboulnaga, A., & Berners-Lee, T. (2016). *Solid :a platform for decentralized social applications based on linked data*. http://emansour.com/research/lusail/solid_protocols.pdf

Summers, S. L., & Sweeney, J. T. (1998). Fraudulently misstated financial statements and insider trading: An empirical analysis. *The Accounting Review*, *73*(1), 131-146. https://www.jstor.org/stable/248345

Weiss, G. M. (2005). Data mining in telecommunications. In O. Maimon & L. Rokach (Ed.), *Data Mining and Knowledge Discovery Handbook* (ss. 1189-1201). Springer-Verlag. https://doi.org/10.1007/0-387-25465-X_56

Yaga, D., Mell, P., Roby, N., & Scarfone, K. (2018). *Blockchain technology overview* (NIST IR 8202; s. NIST IR 8202). National Institute of Standards and Technology. https://doi.org/10.6028/NIST.IR.8202

Yli-Huumo, J., Ko, D., Choi, S., Park, S., & Smolander, K. (2016). Where is current research on blockchain technology? —A systematic review. *PLOS ONE*, *11*(10), e0163477. https://doi.org/10.1371/journal.pone.0163477

Yufeng Kou, Chang-Tien Lu, Sirwongwattana, S., & Yo-Ping Huang. (2004). Survey of fraud detection techniques. *IEEE International Conference on Networking, Sensing and Control, 2004*, *2*, 749-754. https://doi.org/10.1109/ICNSC.2004.1297040

AJIT-e Academic Journal of Information Technology
10.5824/ajite.2023.04.004.x

2023 • Fall - Güz • Volume – Cilt: 14 • Issue – Sayı: 55

Digital Natives' Academician-Student Relationships

Ahmet İYICİ, *Eastern Mediterranean University, Department of Communication and Media Studies, Research Assistant, 20600031@emu.edu.tr,* *0000-0002-8224-773*

Ülfet Kutoğlu KURUÇ, *Eastern Mediterranean University, Department of Public Relations and Advertising, Associate Professor Doctor, ulfet.kutoglu@emu.edu.tr,* 0000-0003-1588-2379

ABSTRACT

Digital natives born with advanced digital media technologies are acknowledged as the first generation of the 21st century. This quantitative study seeks to explore digital natives' stimuli and perceptions towards technology-oriented academician-student interactions at a major university in North Cyprus amid the COVID-19 pandemic. Participants (N=259 Gen Z learners) in a developing country seem to value the virtualization of academician-student interactions in higher education because digital technologies eliminate the existing and possible communication obstacles between educators and learners especially during the crisis situations. It was underlined that digital natives mostly prefer mobile communication in their lives with the belief that technology facilitates, enhances, enriches and triggers interactions between educators and learners. Hence, digital learners mostly prefer blended education and digital communication because participants claim that digitalization escalates the effectiveness of teaching and communication. Digital-assisted education ascends learners' self-confidence and desire towards initiating interactions and comprehending the course contents.

Keywords : Digital Natives, Educational Technologies, Interpersonal Communication, New Media Technologies, Tertiary Education

Dijital Yerlilerin Akademisyen-Öğrenci İlişkileri

ÖZ

Dijital yerliler, 21. yüzyılın gelişmiş dijital medya teknolojileriyle doğmuş ilk kuşağı olarak kabul edilmektedir. Bu nicel çalışma, COVID-19 pandemisi sırasında Kuzey Kıbrıs'taki en köklü devlet üniversitesinde bulunan dijital yerlilerin teknoloji odaklı akademisyen-öğrenci etkileşimlerine yönelik uyaranlarını ve algılarını keşfetmeyi amaçlamaktadır. Gelişmekte olan bu ülkedeki katılımcıların (N=259 Z kuşağı öğrencileri), yüksek öğretimde akademisyen-öğrenci etkileşimlerinin dijitalleşmesine değer verdiği ortaya çıkmıştır. Çünkü katılımcılara göre dijital teknolojiler, özellikle kriz durumlarında eğitimciler ve öğrenciler arasındaki ve olası iletişim engellerini ortadan kaldırmaktadır. Teknolojinin eğitimciler ve öğrenciler arasındaki etkileşimi kolaylaştırdığı, geliştirdiği, zenginleştirdiği ve tetiklediği inancıyla dijital yerlilerin

Araştırma Makalesi / Research Article
Date Received: 20.09.2023
Publishing Date: 22.11.2023

AJIT-e Academic Journal of Information Technology
2023 Fall/Güz – Cilt/Vol: 14 - Sayı/Issue: 55
10.5824/ajite.2023.04.004.x

hayatlarında çoğunlukla dijital iletişimi tercih ettikleri bulguları öne çıkmıştır. Dijital öğrenenler çoğunlukla harmanlanmış eğitimi ve dijital iletişimi tercih etmiştir çünkü katılımcılar dijitalleşmenin öğretim ve iletişimin etkinliğini artırdığı üzerinde durmuşlardır. Çalışmanın diğer bir bulgusu ise, dijital destekli eğitimin, öğrencilerin özgüvenini ve sınıf içi etkileşimi başlatma ve ders içeriğini anlama isteğini artırdığıdır.

Anahtar Kelimeler : Dijital Yerliler, Kişilerarası İletişim, Eğitim Teknolojileri, Yeni Medya Teknolojileri, Yüksek Öğretim

INTRODUCTION

Recent technological, cultural and social improvements all around the world have dramatically affected the lifestyles, interpersonal communication and upbringing of the young individuals called the digital natives (Ivan, 2022). Each generation holds unique and distinct attributes such as cultural, historical, personal and intellectual that eventually form the generational line (Lengel et al., 2022). Consequently, individuals are classified according to their similarities and differences, which are determined by their common positions in the historical process, biological and physical age phenomena and the course of life (Zhou & Charoensukmongkol, 2022).

The daily lives of digital natives are influenced and governed intensely by the advancements in new media technologies due to being born in the digital opportunities such as advanced technological tools like smartphones with fast and uninterrupted internet connection (Fortunati, 2022). All these innovations and digital transformations induce major changes in personality traits of each generation as means for communication especially amid the COVID-19 pandemic (Holzer et al., 2022). As He and Zhang (2022) point out, new media technologies provide positive contributions in terms of security and belonging, which are the affective needs of individuals. Yet, a new phenomenon known as "phubbing", caused by the excessive use of smartphones, has been proposed to describe the tension and discomfort felt by the individuals when one of the parties in a social environment is constantly busy with their smartphone instead of communicating with one another (Büttner et al., 2021). The important feature of this era in terms of communication is that the COVID-19 is the first pandemic of the social media era that declined the face-to-face interactions and enhanced the mobile interpersonal communication among people (Dumas & Stough, 2022).

