Digital Education Products: Can Digital Education Products Affect GDP Growth?

AFAG HUSEYN[1], ELNURA SHAFIZADE[1], SUGRA HUMBATOVA[2], TAHMASIB HUSEYNOV[3]
[1]Department of Business Administration, UNEC Business School,
Azerbaijan State University of Economics (UNEC),
Istiqlaliyyat str. 6, Baku,
AZERBAIJAN

[2]Department of Economics,
Azerbaijan State University of Economics (UNEC),
Istiqlaliyyat str. 6, Baku,
AZERBAIJAN

[3]International Center for Graduate Education,
Azerbaijan State University of Economics (UNEC),
Istiqlaliyyat str. 6, Baku,
AZERBAIJAN

Abstract: - The widespread use of new information and communication technologies in education has changed the nature of the general economic environment. There is an increase in digital educational resources all over the world. However, what is the weight of the business of digital education products in GDP and how this business affects GDP growth? The paucity of literature on the relationship between digital educational products and GDP calls for a thorough study of this relationship. The article is devoted to an analysis of the relationship between digital educational products and GDP. This is one of the problems with the development of the digital economy. Our main research hypothesis is to find the level of connection between digital educational products (resources) and GDP, as well as the level of influence of qualitative and quantitative factors on this connection. It should be noted that the absence of many statistical data during the analysis made our work difficult, and many factors are of a qualitative or fuzzy nature. Based on such indicators, econometric models are not suitable for determining the dependence of a factor on other parameters. The study used the statistical data of Azerbaijan for 2010-2020. The fuzzy output logic method was implemented in the MATLAB software package. It was revealed that digital educational products affect the growth of the GDP and the balanced development of the country. The approach proposed in this paper is that the digitalization of education and the improvement of public education and technology policies should continue. We believe that in connection with the growth of the digital education market, the State Statistics Committee will need to generate specific data on digital educational products in the future.

Key-Words: - Digital economy, Digital educational, GDP, Development, Education and technology policy, Fuzzy Model

Received: April 14, 2023. Revised: September 22, 2023. Accepted: October 1, 2023. Published: October 13, 2023.

1 Introduction

Our research shows that in recent decades, the world economic system has taken on a new look that is associated with virtual and intangible factors: information, investment, technology, labor, intellectual and financial resources, management systems, political, and in some cases, even religious processes, [1]. The fundamental changes that characterize the new economic system require a reassessment of hitherto known scientific theories and approaches. Theoretical results and postulates typical of industrial economy laws are unable to explain a number of processes and situations of the new economic system in the era of globalization, and the emergence of new guidelines and priorities places the state in charge of revising its economic system and policies as well as selecting mechanisms for implementing its directions.

The globalization of the world economy is primarily characterized by the emergence of qualitative changes in the real sector of the economy and the infrastructure sector.

Preference is given to the production of high-tech and science-intensive products as the final product, which gradually creates conditions for strengthening the exchange of technologies in international trade.

The information capacity of products is increasing, and more attention is being paid to their quality indicators. For example, in computers, the cost of materials is only 2% of the cost of microprocessors, and the cost of information components in expensive cars is 2/3 of their price. Hence, it becomes clear that the importance of raw materials in foreign trade is gradually declining. The fact that high technology is the monopoly of industrialized countries and transnational corporations is a negative situation. That is, there are changes in the system of the world economic hierarchy, which, as a result, shows that the processes of monopolization in the modern world economic system, in part, exist in technology, modern education, fundamental and applied science, the media, and highly qualified personnel. Speaking of industrialized countries, I would like to note that it would be more accurate to call such countries more technologically and informationally advanced. Because the proportion of people employed in these countries is only 20% of industry, and the rest are employed in the service and technology sectors, [2]. As a result, these countries, becoming centers of income from these technologies, and also centers of new applied technologies, attract potential scientific and technical personnel. As a result, countries deprived of such opportunities face both a shortage of specialists and a situation where "brains and intellects" leave their countries. Another question is whether the development of ICT and the mass use of "online" communication have changed the structure of "space-time-matter", that is, the essence of existence. Thus, in society and its development, changes began to occur. Large masses of people were able to reduce time and expand space by sharing "everyone with everyone" (peer-to-peer). In economic terms, such a situation led to the appearance of virtuality. Loyalty not only covers production spheres related to trade, but also plays a role in increasing the independence of the spheres of knowledge and education and the capital invested in them.

Traditional mass media are replaced by websites, and new information carriers are created. They also develop network platforms, forming a new economic environment, and as a result, global networks of economic influence are created, [3]. For example, Google, Facebook, etc. They collect information about wishes and aspirations, demand characteristics, and participate in its formation, creating a database and influencing the creation of a new economic environment. Thus, world economic processes have a new volume of information, and the current vector of changes even sometimes becomes unpredictable. This means that the theories and laws that have previously worked in the real economy may no longer be able to fully explain and operate in a variety of processes. That is, new laws for the new economic system are formed. It is clear that the analysis of changes in the real sector is not enough for the analysis of the virtual economy. However, the system of indicators for the virtual economy has not yet been fully formed, and research in this area continues, [4]. Turning to theory, it should be noted that modern economic growth, which is the main indicator, is perceived when the GDP growth rate constantly exceeds the population growth rate. This was seen as a new phenomenon in the history of the world and the economy. On the other hand, the law of diminishing returns in traditional economic theory can no longer explain a number of processes in the modern era and does not apply to them. That is, as information products spread, in volume and scale, they generate more income, and this income opportunity can be applied in the long term.

Despite the high fixed costs and low variable costs of an information product, the original product is expensive to create, but as the scale of production increases, re-production becomes cheap. This leads to a sharp increase in the intensity of the income generated due to the increasing scale of the virtual economy. But “because so many of the internet services and digital products we each use are free, they largely go uncounted in official measures of economic activity such as GDP and productivity (which is simply GDP/hours worked). The contribution of the information sector as a fraction of the total GDP has barely changed over the past 40 years (hovering between 4-5% and reaching a high of only 5.5% at the end of 2018). The reason is that GDP is based on what people pay for goods and services, so if something has zero price, then it has zero weight in GDP”, [4]. This problem is growing every year, and so far, digital educational products have not fully reflected in GDP growth.

The expansion of digital data flows is important for the achievement of virtually all the Sustainable Development Goals. The COVID-19 pandemic had a dramatic impact on Internet traffic, as most activities increasingly took place online. Against this backdrop, global Internet bandwidth rose by 35 percent in 2020, the largest one-year increase since 2013. Monthly global data traffic is expected to surge from 230 exabytes in 2020 to 780 exabytes by 2026, [5].