Generation Z learners, who were born between the years of 1997-2010 and are intertwined with multifarious mobile media innovations can easily adapt to the new media technologies to access information or gratify such needs as socialization, entertainment and education (Giray, 2022). Generation Z has a nature that is goal-oriented, tech-enthusiast and peaceful with diversities, who tend to skip the procedures and formalities to reach to the end promptly (Gabrielova & Buchko, 2021). The reason is parallel with the fact that the majority of fast-learners with technology belong to the Generation Z (Dumas & Stough, 2022).

Additionally, this young, curious and resourceful generation grew up with all the innovations that facilitate their lives in such fields as communication and education (Azimi et al., 2021). The majority of students utilize educational technologies like Microsoft Teams and Zoom to connect their courses during the COVID-19 pandemic (Aagaard, 2022). Especially at the earlier times of pandemic, the almost only mobile communication channels were social media platforms. Therefore, curriculum and further educational activities should be assembled and maintained in a way to embrace the needs of digital natives, ongoing technological advancements and harmony in usage and preferences of technologies (Martínez & Olsson, 2022). The recent studies have manifested that the Z generation learners tend to communicate and interact with others through new media technologies intensively. As Ho et al. (2022) argue, the concept of technology-mediated interpersonal communication was derived from the growing usage and attachment of new media technologies as means for communication with the COVID-19 pandemic. Bearing that in mind, the present study was carried out to reveal technology-oriented interactions between digital natives and educators at tertiary education during the crisis times.

1. LITERATURE REVIEW

1.1. Digital Natives and Digital Interpersonal Communication

The effectiveness of new media technologies in the COVID-19 pandemic and individuals' devotions to technologies have led to a prompt alteration in digital natives' communication habits (Wei, 2022). Mobile communication technologies like WhatsApp, take an exceptional place in the communications of Z youngsters (Yue et al., 2023). Although the release date has not been determined yet, WhatsApp application will also allow users, as Facebook and Instagram, to convert their profile pictures into avatars and also share them with other people as emojis (Tech, 2022). Lately, young people employ such mobile communication platforms as WhatsApp, more adeptly than the older population like X generation (Karthika et al., 2022). Generation Z is considered as the first and leading generation of the 21st century holding the opportunities of the information age. Majority of countries seem to have prepared appropriate multi-level technological conditions so far for the younger generation, especially the centennials to be able to operate their inner tech-skills and benefit highly from technology (Proszek, 2019). Zuo and Hong's (2022) study confirm that although this generation is considered as natural technologists, such inventive individuals still need a guidance for the productive use of the Internet and digital tools towards perpetually evolving and growing telecommunications.

Digital natives dissociate from prior generations in that they are exceptionally dependent on the Internet. They track technological developments closely, interact and communicate regularly through several mobile communications such as mobile phones and social networking sites, can easily articulate their wishes and provide continuous and more access to the virtual environments (Azimi et al., 2021). As Menon's (2022) study affirms, due to the fact that digital natives feel more comfortable with technology, social media are one of their prominent communication platforms especially Instagram and WhatsApp. Apart from their socialization needs, Z generation prefer digital possibilities to access information in their daily and academic lives during the COVID-19 pandemic (Lausch & Rossetto, 2022). Accelerated developments in mobile communications turn generation Z into a courageous,

curious, learning/solution-oriented and impatient individuals, who seek for shortcuts in life as they do in virtual settings (Ntshangase, 2022).

Technology facilitates the interactive communication especially in the COVID-19 pandemic among individuals even if they speak different languages regardless of time and space (Tarihoran et al., 2022). For instance, lately, a popular virtual space called the Metaverse provides its users with real-life experiences such as shopping, socializing, purchasing lands and visiting countries in the online environment (Tlili et al., 2022). Yet, people need assisting equipment such as virtual reality glasses in order to take part in this cyberspace. Furthermore, it is vital to recognize the new language developed by young people at the virtual settings consisting of unique communication codes. Nevertheless, the majority of relevant studies underline how the modern technologies enslave and isolate humans at their homes. At this point, Valkenburg et al. (2021) develop a counter-argument that draws attention to the fact that young people also acquire positive attributes including the advanced cooperation skills and the self-confidence in establishing and maintaining online interpersonal communication. In the light of this, parents and adults, who cannot separate their children from digital tools, have no choice but to communicate with these youth via the new media technologies (Djafarova & Foots, 2022).

1.2. Digital Natives and Education

As the Z generation children are pretty intertwined with mobile communication technologies from their early childhood, Z gen initially spend time on their parents' technological appliances as babies, then, the majority of generation Z individuals have their own electronic devices until the primary education age (Karthika et al., 2022). Thus, digital natives have proved to be very fast in speaking, thinking, learning, advancing academically in the distance education settings (Rosen, 2022). Compared to previous generations, these individuals have higher IQ, self-confidence and the ability to multitask. Hence, the education methods that are implemented for the prior generations may be insufficient for the Z generation individuals (Tutgun and Özdener, 2011). The majority of studies conducted during the pandemic emphasize that this new generation has a more enduring capacity for learning through mobile media, thus, technology-assisted educational materials such as games, e-books and e-libraries are required to be integrated into education (Kinsky et al., 2021). Digital natives expect technology-assisted education, such as course videos with animations or avatars, due to their high technological aptitudes (Hicks et al., 2021).

Digital natives learn with technology-oriented teaching/learning methods (Proszek, 2019). Educational technologies such as digital libraries and online discussion boards, facilitate the learning and increase the motivation of Z generation (Chen & Bogachenko, 2021). The process of integrating traditional teaching-learning techniques into educational technologies called "Blended or Hybrid" model, which was popularized amid the COVID-19 pandemic (Moreno-Guerrero et al., 2021). The "Blend Flex" model refers to both blended and resilient learning environments, where conventional and contemporary digital instruction approaches are used together to enhance learning (Miller et al., 2020). In this regard, educators need to learn how to employ online educational materials to capture the essence of their students.

Therefore, electronic learning materials such as e-workbooks and online video lecturing should play an important role in the education process (Aydın-Aitchison, 2022). The reason is related with the fact that the digital innovations allow autonomous learning where learners can regulate their own learning environments (Li et al., 2021).

Intergenerational, educational and technological transformations require educators and learners to revamp their teaching and learning approaches based on the attributes of the ongoing information age (Mateus et al., 2022). The rapid advancements in the new media technologies have caused a change in instruction and learning styles for both the educators and learners (Garris & Fleck, 2022). As argued by Martínez and Olsson (2022), generation Z learners can operate technology more easily, while individuals in the older age groups including X and Y generations confront difficulties in utilizing digital opportunities. This can be considered as a social phenomenon and intergenerational differences that bring up the concept of digital citizenship generation Z holds (Kapoor et al., 2021). Digital citizenship explains the advanced skills to employ mobile communication technologies regularly, ethically, critically, beneficially and safely in representing themselves (Valkenburg et al., 2021). Adoption of the constructivist approach and student-centered model in education facilitate the alterations in academicians' and students' roles in the classroom (Payaprom & Payaprom, 2020).

1.3. Communication between Learners vs Educators during Crisis Times

The ultimate duty of educators can be considered as leading the desired behavioral change in students based on their goals (Wang & Sun, 2021). A positive classroom environment, mutual understanding and efficacious communication between educators and learners should be ensured to achieve the desired goals in education (Errisuriz et al., 2022). Interpersonal relations between academicians and students are considered as a vital element of the teaching/learning process at school due to the necessity of mutual interactions among both parties (Demirdag, 2022). For instance, issues such as the educators' inability to recognize student's needs, inadequacies in communication skills, student's lack of attention and motivation towards the courses influence the classroom atmosphere negatively (Sartor Harada et al., 2022).

Considering the characteristic differences of digital natives, their communication patterns, learning and teaching approaches differ among generations, thus, digital natives prefer to carry on more sincere and close interpersonal relations with their classmates and educators virtually (Garris & Fleck, 2022). As elicited by Aydın-Aitchison (2022), although the Gen Zers are regarded as innovative, creative and original individuals, such youth may distance themselves from their academicians and even their parents in cases of lack of technology. Hence, traditional methods of lecturing in the classroom settings are less effective and need to be enriched with educational technologies such as learning in virtual reality environments like Metaverse (Karahisar, 2013). Metaverse was initially coined by Stephenson (1992) to explain virtual settings, where individuals' perceptions and daily activities in real life are transferred to the digital space by certain equipment such as headsets and 3D glasses (Sanfilippo et al., 2022). Such artificial spaces allow learners to expand their learning by interactive educational equipments (Tlili et al., 2022).

1.4. Generation Z: Patterns of Technology Usage

Digitalization is at the center in every field from lifestyle to production, from health to education especially amid the COVID-19 pandemic (Zuo & Hong, 2022). Generation Z was born into the technology that determines today's trends and they are well-aware of the fact that the path of future passes through digital conformation (Tsatsou, 2021). Therefore, generation Z prepare themselves and their futures for digital transformations. Young people, who integrate their investments, education and future plans into digital, initiate a technology-driven transformation in their communication models as well (Abdullah et al., 2022). Generation Z individuals frequently opt to establish a comfortable communication model through social media within the framework of liberty, equality, mutual understanding and empathy (Kapoor et al., 2021).

Growing up during the tremendous expansion of the technological revolution, Gen Zers have intuitively interiorized high-tech habits and associated them with their social and personal attitudes (Gabrielova & Buchko, 2021). It is the generation that was born and inevitably live with technology, has the highest creativity and the most casualness in different communication platforms (Kolak et al., 2022). To elaborate, generation Z is often considered as pretty complicated and hyperactive individuals, who consume media products quickly and live fast compared to previous generations (Djafarova & Foots, 2022). Generation Z youth, which are distinguished from other generations by their commitment to technology, consider the Internet and mobile media such as smartphones as an imperative need for their social, personal and academic affairs (Menon, 2022).

Digital instruments that constituted for multipurpose, attract generation Z more and make them feel privileged (Zuo & Hong, 2022). Therefore, members of this generation prefer to socialize at home via the social media instead of playing outside and maintaining face-to-face interactions with others (Öngün, 2010). Individuals in this generation consider social media as the primary communication tool and best environment for socialization, due to its rapid information exchange (Dar & Nagrath, 2022). Generation Z do not only seek and acquire information, but also share what they know on websites or online blogs, which in turn facilitate the research of other people, who seek information online on particular issues (Payaprom & Payaprom, 2020). In this regard, it can be concluded that the digital natives, who are freely visible in the virtual space, can influence the masses through TikTok or Instagram (Wong et al., 2020). Social media's power to expand social circles enables Gen Zers to think and act outside the box. Hence, Z generation pursue their passions on an uncapped level through social media. For example, YouTube provides unlimited/free educational videos on a wide range of topics from teaching to initiating personal businesses, taken during real lectures at several reputable universities around the world, thus, the Internet turns everyone's dreams into reality in this digital era (Pires et al., 2022).

2. METHODOLOGY

The empirical data have been gathered using a quantitative survey method to encompass numeric representation of the issue studied. The following research questions have

been set to investigate digital natives' stimuli and perceptions in digital mediated academician-student interactions at tertiary education:

RQ1: To what extent do digital technologies alter digital natives' stimuli and perceptions regarding the technology-mediated communication in education during the COVID-19 pandemic?

RQ2: To what extent do digital technologies mediate digital natives' interpersonal communication at tertiary education during the COVID-19 pandemic?

RQ3: To what extent do the virtual educational technologies mediate and enrich teaching-learning strategies at tertiary education during crisis times?

2.1. Research Design and Sample

A descriptive quantitative research has been favored to shed light on digital natives' perceptions and feelings concerning the academician-student interactions at the major higher education institution in North Cyprus, a developing country, during the earlier stage of the virus called the SARS-CoV-2. In this respect, a total of 259 Z generation students (N=259) were reached. Participants were selected using the convenience sampling technique, which is one of the non-probability sampling methods that allows sampling from a conveniently close area. The majority of participants were from Middle East countries that are Turkey (23.5%), Iran (13.7%) Jordan (9.8%) and African countries such as Nigeria (17.4%). The data collection process was carried out by online questionnaires directed to Google Forms, which covers the period between the 25th of March 2020 and the 27th of May 2020 at four faculties which are Communication & Media Studies, Education, Engineering and Business and Economics.