Digital education is defined as an inventive method of using digital technologies and tools that is carried out during the whole process of teaching and learning. Post-pandemic growth in investment in education technology is linked to the recent rapid "digitization" and "identification", [6], [7]. The global digital education market is expected to be valued at USD 77.23 billion by 2028 and to grow at a compound annual growth rate (CAGR) of 30.5% during the forecast period, [8]. The global online education market promises to reach $282.62 billion by 2023. According to Global Market Insights, in 2017, it was measured at $159 billion; in 2018, it was $190 billion; and in 2019, it was $205 billion. Its average annual rate of growth in the next 5–7 years, according to various forecasts, will be 7–10% (in global reports, they take an average figure, adjusted for the fact that the growth of the industry is uneven), [9].

In the digital economy, the focus is on owning and controlling digital assets with permanent future economic benefits, [7], [10]. What matters is the ownership and control of digital platforms, shared content, digital user data collected, and associated copying or intellectual property rights. We understand that educational technology is embedded in broader shifts in the global digital economy, where resources, services, or data sources that can be created as property bring future and permanent economic benefits through forms of economic rent, [7], [11]. Intellectual property in digital education can be classified as "returnable income". potential as "expected future cash flows", [7], [12].

As we can see, the digital education market is constantly growing, and the volume of digital educational products is growing along with it, which are often improved. Our main research hypothesis postulates a link between digital educational products and GDP. An increase in the number of digital educational products may increase their weight in the structure of GDP, which may eventually affect its growth. Based on this, we set ourselves the task of identifying the relationship between digital educational products and GDP. It has been determined that the literature on the relationship between digital educational products (resources) and GDP is insufficient, and a comprehensive study of this relationship has not been conducted. Our main research hypothesis is to find the level of connection between digital educational products (resources) and GDP, as well as the level of influence of qualitative and quantitative factors on this connection.

The article is structured as follows: In the second section, we outline digital education and digital educational products. In the third section, we review the literature and point out existing research gaps. After that, we outline the missing statistics and research methods and the construction of logical rules based on expert reasoning. This section is followed by the results obtained. In the final section, we give conclusions, directions for future research, and a list of used literature.

2 Digital Educational

Changes in the world and capital embodied in market knowledge are valued more than capital reflected in material form. This reflects the formation of a new world, a new society, a new system of relations, a completely different way of thinking and principles of interaction, and a knowledge economy with high dynamism in time and space. Let's note one point. But what is meant by the knowledge economy? It should be noted that it is frequently associated with the information and network economies, not separately, but all together in a number of works of literature, [13], [14], [15], [16], [17]. But there are principles that the knowledge economy itself refers to. Basically, this is the presence of a person's internal potential, abilities, talent, and non-standard approach to various processes and events. In a nutshell, these are principles formed on the basis of a person's psychological, spiritual, and socioeconomic values. Today, not only innovations but also a person's, his leading role in economic growth and increasing the competitiveness of the country are becoming more and more discussed, [18], [19], [20], [21]. The sharp increase in the exchange of information and the acceleration of economic dynamism ultimately create a demand for increased knowledge. To achieve the transition to a low-carbon and resource-saving economy, we need to introduce new tools, technologies, products, and production models through education, [22]. Considering that only knowledge creates more knowledge, its increase can lead to the enrichment of intellectual resources and increase their productivity. In other words, the acquisition of knowledge does not reduce them as a resources, but, on the contrary, increases them. Thus, this process spreads from one person to the whole society. We can say that the dissemination of knowledge is limited to the use of patents and licenses as a result of intellectual creativity. The predominance of the fourth-fifth technological structure may lead to their lagging behind in the competitive struggle and the loss of their positions on the world market compared to countries that are already using the advantages of the new technological structure in the context of globalization. On the other hand, the fact that knowledge is a product, different from information and ordinary resources, requires that it be treated not only as a main resource and product but also as a management tool. Therefore, in the new economic model, the approach to this problem is changing, the right to individual use of knowledge is limited, and the opportunities for its use by society are gradually increasing. At this time, it is necessary not to use a person as a resource but to use his internal capabilities to create conditions for the development of personality and an external environment for self-development and the perfection of moral values. At that time, the Prime Minister of India, Jawaharlal Nehru, pointed out in his book that "the very rapid growth of technology and the practical application of vast developments in scientific knowledge are now changing the world picture with amazing rapidity, leading to new problems", [23]. New technologies require new thinking. If we pay attention to the experience of developed foreign countries, we will see that this is an increase in the creative and intellectual activity of a person. This has already begun to manifest itself as one of the defining competitive advantages and in some cases, the most important one. Every day, a new class is formed and grows—the creative class (strata). There is a growing need to increase opportunities for human creativity, intellectual activity, and the expansion of opportunities for creativity. As a result, in the conditions of globalization, the formation of the ability to transition from creative groups to a creative society and the use of "global streams of talent" are required. This is possible with the development of new methods, technologies, transmitters of information, and means of communication. After the pandemic, certain studies explained how sustainable development goals represent the interrelationship between digitalization and sustainability, [24]. Building digital networks, business managers, and policymakers using digital means can create some unique opportunities to strategically address sustainable development challenges for the United Nations Targets (SDG) to ensure higher productivity, better education, and an equality-oriented society. The idea of data-driven governance introduced in the 2030 Agenda for Sustainable Development emphasizes the need to "significantly increase the availability of high-quality, timely, reliable, and disaggregated data by 2030", [24], [25]. Digital educational resources play a special role in this process.

It is clear that the use of electronic resources in the educational process creates a number of opportunities. The presentation of educational materials in digital format allows you to conduct lessons more effectively and check the level of knowledge interactively; more complex experiments do not require additional resources. The government has taken a number of steps to expand the use of electronic resources in the educational process. "Program of Provision of General Education Schools of the Republic of Azerbaijan with Information and Communication Technologies for 2005-2007" was adopted. Within the framework of the state program, 37.9 thousand copies of 20 names of the history of Azerbaijan, 15, 160 million copies of electronic textbooks on eight names of chemistry, 22, 740 million copies of 12 names of electronic textbooks on biology, 10, 2 thousand copies of the history of Azerbaijan, etc. were prepared.

Since the adoption of the "State Program of Informatization of the Education System of the Republic of Azerbaijan for 2008-2012", the creation and use of electronic resources in the educational process have expanded even more. As part of this state program, 122 electronic lessons on 8 subjects (physics, chemistry, biology, geography, literature, mathematics, computer science, and music) are available on the National Educational Portal (www.edu.az). On the portal there are such electronic resources as "The message of the heritage of Azerbaijan", "The virtual museum of Uzeir Hajibekov", "Living voices of the history of Azerbaijan", "Language Learning Inserts" and "Learning English". Also, as an example, you can give INFOKO resources for primary classes. To evaluate the quality of electronic resources, the Ministry of Education created the Council for the Evaluation of Electronic Educational Resources.