2.2. Ethical Considerations

Consequently, all the official processes such as applying for faculties' ethics committees and university's "Research and Publication Ethics Board" have been completed by the researchers in the scope of ethical codes and transparency. As soon as all the research permissions obtained formally, an informed consent form and questionnaire were delivered to faculty deans and chairs. After a screening process and obtaining their permissions to collect data in their faculties and departments, the official data collection process had begun. Participants were informed regarding the study and their permissions were obtained with an informed consent form. Initially a pilot study was conducted to assess the validity and reliability of the questionnaire and research questions. Conducting a pilot study led to a minor alteration in few questions on a sentence basis, which increased the clarity intelligibility of questions.

2.3. Data Collection Tool

A questionnaire and scale were generated by researchers to serve the purposes of the present study. Experts on communication and education fields have contributed in the process of developing this questionnaire. The questionnaire consists of two major sections. The first section presents 16 multiple choice questions and the second part includes Likert Scale questions. A five-point Likert Questions from 5 to 1 (5: Strongly Agree, 4: Agree, 3: Undecided, 2: Disagree, 1: Strongly Disagree) have been used. There are 15 questions in the questionnaire

10.5824/ajite.2023.04.004.x

and 22 items in the scale. Since the questionnaire was formed specific to this study, validity and reliability tests were inevitable. Performing such tests proved that the Alpha Coefficient rate was 0.925. The Cronbach's Alpha affirms scale's authenticity and accuracy, which suggests the ratio between 0.7 and 0.95 for the studies to be conducted in humanities and social sciences (Tavakol & Dennick, 2011). Considering the value obtained after performing the reliability test (0.925), it could be said that this study is exceptionally reliable (see table 1 below).

Table 1: Cronbach's Alpha

Cronbach's Alpha	N of Items
.925	22

2.4. Data Collection Procedures

The questions/items that the questionnaire encompass were formed by researchers based on the scope and purposes of this research to collect data from the digital natives in higher education. The main theme of the data collection tool stands out as the digitalized academician-student interactions of the digital natives at the higher education amid the SARS-CoV-2. Due to the pandemic rules, traditional print-out surveys cannot be distributed to the participants, thus, the online questionnaire was prepared and distributed with the link in the Google Forms.

2.5. Data Analysis

As a result of conducting the online questionnaire, the data collected from Z generation learners (N=259) at tertiary education and the IBM SPSS Statistics 22 (Statistical Package for Social Sciences) was favored to analyze the data obtained. In this respect, descriptive statistics and frequency tables were taken into account when the votes of digital native learners were 50% and above. Conducting the KMO (Kaiser-Mayer-Olkin) and Bartlett's test proves that the sample ratio is convincing with =0.940>0.5 (see table 2). Additionally, when contemplating factor analysis, KMO and Bartlett's tests are crucial stages since they assist to establish whether the data have adequate intercorrelations across variables to justify dimensionality reduction strategies.

Table 2: KMO and Bartlett's Test

	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.940
Bartlett's Test of Sphericity	**Approx. Chi-Square**	4223.039
	df	351
	Sig.	.000

3. RESULTS AND DISCUSSIONS

The usage of mobile media technologies in education and communication has gained a momentum in recent years due to manifestation of the SARS-CoV-2 that commonly

acknowledged as the COVID-19 pandemic (Tran, 2022). In online education model that varies the duties and responsibilities of educators and learners greatly, the quality of education in these environments has begun to be discussed exhaustively.

Earlier discussions regarding the Z generation's increaing reliance over mobile media platforms are also confirmed by the 53.5% of the student participants, who mostly opt to initiate technology-mediated interpersonal communication (See table 3). This statement contradicts with the regular communication patterns of older generations, which, according to Faulkner et al. (2022) is beneficial because intergenerational tenets regarding the aging process, life experiences and communication patterns can be passed on among generations.

Table 3: Digital Natives' Communication Preferences in Academician-Student Interactions

Which one of the following do you prefer the most for interpersonal communication?	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Communicating through Social Media Platforms (e.g., WhatsApp, Facebook etc.)	128	53.5	53.5	91.5
Communicating face to face	109	39.0	39.0	39.0
Communicating on phone	15	5.8	5.8	97.3
Communicating through e-mail	7	1.7	1.7	100.0
Total	259	100.0	100.0	

The majority of the participants (65.3%) claim that mobile media technologies led to a shift from physical communication to digitalized interpersonal communication. While the 79.5% of the participants approve that the mobile communication platforms improve interpersonal relations between people, 54.4% of the Gen Z learners argue that the new technologies enhance individuals' communication skills (see table 4). While the majority of participants (76.4%) assert that the digital tools facilitate communication initiatives among individuals, 85.7% of the pandemic learners point out that they prefer technology-assisted communication more due to the absence of time and distance issues. The present study revealed that the majority of learners (89.6%) claim that computer-mediated education enables easier and faster access to information and learning materials. Since the technology-mediated education platforms are classified as interactive learning environments, social presence in interpersonal communication can be experienced by sender and receiver in their two-way communications. To elaborate, social presence can be defined as the communication between individuals through the digital tools feeling in the real environment and perceiving depth of relations with the community as it is in the physical settings (Zou et al., 2021). At the end of the data collection process, findings verified that the strongly agree/ agree rates that were provided by Gen Zers on the 5-point Likert Scale were considerably higher than the strongly disagree/ disagree and undecided rates. Therefore, in order to assure reliability and accuracy among findings, researchers solely decided to demonstrate the number of consensus in tables 4 and 5.

Table 4: Digital Natives' Responds to Digitalization of Academician-Student Interactions

[#]	**Items**	**Agree rates out of 259**	**Percentage [%]**

1	Digitalization enriches communication and education sources	218	84.1%
2	Digitalization improves interpersonal communication among academicians and students	206	79.5%
3	Digitalization facilitates the initiation of communication in the classroom	198	76.4%
4	Digitalization facilitates academician-student interactions	193	74.5%
5	Digitalization facilitates sincere interpersonal relations among academicians and students	191	73.8%
6	Digitalization encourages students' active participation in the classroom	189	73%
7	Digitalization eliminates the communication barriers between academicians and students	173	66.8%
8	Digitalization reduces face-to-face interactions	171	66%
9	Digitalization enhances communication skills among academicians and students	141	54.4%
10	Digital tools are more preferred for educational communication	128	53.5%

As illustrated in the table 4, although the majority of participants agree that mobile media facilities enhance interpersonal communication (79.5%), the findings proved that 46.5% of the participants still remain hesitant towards digital interpersonal communication. As mentioned earlier, the major portion of sample has been constituted by students from Middle Eastern and African countries. Even though the respondents were digital natives, such countries as Africa may still experience the digital divide. Despite the digital divide, >50% of the participants still provided positive responses on items regarding the use of mobile media technologies. So, Z generation learners still seem to be more hesitant considering the impacts of digital tools in interpersonal communication.