In addition, the electronic learning platform Intel SKOOOL is adapted to the education system of Azerbaijan, and 400 electronic lessons are adapted to the portal www.skoool.edu.az. As a result, an archive of more than 2000 electronic resources was formed in 2010-2012.

Due to the COVID-19 pandemic, mainly since 2020, electronic lessons and textbooks have become the basis of educational resources in the education system of Azerbaijan.

Along with these positive changes, there are also many problems. The main problems can be formulated in four groups:

1. Obstacles on the way to increasing the share of intangible assets in GDP
2. Problems with defining and protecting intangible asset property rights
3. Low operability of information for authors
4. Difficulties of adapting to the requirements of a new technological system

We will focus our study on the analysis of the relationship between GDP and digital educational products (resources), paying more attention to the problem of group I.

To do this, we conducted a series of analyses.

3 Literature Review

The following section provides a brief overview of the existing literature on and related to the relationship between digital education and GDP. The rest of the article is structured as follows: Section 4 discusses the data and methodology used in our analysis, including any limitations. Section 5 presents the results of our model, and Section 6 discusses these results and their implications for our research hypotheses. Finally, the final section summarizes the main findings and provides direction.

3.1 Relationship between Digital Education and GDP, Economic Development

The difference between our article and other articles of this type is that there is a direct link between digital education and GDP. The main difference between the current study and the available literature is as follows: this article examines the impact of both qualitative and quantitative indicators on GDP. Such quantitative indicators as the weight of products (resources) of digital education in GDP, the use of web pages (Internet portals), software development, the number of products (services) in the field of ICT, Internet communication, and the number of employees working in the field of ICT in many countries attach great importance to determining the level of development of the information society. However, we assume that the development of the digital educational market is particularly influenced by the quality of the digital educational product. Because customer satisfaction is of great importance in the reuse and distribution of this product, this affects the volume of their sales, which can directly affect the growth of the GDP. Therefore, unlike other studies, we consider the impact of such qualitative indicators as the flexibility of use in all specialty profiles and satisfaction with product quality. Using these indicators for analysis can give an idea of the potential for GDP growth in countries where digital education exists. Our study will help determine the level of influence of the flexibility of using digital products in all specialty profiles and satisfaction with the quality of digital educational products on GDP. We believe that by stimulating an increase in the quality and flexibility of the use of educational products, it is possible to achieve not only the development of the information society but also the growth of the GDP. The literature reviewed by us showed that there are no studies on the impact of the above qualitative and quantitative indicators on GDP using the fuzzy logic method.

Studies mainly cover the impact of education on GDP and economic development, [26], [27], [28], [29], [30], [31], [32], [33], [34]. We started the literature review with general studies and presented them in the following order: Using panel data from 2000 to 2014 from the education and technology sectors in 53 countries, discovered and assessed the relationship between education and technology efficiency and national competitiveness, national balanced development, national energy efficiency, exports, employment, and also nationwide macro- and micro-development, [35]. It has been determined that educational and technological efficiency contribute to overall development to varying degrees, depending on the dynamics of economic development and the direction of educational and technological policy, and the effect has been assessed. It has been determined that educational and technological efficiency contribute to overall development to varying degrees, depending on the dynamics of economic development and the direction of educational and technological policy. Here, for the first time, efficiency was used as a driving force to measure the impact on a country's development. We also used this as a driving force in our study to measure the impact of digital educational products (resources) on GDP. According to Lazović et al., the most important factor influencing GDP growth in middle-income countries is investment in education, while infrastructure plays a leading role in economic growth in high-income countries, [36]. The most important factor is education, since the coefficient of influence of this factor is positive and has a maximum value. Thus, an increase in all educational variables with a positive sign, such as government spending on education, adult and youth literacy rates, and the population, leads to faster economic growth. [37], examined the relationship between education, digitalization, and financial development between 1996 and 2019 using the BVAR model to demonstrate the differences between developed and emerging economies in Europe and concluded that financial development, including its two main components, financial institutions and financial markets, demonstrate the dynamic interdependence between digitalization and education. In addition, education was also identified as the leading variable in the financial development, education, and digitalization package. They also note that there are corresponding geographic differences between Western, more developed, and Eastern, emerging economies, and that while developed countries are approaching their full potential in terms of levels of digitalization, education, and financial development, developing countries still have significant potential for growth, as the results in, [36], confirm above, highlighting that many developing European countries have experienced a high level of digitalization in recent years but less progress in education and financial development. In addition, [38], considered education as important among many factors influencing the poverty rate, which is the main macroeconomic indicator of economic development and economic growth, and quantitatively analyzed the relationship between the average year of schooling and per capita gross domestic product income and found that this relationship was significant in China and a positive correlation was found. [39], proved the importance of the digital transformation of education and higher education institutions for sustainable development on a scientific and practical basis. In, [40], they conducted a systematic review of articles related to innovative approaches to the sustainability of digital education in their research and sought answers to questions such as "What are the main challenges of sustainability in digital education and how to overcome these challenges associated with educational innovation?".

Barro found a positive relationship between years of schooling and economic growth in almost 100 countries from 1960 to 1995, [26]. [41], examined the relationship between investment in ICT, education, and health in five West African countries and noted that additional investment in health and education beyond ICT itself has a significant impact on human development. [34], examined the impact of both secondary and tertiary education on economic growth in Spain over the period 1971–2013, highlighting their importance for economic growth. In, [33], were able to shed light on the contention that secondary and tertiary education played a central and important role in economic growth in India between 1975 and 2013, between 2016 primary education. [42], examined whether education contributes to economic growth in 45 sub-Saharan African countries from 1993 to 2015 and concluded that the Internet has a positive effect on economic growth in countries with better access to education. In addition, [43], studied the impact of tertiary education on gross domestic product (GDP) per capita in EU regions and found that the most favorable relationship between GDP per capita and tertiary education was in Central and Northern Europe and Ireland, while in southern Russia as well as in some regions of Eastern Europe, this relationship was determined to be weak.

3.2 Application of Fuzzy Logic in Economic Processes

Fuzzy logic is widely used in modeling various types of economic processes. Such as in, [44], which applied fuzzy logic inference rules to a model for optimizing the production and sectoral structure of agriculture to ensure food security. [45], applied fuzzy logic to profit optimization in virtual businesses. In, [46], attention is paid to risk assessment optimization for decision support using an intelligent model based on fuzzy inference and renewable rules. In their research, [47], they assess the stability of the banking system based on fuzzy logic methods. In, [48], investigate a decision-making model based on fuzzy inference to predict the impact of SCORÂ® indicators on customer perceived value. In their approaches, [49], review using fuzzy inference systems for the creation of forex market predictive models.

Research shows that the relationship between GDP and digital educational products is understudied. There is a strong need to use mathematical modeling to measure the impact of digital educational products on GDP. Such mathematical models allow to predict GDP depending on the volume of digital educational products.

Fuzzy logic is one of the most widely used direction in mathematical modeling of economic processes. This is due to the nature of the economic system and processes. In the article, fuzzy logic inference method was used to measure the impact of digital educational products on GDP. The reasons of this are further explained in the next section.

4 Materials and Methods

It should be noted that the absence of many statistical data (the volume of digital educational products produced in piece or total terms; sales of these products; frequency of use of these products, the cost of digital educational products; the number of personnel involved in the development of a digital educational product, and others) during the analysis made our work difficult, and many factors are of a qualitative or fuzzy nature. Based on such indicators, econometric models are not suitable for determining the dependence of a factor on other parameters. Various mathematical methods are used to work with qualitative or fuzzy indicators. The method of fuzzy inference systems (FIS) is one of them, [44], [45], [46], [47], [48], [49], [50], [51], [52], [53], [54], [55], [56], [57], [58]. This system was proposed in 1975 by Ebhasim Mamdani. Basically, it was anticipated to control a steam engine and boiler combination by synthesizing a set of fuzzy rules obtained from people working on the system. This method allows you to determine the dependence using both quantitative and qualitative indicators, as well as fuzzy indicators. Therefore, in our study, we use the method of fuzzy inference systems. In the analysis, we used data that is publicly available to the State Statistics Committee and is shown in Table 1.

— The decision making block: Performs an operation on the rules.
— Fuzzification Interface block: It converts crisp quantities into fuzzy quantities.
— Defuzzification Interface block: It converts fuzzy quantities into crisp quantities.

The block diagram of the fuzzy inference system is given in Figure 1.

We'll apply a fuzzy inference system for defining the weight of digital education products (resources) in GDP, [44], [45], [46], [47], [48], [49], [56], [57], [58].

Functional blocks of fuzzy inference systems (FIS) are, [44], [45], [50], [51], [52]:
— Rule Base: It contains fuzzy IF-THEN rules.
— Database: This block defines the membership functions of fuzzy sets used in fuzzy rules.

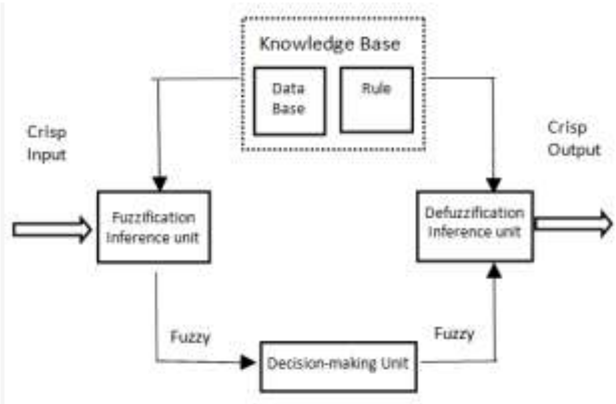

Fig. 1: Block diagram of the fuzzy inference system
Source: FuzzyLogic.pdf (northeastern.edu)

Table 1. Statistical data of Azerbaijan in the 2010-2020 years. (stat.com.az)

Years	Usage of web pages (internet portals) (1000 USD)	Software development (1000 USD)	Amount of products and services in the ICT sector (million USD)	Internet communication (1000 USD)	Number of employees working in the ICT sector, (1000 person)
2010	0.250657977	3166.186239	1436.520867	51678.15516	17,3
2011	86.33184997	6170.120788	1572.027972	78570.88366	17,5
2012	193.5031847	6206.496815	1809.171975	109969.4268	17,6
2013	181.6443595	12814.27661	1947.737412	125469.7259	17,9
2014	792.7078021	16886.28251	2011.09128	141361.5502	18,0
2015	502.3085802	11122.86777	1019.109914	72151.98153	18,3
2016	1177.443949	12743.32185	878.6920427	67379.5674	18,5
2017	1155.932004	19135.6979	992.8827716	78049.5265	19,0
2018	1257.808364	24364.56679	1074.525028	85477.32486	19,3
2019	2492.912182	39789.77707	1225.339686	92407.50544	19,9
2020	2234.221516	41509.20534	1361.802247	117161.3435	20,1

Source: https://www.stat.gov.az/source/information_society/ (01.11.2022)

Steps for computing the output by the method FIS are as follows, [50], [51], [52]:
Step 1. determining a set of fuzzy rules;

Step 2. fuzzifying the inputs using the input membership functions;
Step 3. combining the fuzzified inputs according to the fuzzy rules to establish a rule strength;
Step 4. finding the consequence of the rule by combining the rule strength and the output membership function;
Step 5. combining the consequences to get an output distribution;
Step 6. defuzzifying the output distribution (this step is only needed if a crisp output (class) is needed).

So, first, we define output and input linguistic variables. So, linguistic variables are: weight of digital education products (resources) in GDP; usage of web pages (internet portals); software development, amount of products (services) in the ICT sector; Internet communication, number of employees working in the ICT sector; flexibility of use in all specialty profiles; satisfaction with product quality. Input variables for them are: usage of web pages (internet portals), software development, amount of products (services) in the ICT sector, Internet communication, number of employees working in the ICT sector, flexibility of use in all specialty profiles, satisfaction with product quality; and output variables are: weight of digital education products (resources) in GDP. Suppose we denote these linguistic variables, such as:

- weight of digital education products (resources) in GDP - y;
- Usage of web pages (internet portals)- x_1;
- Software development - x_2;
- Amount of products (services) in the ICT sector - x_3;
- Internet communication -x_4;
- Number of employees working in the ICT sector - x_5
- Flexibility of use in all specialty profiles-x_6
- Satisfaction with product quality -x_7.

Table 2 shows the term sets (bad, middle, and good) for these variables.

The interval values of these variables, corresponding to their term sets, are given in Table 3. For defining interval values of the weight of digital education products (resources) in GDP, statistical data from word practice was used. All this data is given in percent, and the minimal value of this parameter is 0%, but the maximal is 15%. So, the interval values of the weight of digital education products (resources) in GDP will be [0-15] (in percent).

The linguistic variables x_6 (flexibility of using in all specialty profiles) and x_7 (satisfaction with product quality) are quality parameters. The interval values of these variables were estimated based on expert assessment as [0-10], [48], [55].