As portrayed in the table 5 below, 80.3% of Z generation learners assert that the new media technologies should take a significant part in instruction and learning processes. Recently implementing hybrid education approaches encompass both conventional and contemporary teaching methods in interactive environments, where various needs of students such as communication, education and entertainment are met simultaneously (Purba, 2021). As 84.1% of the learner participants declare, interactive learning platforms offer diverse and unique sources for accessing knowledge, which, in turn, allow the Z generation students to elevate their interpersonal communication with their classmates and instructors along with the quality of their assignments and projects (74.9%).

66.8% of the post-millenial students affirm that the usage of digital tools either in education or communication eliminate the existing and possible communication barriers among educators and learners. Removing communication impediments with the integration of digital tools ascend the effectiveness of interpersonal communication and teaching/learning. 74.5% of the respondents highlight that the usage of mobile media platforms such as WhatsApp and Facebook are crucial for the betterment of the academician-student relationships. Followed by 76.5% of the participants pointing out that the mobile communication technologies are also vital for academic achivement in higher education during the COVID-19 pandemic (see table 5). In this respect, 73.8% of the Z generation

participants confirm that taking advantage of mobile media apps such as WhatsApp class groups for educational matters allow students to build genuine and pacifist interpersonal relations with their academicians and classmates inside or outside of the school settings. As 83% of the Z generation learners underline, such online ensembles also ensure the continuity of learnings and social interactions regardless of formal settings. 64.4% of the participants report that incorporating educational technologies such as animated course videos at tertiary education is an effective way to improve teaching and learning. Apart from the contributions in teaching and learning processes, 73% of the learners from Z generation affirm that pursuing academician-student interactions outside of the school settings via mobile media make it easier for students to initiate an interaction in the classroom during crisis times. However, 85.3% of the participants confirm that the uncertainty amid the COVID-19 pandemic has normalized students' ignorance towards official working hours of professionals by establishing intense interactions with academicians almost 24 hours a day via social media platforms. As 52.1% of the digital natives participants assert, such distortions eventually lead to the major alterations in educators' roles in the classroom (see table 5). For instance, traditionalist academicians, who desire to be the only authority and source of information in the classroom, would never modify their roles according to the students' expectations (Szymkowiak et al., 2021). Contemporary instructors eager to utilize digital innovations in delivering lectures and the present research revealed that the Z generation learners are happier when education is computer-mediated and they take part in the decision-making processes in the classroom (63.3%). As table 5 illustrates, 72.6% of Z generation learners affirm that the use of technologies as means for teaching and learning facilitate the comprehension of information while 61.4% of them report that the educational technologies boost their motivations towards the courses. Stewart and Smith (2022) claim that the digital classes assisted with virtual reality instruments and mobile media tools, which can be exemplified as educational games, prompt learners to a better academic pathway by ascending their motivations. Followed by 51.9% of respondents underlining that embedding mobile communications to learning materials rise students' self-esteem, which results in active participation and uninterrupted attention in the classroom (see table 5). On the other hand, it is worthy stating the fact that the mobile communications decline face-to-face interactions among people (66%).

Table 5: Digital Natives' Responses to Usage of Educational Technologies at Tertiary Education

[#]	Items	Agree rates out of 259	Percentage [%]
1	Educational technologies ensure reaching diverse information	232	89.6%
2	Educational technologies extend educators' working hours	221	85.3%
3	Educational technologies encourage online class groups and reinforce learning-instruction	215	83%
4	Educational technologies should take part in the education system	208	80.3%
5	Educational technologies enhance academic achievement	198	76.5%
6	Educational technologies enhance the quality of learning	194	74.9%
7	Educational technologies facilitate students' comprehension of new information	188	72.6%
8	Educational technologies improve the quality of education	167	64.4%

9	Educational technologies equalize power between students and academicians, thus, students are included in the decision-making processes in class	164	63.3%
10	Educational technologies boost students' motivation to learn	159	61.4%
11	Educational technologies emerge student-centered approaches that turn educators into guides-facilitators	135	52.1%
12	Educational technologies elevate students' self-confidence	129	51.9%

CONCLUSIONS

This study attempts to divulge digital natives' feelings and perceptions concerning the digital academician-student interactions and teaching-learning at the higher education during the COVID-19 pandemic. This study confirms that the majority of digital native students at tertiary education choose to sustain mobile media assisted interpersonal communication, which confirms that in-person face-to-face communication is a second option for Z generation. In this regard, it is reported that the participants are well-aware of the fact that the nature of communication has been transformed from physical to digital space. Considering all, the major finding of the study that "digital technologies altered digital natives' stimuli and perceptions in higher education to a great extent" addresses the first research question. Yet, Z generation learners believe that the technology facilitate, enhance and elevate interpersonal communication among people. The reason appears to be related with the common belief that the information and communication technologies (ICT) make it easier for people to initiate two-way interactions. In this regard, the data exhaustively respond the second research question with the finding that the modern technologies mediate Gen Zers interpersonal communication to the significant and positive extent. Moreover, the majority of participants agreed upon items presented in the scale such as "digital tools elevate interpersonal communication, motivation and cultivate self-esteem of Z generation in higher education". When participants (*N*=259) were asked about interactive teaching and learning, the majority declare that they prefer blended education at tertiary education, which is the combination of traditional and modern teaching/learning methods. As participants affirm, technology-driven education foster digital natives' enthusiasm in courses considering the rapid and easy access to educational materials online. That is why, digital natives feel positive regarding technology-mediated communication and education. As the data assert, digitalization provides Gen Zers with a great assistance in their learnings by enabling them to explore new horizons in education and learn with enriched educational materials. Given all, these findings address the third research question and highlight how innovative technologies mediate teaching and learning strategies at tertiary education during such crisis times as the COVID-19 pandemic.

To conclude, there are abundant evidence parallel to the present study that the digital opportunities alter Z generation learners' perceptions and feelings positively by offering digitally-assisted communication and education during the COVID-19 pandemic at tertiary education. As declared by the majority of participants, the information and communication technologies in education gratify Z generation students' needs and expectations. This study also proves that the mobile communication tools improve students' academic achievements in universities. Research findings and the relevant literature affirm that the post-millenial

learners anticipate blended learning approaches from the educators at higher education especially in such crisis periods. Although the mobile media innovations lead to positive changes in the form of communication, the digital native learners approve that integration of digital tools have reduced face-to-face communication by shifting physical communication to the cyberspace. Yet, digital native learners are pretty happy with that alteration due to their technology affection. As this research further proves, digital native learners want digital-mediated communication and education, which serve more to students' cognitive, affective and psychological needs. Finally, the findings verify that screen-based lecturing and digital interpersonal relations are preferred by digital native learners during the COVID-19 pandemic.

REFERENCES

Aagaard, J. (2022). On the dynamics of Zoom Fatigue. Convergence: *The International Journal of Research into New Media Technologies, 28*(6), 1878–1891. https://doi.org/10.1177/13548565221099711

Abdullah, Z., Anumudu, C. E., & Raza, S. H. (2022). Examining the Digital Organizational Identity through Content Analysis of Missions and Vision Statements of Malaysian and Singaporean SME Company Websites. *The Bottom Line, 35*(2/3), 137–158. https://doi.org/10.1108/bl-12-2021-0108

Aydın-Aitchison, A. (2022). The Pandemic, the Pivot and Building from Remote Emergency Instruction to Quality Online Learning. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4088508

Azimi, S., Andonova, Y., & Schewe, C. (2021). Closer Together or Further Apart? Values of Hero Generations Y and Z during Crisis. *Young Consumers, 23*(2), 179–196. https://doi.org/10.1108/yc-03-2021-1300

Büttner, C. M., Gloster, A. T., & Greifeneder, R. (2021). Your Phone Ruins our Lunch: Attitudes, Norms, and Valuing the Interaction Predict Phone Use and Phubbing in Dyadic Social Interactions. *Mobile Media & Communication, 10*(3), 387–405. https://doi.org/10.1177/20501579211059914

Chen, J., & Bogachenko, T. (2022). Online Community Building in Distance Education: The Case of Social Presence in the Blackboard Discussion Board versus Multimodal VoiceThread Interaction. *Educational Technology & Society, 25*(2), 65–72.

Dar, S. A., & Nagrath, D. (2022). The Impact that social media has had on today's generation of Indian youth: An analytical study. *Morfai Journal, 2*(2), 377–386. https://doi.org/10.54443/morfai.v2i2.291

Demirdag, S. (2022). The mediating role of communication skills in the relationship between leadership style and 21st-century skills. *South African Journal of Education, 42*(2), 1–11. https://doi.org/10.15700/saje.v42n2a2053

Djafarova, E., & Foots, S. (2022). Exploring Ethical Consumption of Generation Z: Theory of Planned Behaviour. *Young Consumers: Insight and Ideas for Responsible Marketers 23*(3), 413–431. https://doi.org/10.1108/yc-10-2021-1405

Dumas, J. E., & Stough, R. A. (2022). When Influencers are not very influential: The Negative Effects of Social Media Verification. *Journal of Consumer Behaviour, 21*(3), 614–624. https://doi.org/10.1002/cb.2039

Errisuriz, V. L., Villatoro, A. P., & McDaniel, M. D. (2022). Contextualizing the Impact of the COVID-19 Pandemic on the Educational Experiences and Outcomes of Latinx College Students in Texas. *Journal of Latinos and Education, 21*(3), 319–334. https://doi.org/10.1080/15348431.2022.2052294

Faulkner, S. L., Watson, W. K., & Shetterly, J. (2022). Intergenerational Connections: An Online Community Engagement Project. *Communication Teacher*, 1–9. https://doi.org/10.1080/17404622.2022.2077973

Fortunati, L. (2022). The Smartphone between the Present and the Future: Five changes. *Mobile Media & Communication*, 1–6. https://doi.org/10.1177/20501579221131223

Gabrielova, K., & Buchko, A. A. (2021). Here Comes Generation Z: Millennials as Managers. *Business Horizons, 64*(4), 489–499. https://doi.org/10.1016/j.bushor.2021.02.013

Garris, C. P., & Fleck, B. (2022). Student Evaluations of Transitioned-Online Courses during the COVID-19 Pandemic. Scholarship of Teaching and Learning in Psychology, 8(2), 119–139. https://doi.org/10.1037/stl0000229

Giray, L. (2022) Meet the Centennials: Understanding the Generation Z Students. International *Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 2*(4), 9–18. https://doi.org/10.14456/jsasr.2022.26

Golob, B. (2022). Finding me in Social Me-dia: Teaching Students to use Social Networking Platforms legally and mindfully. *Communication Teacher*, 1-8. https://doi.org/10.1080/17404622.2022.2118340

He, G., & Zhang, Y. (2022). (Im) Mobility and Performance of Emotions: Chinese International Students' Difficult Journeys to Home during the COVID-19 Pandemic. *Mobile Media & Communication*, 1–23. https://doi.org/10.1177/20501579221119585

Hicks, L. J., Caron, E. E., & Smilek, D. (2021). SARS-CoV-2 and Learning: The Impact of a Global Pandemic on Undergraduate Learning Experiences. Scholarship of Teaching and Learning in Psychology. https://doi.org/10.1037/stl0000250

Ho, M. T., Mantello, P., Ghotbi, N., Nguyen, M. H., Nguyen, H. K. T., & Vuong, Q. H. (2022). Rethinking Technological Acceptance in the Age of Emotional AI: Surveying Gen Z (Zoomer) Attitudes toward Non-conscious Data Collection. *Technology in Society,* 70, 102011. https://doi.org/10.1016/j.techsoc.2022.102011

Holzer, B. M., Ramuz, O., Minder, C. E., & Zimmerli, L. (2022). Motivation and Personality Factors of Generation Z High School Students Aspiring to Study Human Medicine. *BMC Medical Education, 22*(1), 1–10. https://doi.org/10.1186/s12909-021-03099-4

Ivan, L. (2022). Interpersonal Communication in the Information Age: Opportunities and Disruptions. *American Behavioral Scientist*, 1–13. https://doi.org/10.1177/00027642221092801

Kapoor, P. S., Balaji, M., & Jiang, Y. (2021). Effectiveness of Sustainability Communication on Social Media: Role of Message Appeal and Message Source. *International Journal of Contemporary Hospitality Management*, *33*(3), 949–972. https://doi.org/10.1108/ijchm-09-2020-0974

Karahisar, T. (2013) "Dijital Nesil, Dijital İletişim ve Dijitalleşen (!) Türkçe," *AJIT-e: Online Academic Journal of Information Technology*, *4*(12), pp. 71–83. https://doi.org/10.5824/1309-1581.2013.3.006.x.