Table 2. Term sets of input and output linguistic variables

Linguistic variables	Variables	Term sets		
Output variables				
weight of digital education products (resources) in GDP, (in percent)	y	bad	middle	good
İnput variables				
Usage of web pages (internet portals) (1000 USD)	x_1	bad	middle	good
Software development (1000 USD)	x_2	bad	middle	good
Amount of products (services) in the ICT sector (mln USD)	x_3	bad	middle	good
Internet communication (1000 USD)	x_4	bad	middle	good
Number of employees working in the ICT sector, thousands of people	x_5	bad	middle	good
Flexibility of use in all specialty profiles	x_6	bad	middle	good
Satisfaction with product quality	x_7	bad	middle	good

Source: Developed by the authors in the MATLAB program

Table 3. Interval values of input and output variables corresponding to their term sets

Variables	Term sets		
	bad	middle	good
Output variables			
y	[0-5]	[5-10]	[10-15]
x_1	[0.25-831.1378325]	[831.1378325-1662.025007]	[1662.025007-2492.92]
x_2	[3166.18-15947.19261]	[15947.19261-28728.19897]	[28728.19897-41509.21]
x_3	[878.6-1256.158455]	[1256.158455-1633.624868]	[1633.624868-2011.1]
x_4	[51678.16-81572.62018]	[81572.62018-111467.0852]	[111467.0852-141361.55]
x_5	[17-20]	[18-19]	[19-20]
x_6	[0-3]	[3-6]	[6-10]
x_7	[0-3]	[3-6]	[6-10]

Source: Developed by the authors in the MATLAB program

Then, it is implemented using fuzzy sets for fuzzing. The membership function for these fuzzy sets is constructed as a Gaussian function.

The next step is to construct logical rules on the base of expert reasoning. For example, expert reasoning can be written in the following form:

— If (usage of web pages is bad) and (software development is bad) and (amount of products (services) in the ICT sector is bad) and (internet communication is bad) and (the number of employees working in the ICT sector is bad) and (flexibility of using in all specialty profiles is bad) and (satisfaction with product quality is bad), then (weight of digital education products (resources) in GDP is bad);

— If (usage of web pages is middle) and (software development is middle) and (amount of products (services) in the ICT sector is middle) and (internet communication is middle) and (the number of employees working in the ICT sector is middle) and (flexibility of using in all specialty profiles is middle) and (satisfaction with product quality is middle), then (weight of digital education products (resources) in GDP is middle);

— If (usage of web pages is good) and (software development is good) and (amount of products (services) in the ICT sector is good) and (Internet communication is good) and (the number of employees working in the ICT sector is good) and (flexibility of using in all specialty profiles is good) and (satisfaction with product quality is god), then (weight of digital education products (resources) in GDP is good);

— If (usage of web pages is bad) and (software development is middle) and (amount of products (services) in the ICT sector is middle) and (internet communication is middle) and (the number of employees working in the ICT sector is middle) and (flexibility of using in all specialty profiles is middle) and (satisfaction with product quality is middle), then (weight of digital education products (resources) in GDP is middle);

— If (usage of web pages is bad) and (software development is bad) and (amount of products (services) in the ICT sector is middle) and (internet communication is middle) and (the number of employees working in the ICT sector is middle) and (flexibility of using in all specialty profiles is middle) and (satisfaction with product quality is middle), then (weight of digital education products (resources) in GDP is middle);

— If (usage of web pages is bad) and (software development is bad) and (amount of products (services) in the ICT sector is bad) and (internet communication is middle) and (the number of employees working in the ICT sector is middle) and (flexibility of using in all specialty profiles is middle) and (satisfaction with product quality is middle), then (weight of digital education products (resources) in GDP is middle);

— If (usage of web pages is bad) and (software development is bad) and (amount of products (services) in the ICT sector is bad) and (internet communication is bad) and (the number of employees working in the ICT sector is middle) and (flexibility of using in all specialty profiles is middle) and (satisfaction with product quality is middle), then (weight of digital education products (resources) in GDP is bad);

— If (usage of web pages is bad) and (software development is bad) and (amount of products (services) in the ICT sector is bad) and (internet communication is bad) and (the number of employees working in the ICT sector is bad) and (flexibility of using in all specialty profiles is middle) and (satisfaction with product quality is middle), then (weight of digital education products (resources) in GDP is bad);

— If (usage of web pages is bad) and (software development is bad) and (amount of products (services) in the ICT sector is bad) and (internet communication is bad) and (the number of employees working in the ICT sector is bad) and (flexibility of using in all specialty profiles is bad) and (satisfaction with product quality is middle), then (weight of digital education products (resources) in GDP is bad);

— If (usage of web pages is middle) and (software development is bad) and (amount of products (services) in the ICT sector is bad) and (internet communication is bad) and (the number of employees working in the ICT sector is bad) and (flexibility of using in all specialty profiles is bad) and (satisfaction with product quality is bad), then (weight of digital education products (resources) in GDP is bad);

— If (usage of web pages is middle) and (software development is middle) and (amount of products (services) in the ICT sector is bad) and (internet communication is bad) and (the number of employees working in the ICT sector is bad) and (flexibility of using in all specialty profiles is bad) and (satisfaction with product quality is bad), then (weight of digital education products (resources) in GDP is bad);

— If (usage of web pages is middle) and (software development is middle) and (amount of products (services) in the ICT sector is middle) and (internet communication is bad) and (the number of employees working in the ICT sector is bad) and (flexibility of using in all specialty profiles is bad) and (satisfaction with product quality is bad), then (weight of digital education products (resources) in GDP is bad), etc.

—

Then fuzzy inference logic rules will be in the following form:

If (x_1 is bad) and (x_2 is bad) and (x_3 is bad) and (x_4 is bad) and (x_5 is bad) and (x_6 is bad) and (x_7 is bad), then (y is bad);

If (x_1 is middle) and (x_2 is middle) and (x_3 is middle) and (x_4 is middle) and (x_5 is middle) and (x_6 is middle) and (x_7 is middle), then (y is middle);

If (x_1 is good) and (x_2 is good) and (x_3 is good) and (x_4 is good) and (x_5 is good) and (x_6 is good) and (x_7 is god), then (y is good);

If (x_1 is bad) and (x_2 is middle) and (x_3 is middle) and (x_4 is middle) and (x_5 is middle) and (x_6 is middle) and (x_7 is middle), then (y is middle);

If (x_1 is bad) and (x_2 is bad) and (x_3 is middle) and (x_4 is middle) and (x_5 is middle) and (x_6 is middle) and (x_7 is middle), then (y is middle);

If (x_1 is bad) and (x_2 is bad) and (x_3 is bad) and (x_4 is middle) and (x_5 is middle) and (x_6 is middle) and (x_7 is middle). then (y is middle);

If (x_1 is bad) and (x_2 is bad) and (x_3 is bad) and (x_4 is bad) and (x_5 is middle) and (x_6 is middle) and (x_7 is middle), then (y is bad);

If (x_1 is bad) and (x_2 is bad) and (x_3 is bad) and (x_4 is bad) and (x_5 is bad) and (x_6 is middle) and (x_7 is middle), then (y is bad);

If (x_1 is bad) and (x_2 is bad) and (x_3 is bad) and (x_4 is bad) and (x_5 is bad) and (x_6 is bad) and (x_7 is middle), then (y is bad);

If (x_1 is middle) and (x_2 is bad) and (x_3 is bad) and (x_4 is bad) and (x_5 is bad) and (x_6 is bad) and (x_7 is bad), then (y is bad);

If (x_1 is middle) and (x_2 is middle) and (x_3 is bad) and (x_4 is bad) and (x_5 is bad) and (x_6 is bad) and (x_7 is bad), then (y is bad);

If (x_1 is middle) and (x_2 is middle) and (x_3 is middle) and (x_4 is bad) and (x_5 is bad) and (x_6 is bad) and (x_7 is bad), then (y is bad) and etc.