Karthika, I., Kalpanadevi, P., Mythili, L., Sugantha, M., & Parveen Banu, K. (2022). Impact of Social Media Marketing on Buying Behaviour: Comparison among Gen X, Millennial and Gen Z. *International Journal of Early Childhood Special Education (INT-JECS), 14*(3), 7827–7830. https://doi.org/10.9756/int-jecse/v14i3.931

Kinsky, E. S., Merle, P. F., & Freberg, K. (2021). Zooming through a Pandemic: An Examination of Marketable Skills gained by University Students during the COVID-19 Crisis. *Howard Journal of Communications, 32*(5), 507–529. https://doi.org/10.1080/10646175.2021.1965927

Kolak, A., Markić, I., & Horvat, Z. (2022). Parents' attitudes towards distance learning during the COVID-19 pandemic. *South African Journal of Education, 42*(3), 1–13. https://doi.org/10.15700/saje.v42n3a2129

Lengel, L. M., Mechehoud, M., & Newsom, V. A. (2022). Intercultural Communication, Creative Practice and Embodied Activisms: Arts-based Interculturality in the Maghreb. *Language and Intercultural Communication, 22*(2), 235–252. https://doi.org/10.1080/14708477.2022.2032122

Li, J., Liu, J., Yuan, R., & Shadiev, R. (2022). The Influence of Socially Shared Regulation on Computational Thinking Performance in Cooperative Learning. *Educational Technology & Society, 25*(1), 48–60.

Martínez, C., & Olsson, T. (2022). The Warm Expert—a Warm Teacher? Learning about Digital Media in Intergenerational Interaction. *Convergence: The International Journal of Research into New Media Technologies*, 1–17. https://doi.org/10.1177/13548565211070409

Mateus, J.-C., Andrada, P., González-Cabrera, C., Ugalde, C., & Novomisky, S. (2022). Teachers' Perspectives for a Critical Agenda in Media Education Post COVID-19. A Comparative Study in Latin America. *Comunicar, 30*(70), 9–19. https://doi.org/10.3916/c70-2022-01

Menon, D. (2022). Updating 'Stories' on Social Media and its relationships to Contextual Age and Narcissism: A Tale of Three Platforms – WhatsApp, Instagram and Facebook. *Heliyon, 8*(5), 1–11. https://doi.org/10.1016/j.heliyon.2022.e09412

Miller, A. N., Sellnow, D. D., & Strawser, M. G. (2020). Pandemic Pedagogy Challenges and Opportunities: Instruction Communication in Remote, HyFlex, and BlendFlex courses. *Communication Education, 70*(2), 202–204. https://doi.org/10.1080/03634523.2020.1857418

Moreno-Guerrero, A.-J., Soler-Costa, R., Marín-Marín, J.-A., & López-Belmonte, J. (2021). Flipped Learning and Good Teaching Practices in Secondary Education. *Comunicar, 29*(68), 107–117. https://doi.org/10.3916/c68-2021-09

Ntshangase, S. Z. (2022). Interactive pedagogy elevating learners as producers of knowledge in the isiZulu classroom. *South African Journal of Education, 42*(2), 1–11. https://doi.org/10.15700/saje.v42n2a2095

Öngün, E. (2010) "Öğrenmede Ağ Kullanımı," *AJIT-e: Online Academic Journal of Information Technology*, 1(1), pp. 13–14. https://doi.org/10.5824/1309-1581.2010.005.x.

Payaprom, S., & Payaprom, Y. (2020). Identifying Learning Styles of Language Learners: A Useful Step in Moving towards the Learner-centred Approach. *Dil ve Dilbilimi Çalışmaları Dergisi, 16*(1), 59–72. https://doi.org/10.17263/jlls.712646

Pires, F., Masanet, M.-J., Tomasena, J. M., & Scolari, C. A. (2022). Learning with YouTube: Beyond Formal and Informal through New Actors, Strategies and Affordances. *Convergence: The International Journal of Research into New Media Technologies, 28*(3), 838–853. https://doi.org/10.1177/13548565211020545

Proszek, J. M. (2019). Developing a Digital Voice: Embedding Digital Communication Networks, Platforms, and Technologies in the 21st-century Classroom. *Journal of Communication Pedagogy*, 2, 127-133. https://doi.org/10.31446/JCP.2019.22

Pugachev, A. A. (2022). Analysis of Russian and global game studies: ludology vs. narratology. RUDN *Journal of Studies in Literature and Journalism, 27*(4), 823–832. https://doi.org/10.22363/2312-9220-2022-27-4-823-832

Purba, R. A. (2021). The Effectiveness Combination of Blended Learning and Flipped Classroom with Edmodo as a Digital Media Innovation for Learning from Home. *Journal of Education Technology, 5*(3). https://doi.org/10.23887/jet.v5i3.36210

Rosen, D. J. (2022). Technology for Simultaneous Blended or Flex (HyFlex or BlendFlex) Instruction. Adult Literacy Education: *The International Journal of Literacy, Language, and Numeracy, 4*(2), 76–80. https://doi.org/10.35847/drosen.4.2.76

Sanfilippo, F., Blazauskas, T., Salvietti, G., Ramos, I., Vert, S., Radianti, J., Majchrzak, T. A., & Oliveira, D. (2022). A Perspective Review on Integrating VR/AR with Haptics into STEM Education for Multi-Sensory Learning. *Robotics, 11*(2), 41. https://doi.org/10.3390/robotics11020041

Sartor Harada, A., Azevedo Gomes, J., Ulloa Guerra, O., Ruiz, R., & Calderón, R. (2022). Digital competencies: perceptions of primary school teachers pursuing master's degrees from eight African countries. *South African Journal of Education, 42*(3), 1–11. https://doi.org/10.15700/saje.v42n3a2063

Stewart, N. K., & Smith, R. (2022). Networked Students Gaming Together: Mobile Scavenger Hunts for Online Classrooms. *Communication Teacher*, 1–7. https://doi.org/10.1080/17404622.2022.2062018

Szymkowiak, A., Melović, B., Dabić, M., Jeganathan, K., & Kundi, G. S. (2021). Information Technology and Gen Z: The Role of Teachers, the Internet, and Technology in the Education of Young People. *Technology in Society,* 65, 101565. https://doi.org/10.1016/j.techsoc.2021.101565

Tarihoran, N., Fachriyah, E., Tressyalina, & Sumirat, I. R. (2022). The Impact of Social Media on the Use of Code Mixing by Generation Z. *International Journal of Interactive Mobile Technologies (iJIM), 16*(07), 54–69. https://doi.org/10.3991/ijim.v16i07.27659

Tavakol, M., & Dennick, R. (2011). Making Sense of Cronbach's Alpha. *International Journal of Medical Education*, 2, 53-55.