5 Results

So the rules are constructed with the support of linguistic variables for the weight of digital education products (resources) in GDP. Transforming the above rules, we'll get fuzzy sets for the output variable y at the base of each rule. The composition method gives a fuzzy set, which is the range of values of fuzzy output variables, and by using the centroid method, we obtain a crisp numerical solution.

A fuzzy inference logic method was realized by the MATLAB software package, [56].

As the solution to this problem for each linguistic variable, we obtain the following crisp values:

If x_1=2000 (*1000 USD) and x_2=30000 (*1000 USD) and x_3=1500 (mln USD) and x_4 =127225 (*1000 USD) and x_5 =19 (*1000 person) and x_6 =5 and x_7 =5, then $y = 7.5$.

The dependence of y (weight of digital education products (resources) in GDP) on x_1(usage of web pages (internet portals)) and x_7 (satisfaction with product quality) is shown in Figure 2.

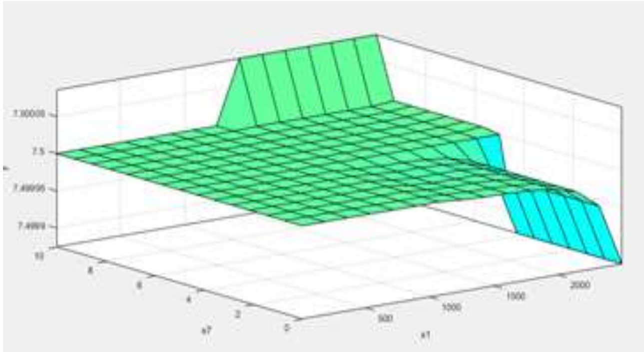

Fig. 2: Dependence of y (weight of digital education products (resources) in GDP) on x_1(usage of web pages (internet portals) and x_7 (satisfaction with product quality)

Source: Developed by the authors in the MATLAB program

As the solution to this problem for each linguistic variable, we obtain the following crisp values:

If x_1=2000 (*1000 USD) and x_2=30000 (*1000 USD) and x_3=1500 (mln USD) and x_4 =127225 (*1000 USD) and x_5 =19 (*1000 person) and x_6 =5 and x_7 =5, then $y = 7.5$.

İf usage of web pages (internet portals) is 2 mln.USD (2000 (*1000 USD)), software development is 30 million USD (30000 (*1000 USD)), amount of products (services) in the ICT sector is 1500 million USD, Internet communication is 127.225 million USD (127225 (*1000 USD)), number of employees working in the ICT sector is 19000 person, flexibility of using all specialty profiles is 5, satisfaction with product quality is 5, then weight of digital education products (resources) in GDP is 7.5%.

This shows that upon reaching the average quality of digital products and the average level of flexibility in the use of digital educational products, there will be a significant increase in GDP. But it is also necessary to take into account that the qualitative indicators vary from country to country. Therefore, to ensure the necessary GDP growth through the sale of digital educational products, it is necessary to ensure a certain level above the indicated quantitative indicators. Despite this, our result showed that there is a clear relationship between the selected quantitative and qualitative indicators and GDP growth.

According to the results of this study, manufacturers of digital educational products and countries wishing to increase GDP through the sale of these products should take into account the motives of consumers. Since it is possible to adjust the quality and quantity of the produced and sold digital educational products, it is also possible to determine changes in the level of GDP. This shows that the changes that are taking place in the information society by improving the accessibility, quality, and volume of digital educational products also have an impact on the development of the digital economy. Therefore, we consider it necessary to further analyze and discuss the impact of qualitative and quantitative indicators of digital educational products on GDP growth, depending on the state of development of the digital economy.

6 Conclusion

It is no coincidence that the United Nations (UN) has proclaimed the 21st century the “Century of Education”, [59]. At present, due to the rapid development of the Internet and digital technologies in the global space, the requirements for the education and formation of young people have generally changed, both in Azerbaijan and around the world. In the modern conditions of the formation of the information society and the formation of a knowledge-based economy, the development of ICT has become one of the most important indicators of the competitiveness, intellectual and scientific potential of a country.

We can see that the result of our research is similar to that of Xu and Liu, [35]. The digitalization of education has a positive impact on stability and development in both developed and developing countries, increasing educational costs and technological efficiency, and being an inevitable choice for every country, both developed and developing, regardless of the stage of development.

The digital economy has five pillars: regulation, infrastructure, network security, cybersecurity, education, training, especially for the digital economy, and building partnerships to create backbone technology platforms. The issues of education and its digitalization are important here, [60].

Mass higher education in the 21st century is more appropriate if it is predominantly distance education, [61]. As we can see, the digital education market is constantly growing, and the volume of digital educational products is growing along with it, which is often improved. Improving education based on high-quality digital material can increase the share of specialists in employment, [62].

These results and the identified relationship between digital educational products and GDP can be used in the development of state programs for the development of digital education.

We believe that, in connection with the growth of the digital education market, the State Committee on Statistics will in the future need to generate data on the volume of digital educational products produced in piece or total terms; sales of digital educational products; frequency of use of these products, the cost of digital educational products; the number of personnel involved in the development of a digital educational product, and others. These indicators can make it possible to analyze the development trend of one of the areas of the digital economy, but also to identify the income and motivation of producers of a digital educational product, identifying not only the volume of these products in GDP, but also revenues to the budget from the taxation of these products. Therefore, we believe that further research is needed in this direction.

References:

[1] Huseyn A. (2012). Theoretical analysis of world economic development priorities and existing problems in the implementation mechanism, "World economic development paradigm: market and beyond", Eurasian Forum of Social Sciences, October 18-21, 2012, ASEU, Collection of reports, Volume I, in Azerbaijan http://www.asbf12.hacettepe.edu.tr/Avrasiya%20-%20Kitab%201.pdfhttp://www.asbf12.hacettepe.edu.tr/Avrasiya%20-%20Kitab%201.pdf (Accessed Date: 19 April 2023)

[2] Kurnysheva I.R. (2005). Macroeconomic development: trends and prospects. M. Science. 2005, p.48.

[3] Tapscott D. and Williams, A. Wikinomics (2007): How Mass Collobaration Changes Everything. New York: Penguin Group, 2007.

[4] Potemkin A. (2004). Virtual economy. M. 2004, pp. 367-369.

[5] Brynjolfsson, BE., A. Kollis (2020). How should we measure the digital economy? Hutchins Center Working Paper #5 7. https://www.brookings.edu/wp-content/uploads/2020/01/WP57-Collis_Brynjolfsson_updated.pdf (Accessed Date: 19 April 2023)

[6] Williamson, B. (2021). Making markets through digital platforms: Pearson, edu-business, and the (e)valuation of higher education. Critical Studies in Education, 62 (1), pp.50-66. https://doi.org/10.1080/17508487.2020.173755616B.

[7] Williamson B., Komljenovic J. (2022) Investing in imagined digital futures: the techno-financial 'futuring' of edtech investors in higher education. Critical studies in education/ Published by Informa UK Limited, trading as Taylor & Francis Group, 2022, https://doi.org/10.1080/17508487.2022.2081587

[8] Digital Economy Report 2021. https://unctad.org/system/files/official-document/der2021_en.pdf (Accessed Date: 19 April 2023)

[9] Digital Education Market Size and Growth Report 2021-2028, https://www.grandviewresearch.com/industry-analysis/digital-education-market-report (Accessed Date: 19 April 2023)

[10] Birch, K., Muniesa, F. (2020). Assetization and technoscientific capitalism. In K. Birch & F. Muniesa (Eds.), Assetization: Turning things into assets in technoscientific capitalism, p.1-41. MIT Press.

[11] Sadowski, J. (2020). The internet of landlords: Digital platforms and new mechanisms of rentier capitalism. Antipode, 52(2), pp.562-580. https://doi.org/10.1111/anti.12595.

[12] Golka, P. (2021). Assetization: A technoscientific or financial phenomenon? Finance and Society, 7 (1), pp.88-93. https://doi.org/10.2218/finsoc.v7i1.5593.

[13] Sellens Joan Torrent (2009). Knowledge, networks and economic activity. Revisiting the network effects in the knowledge economy. Issue 8 | April 2009. Economics and Business Studies Internet Interdisciplinary Institute (IN3) Universitat Oberta de Catalunya (UOC), https://www.uoc.edu/uocpapers/8/dt/eng/torrent.pdf (Accessed Date: 19 April 2023)

[14] Walter W. Powell and Kaisa Snellman (2004). The Knowledge Economy. Annual Review of Sociology. Vol. 30, pp.199-220. Published By: Annual Reviews. https://www.jstor.org/stable/29737691 (Accessed Date: 19 April 2023)

[15] Badillo P.-Y., Bourgeois D. (2014) Information and knowledge society an d network economy: from euphoria to reality, Journal of Economics in Celebration of the Centenary of Cambridge Economics, Cambridge UK, 17-19 Septembre 2 003 (new version, up to da te January 2014),

http://www.patrickbadillo.eu/wp-content/uploads/2014/02/Badillo-digital-society-cambridgeu topia.pdf (Accessed Date: 19 April 2023)

[16] Shahrazad HADAD (2017) Knowledge Economy: Characteristics and Dimensions. Management Dynamics in the Knowledge Economy, Volume 5 no. 2, p.203-225, DOI:10.25019/MDKE/5.2.03, https://core.ac.uk/download/pdf/228448325.pdf (Accessed Date: 19 April 2023)

[17] Koster, F. (2023), Organizations in the knowledge economy. An investigation of knowledge-intensive work practices across 28 European countries, Journal of Advances in Management Research, Vol. 20 No. 1, p.140-159. https://doi.org/10.1108/JAMR-05-2021-0176.

[18] Wignaraja G. (2005) Competitiveness Strategy in Developing Countries. Taylor & Francis e-Library, https://pps.uniga.ac.id/wp-content/uploads/2019/11/POLICY-ANALYSIS-Competitiveness-strategy-in-developing-countries-A-manual-for-policy-analysis.pdf (Accessed Date: 19 April 2023)

[19] Braunerhjelm P. (2010). Entrepreneurship, Innovation and Economic Growth: Past experiences, current knowledge and policy implications. CESIS Electronic Working Paper Series Paper No. 224 https://www.diva-portal.org/smash/get/diva2:484894/FULLTEXT01.pdf (Accessed Date: 19 April 2023)

[20] Kritikos A. (2014) Entrepreneurs and their impact on jobs and economic growth. IZA World of Labor: 8 doi: 10.15185/izawol.8 https://wol.iza.org/articles/entrepreneurs-and-their-impact-on-jobs-and-economic-growth/long (Accessed Date: 19 April 2023)

[21] Dogan E. (2016). The effect of innovation on competitiveness. Econometrics and Statistics Number: 24, pp.60-81, https://dergipark.org.tr/tr/download/article-file/268727 (Accessed Date: 19 April 2023)

[22] Zou, Q.; Sun, X.; Zhou, Z. (2023), Relationship Recognition between Knowledge and Ability Based on the Modularity of Complex Networks. *Sustainability*, *15*, 4119. https://doi.org/10.3390/su15054119

[23] Jawaharlal Nehru, (1985) The Discovery of India, Delhi Oxford University Press, First published 1946 by The Signet Press, second piblished Rajiv Gandhi 1985, Printed at Rekha Printers Pvt. Ltd., New Delhi 110020 and published by Neil O'Brien, Oxford University Press YMCA Library Building, Jai Singh Road, New Delhi 110001/ https://library.bjp.org/jspui/bitstream/123456789/277/1/The-Discovery-Of-India-Jawaharlal-Nehru.pdf (Accessed Date: 19 April 2023)

[24] Burinskienė, A.; Seržantė, M. (2022) Digitalisation as the Indicator of the Evidence of Sustainability in the European Union. *Sustainability*, *14*, 8371, https://doi.org/10.3390/su14148371

[25] El Massah S.; Mohieldin, M. (2020). Digital transformation and localizing the Sustainable Development Goals (SDGs). *Ecol. Econ.*, *169*, 106490. Research of the market of online education (2020). http://research.edmarket.ru/ (Accessed Date: 19 April 2023)

[26] Barro, R.J. (2001). Education and Economic Growth. Annals of Economics and Finance, 14, p.301-328.

[27] Stevens, P., & Weale, M. (2004). Education and economic growth. International handbook on the economics of education, 27, p.205-311.

[28] Ozturk, I. (2008). The role of education in economic development: a theoretical perspective. *Available at SSRN 1137541*.

[29] Papageorgiou, C. (2003). Distinguishing between the effects of primary and post-primary education on economic growth. *Review of Development Economics*, *7*(4), p.622-635.

[30] Aghion, P., Boustan, L., Hoxby, C., & Vandenbussche, J. (2009). The causal impact of education on economic growth: evidence from US. *Brookings papers on economic activity*, *1*(1), p.1-73.

[31] Permani, Risti. (2009). The role of education in economic growth in East Asia: A survey. *Asian-Pacific Economic Literature* 23, 1, p.1-20.