Tech, H. T. (2022, June 30). Get your animated WhatsApp avatar soon; here is how it works. HT Tech. Retrieved August 26, 2022, from https://tech.hindustantimes.com/how-to/get-your-animated-whatsapp-avatar-soon-here-is-how-it-works-71656591698652.html#:%7E:text=Animated%20Avatars%20on%20WhatsApp,-WABetaInfo%20shared%20a&text=All%20you%20will%20need%20to,chats%20and%20groups%20on%20WhatsApp.

Tlili, A., Huang, R., Shehata, B., Liu, D., Zhao, J., Metwally, A. H. S., Wang, H., Denden, M., Bozkurt, A., Lee, L. H., Beyoglu, D., Altinay, F., Sharma, R. C., Altinay, Z., Li, Z., Liu, J., Ahmad, F., Hu, Y., Salha, S., . . . Burgos, D. (2022). Is Metaverse in Education a Blessing or a Curse: A Combined Content and Bibliometric Analysis? *Smart Learning Environments, 9*(1). https://doi.org/10.1186/s40561-022-00205-x

Tran, V. D. (2022). Perceived Satisfaction and Effectiveness of Online Education during the COVID-19 Pandemic: The Moderating Effect of Academic Self-efficacy. *Higher Education Pedagogies, 7*(1), 107–129. https://doi.org/10.1080/23752696.2022.2113112

Tsatsou, P. (2021). Aging: The Two Faces of Janus in Digital Inclusion? *International Journal of Communication*, 15, 1309–1329.

Tutgun, A. and Özdener, N. (2011) "Bilgi ve İletişim Teknolojilerinin Eğitime Entegrasyonu: Bilgisayar Tabanlı Öykü Tamamlama Çalışması Örneği," *AJIT-e: Online Academic Journal of Information Technology*, 2(3), pp. 1–2. https://doi.org/10.5824/1309-1581.2011.2.003.x.

Valkenburg, P., Beyens, I., Pouwels, J. L., van Driel, I. I., & Keijsers, L. (2021). Social Media Use and Adolescents' Self-esteem: Heading for a Person-specific Media Effects Paradigm. *Journal of Communication, 71*(1), 56–78. https://doi.org/10.1093/joc/jqaa039

Wang, H.-Y., & Sun, J. C.-Y. (2022). Influences of Online Synchronous VR Co-Creation on Behavioral Patterns and Motivation in Knowledge Co-Construction. *Educational Technology & Society, 25*(2), 31-47.

Wei, R. (2022). Evolving Mobile Media: Changing Technology and Transforming Behavior. *Mobile Media & Communication*, 1–5. https://doi.org/10.1177/20501579221131448

Wong, L., Tan, G. W., Hew, T., Ooi, K., & Leong, L. (2020). Mobile social media marketing: a new marketing channel among digital natives in higher education? *Journal of Marketing for Higher Education, 32*(1), 113–137. https://doi.org/10.1080/08841241.2020.1834486

Youth: An Analytical Study. *International Journal of English, Literature and Social Science,* 7(4), 048056. https://doi.org/10.22161/ijels.74.8

Yue, Z., Zhang, R., & Xiao, J. (2023). Social media use, perceived social support, and well-being: Evidence from two waves of surveys peri- and post-COVID-19 lockdown. *Journal of Social and Personal Relationships*. https://doi.org/10.1177/02654075231188185

Zhou, J., & Charoensukmongkol, P. (2022). Cultural Intelligence and Adaptive Selling Behaviors in Cross-cultural Selling: The Cognitive Resource Theory and Social Role Theory Perspective. *Journal of Business Research*, 146, 477–488. https://doi.org/10.1016/j.jbusres.2022.03.079

Zou, W., Hu, X., Pan, Z., Li, C., Cai, Y., & Liu, M. (2021). Exploring the Relationship between Social Presence and Learners' Prestige in MOOC Discussion Forums Using Automated Content Analysis and Social Network Analysis. *Computers in Human Behavior*, 115, 106582. https://doi.org/10.1016/j.chb.2020.106582

Zuo, X., & Hong, Z. (2022). The Impact of Digital Technology on Land Rent-Out Behavior: Information Sharing or Exclusion? *Agriculture, 12*(7), 1046. https://doi.org/10.3390/agriculture1207104

APPENDIX: Ethical Approval Form

Doğu Akdeniz Üniversitesi
"Erdem, Bilgi, Gelişim"
Eastern Mediterranean University
"Virtue, Knowledge, Advancement"
99628, Gazimağusa, KUZEY KIBRIS / Famagusta, North Cyprus, via Mersin-10 TURKEY
Tel: (+90) 392 630 1995
Faks/Fax: (+90) 392 630 2919
E-mail: bayek@emu.edu.tr
Etik Kurulu / *Ethics Committee*

Reference No: ETK00-2020-0121 06.04.2020

Subject: Your application for ethical approval.

Re: Ahmet İyici (18500078)

Faculty of Communication and Media Studies.

EMU's Scientific Research and Publication Ethics Board (BAYEK) has approved the decision of the Ethics Board of Communication (date: **02.03.2020**, issue: **70**) granting Ahmet İyici from the Faculty of Communication and Media Studies to pursue with his MA thesis work titled **"The Impacts of New Media Technlogies on Interpersonal Communication : Case Study of Teacher Student Interaction at EMU"** supervised by Assist. Prof. Dr. Ülfet Kutoğlu Kuruç.

Prof. Dr. Yücel Vural
Chair, Board of Scientific Research and Publication Ethics - EMU

YV/ns.

www.emu.edu.tr

ABA
Akademik Bilişim Araştırmaları Derneği

Suadiye Mah. Kazım Özalp Sok. No:15 Kat:2
Şaşkınbakkal Kadıköy/İSTANBUL
Tel: 0216 355 56 19 • Fax: 0216 368 43 30
www.abilar.org