[32] Bloom, D. E., Canning, D., Chan, K. J., & Luca, D. L. (2014). Higher education and economic growth in Africa. *International Journal of African Higher Education*, *1*(1), p.22-57.

[33] Kotásková Sylvie Kobzev. Petr Procházka. Luboš Smutka. Mansoor Maitah. Elena Kuzmenko. Markéta Kopecká. Vladimír Hönig, (2018). The Impact of Education on Economic Growth: The Case of India, Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, Mendel University Press, vol. 66 (1), p.253-262.

[34] Laura Marquez-Ramos & Estefanía Mourelle, (2019). Education and economic growth: an empirical analysis of nonlinearities, Applied Economic Analysis, Emerald Group

Publishing Limited, vol. 27(79), p. 21-45, August.
[35] Xu, H.; Liu, F. (2017). Measuring the Efficiency of Education and Technology via DEA approach: Implications on National Development. Soc. Sci. 6, 136. https://doi.org/10.3390/socsci6040136.
[36] Lazović, V.; Jovović, M.; Backović, T.; Djuričković, T.; Rondović, B. (2022). Is Digital Economy a Good Samaritan to Developing Countries? Sustainability, 14, 8471. https://doi.org/10.3390/su14148471.
[37] Horobet, A.; Mnohoghitnei, I.; Zlatea, E.M.L.; Belascu, L. (2022). The Interplay between Digitalization, Education and Financial Development: A European Case Study. J. Risk Financial Manag.,15, 135. https://doi.org/10.3390/jrfm15030135.
[38] Han, Y.; Liu, L.; Sui, Q.; Zhou, J. Big (2021)/ Data Spatio-Temporal Correlation Analysis and LRIM Model Based Targeted Poverty Alleviation through Education. ISPRS Int. J. Geo-Inf., 10, 837. https://doi.org/10.3390/ijgi10120837.
[39] Hashim, M.A.M.; Tlemsani, I.; Matthews, R.; Mason-Jones, R.; Ndrecaj, V. 2022, Emergent Strategy in Higher Education: Postmodern Digital and the Future? Adm. Sci., 12, 196. https://doi.org/10.3390/admsci12040196.
[40] García-Hernández, A.; García-Valcárcel Muñoz-Repiso, A.; Casillas-Martín, S.; Cabezas-González, M. 2023. Sustainability in Digital Education: A Systematic Review of Innovative Proposals. Educ. Sci., 13, 33. https://doi.org/10.3390/educsci13010033.
[41] Morawczynski, O., Ngwenyama, O. (2007). Unraveling the impact of investments in ICT, education and health on development: an analysis of archival data of five West African countries using regression splines. The Electronic Journal of Information Systems in Developing Countries, 29 (1), p.1-15.
[42] Donou-Adonsou, F. (2019). Technology, education, and economic growth in Sub-Saharan Africa. Telecommunications policy, 43 (4), p.353-360.
[43] Marto M., Lourenço Marques J., Madaleno M., An Evaluation of the Efficiency of Tertiary Education in the Explanation of the Performance of GDP per Capita Applying Data Envelopment Analysis (DEA). Sustainability 2022, 14, 15524. https://doi.org/10.3390/su142315524.
[44] Shafizade, E.R., Shikhlinskaya, R.Yu. (2010): Application of fuzzy inference rules to a model for optimizing the production and sectoral structure of agriculture to ensure food security, Actual Problems of Economics. 1(103), p.286-294,
[45] Shikhlinskaya, R. Y., Shafizadeh, E.R. (2015). Profit Optimization in Virtual Business Applying Fuzzy Logic, Journal of Automation and Information Sciences. 47, Issue 1, p.77-87. doi: 10.1615/JAutomatInfScien.v47.i1.70.
[46] Radhi, Abdulkareem Merhej (2020), Risk assessment optimization for decision support using intelligent model based on fuzzy inference renewable rules, Indonesian Journal of Electrical Engineering and Computer Science,V 19, N 2, p.1028-1035, 2020.
[47] Blahun, Ivan S, Blahun, Ivan I, Blahun, Semen I,(2020) Assessing the stability of the banking system based on fuzzy logic methods, Journal:Banks and Bank Systems, V 15, N 3, P 171-183,2020, Publisher: LLC CPC Business Perspectives, http://dx.doi.org/10.21511/bbs.15(3).2020.15
[48] Zanon, Lucas Gabriel, Arantes, Rafael Ferro Munhoz, Calache, Lucas Daniel Del Rosso, Carpinetti, Luiz Cesar Ribeiro, A (2020) Decision making model based on fuzzy inference to predict the impact of SCORÂ® indicators on customer perceived value, International Journal of Production Economics, vol. 223, p.107520, 0925-5273, Elsevier, https://doi.org/10.1016/j.ijpe.2019.107520
[49] Amaury Hernandez-Aguila, Mario García-Valdez, Juan-Julián Merelo-Guervós, Manuel Castañón-Puga, Oscar Castillo López (2021), Using fuzzy inference systems for the creation of forex market predictive models, IEEE Access, vol. 9, p.69391-69404, 2169-3536, IEEE, doi: 10.1109/ACCESS.2021.3077910
[50] Zadeh, L. (1976) The concept of a linguistic variable and its application to making approximate decisions. M., p.168, *(Original Title: Заде Л., Понатие лингвистической переменной и его применение к принятию приближенных решений, М., 1976, 168 стр.*).
[51] George E. Tsekouras, (2016). Fuzzy rule base simplification using multidimensional scaling and constrained optimization, Fuzzy Sets and Systems 297 (2016) pp.46-72, https://doi.org/10.1016/j.fss.2015.10.009
[52] Miroslav Hudec (2016). Fuzziness in Information Systems: How to Deal with Crisp

and Fuzzy Data in Selection, Classification, and Summarization, p.210.

[53] Radim Bělohlávek, Joseph W. Dauben, George J. Klir (2017): Fuzzy Logic and Mathematics: A Historical Perspective., p.545.

[54] Shankar S. S., Clarence W. De Silva (1995): Intelligent Control: Fuzzy Logic Applications., p.368, (1995). https://doi.org/10.1201/9780203750513

[55] Lotfi A. Zadeh, Ronald R. Yager (1992): An Introduction to Fuzzy Logic Applications in Intelligent Systems, Springer US, p.357. https://doi.org/10.1007/978-1-4615-3640-6

[56] Leonenkov, A.(2003): Fuzzy modeling in MATLAB and fuzzy TECH, St. Petersburg. BHV, Petersburg., p.725.

[57] Josip Čičak, Davor Vašiček (2019), Determining the level of accounting conservatism through the fuzzy logic system, Business Systems Research: International journal of the Society for Advancing Innovation and Research in Economy, Vol. 10, No. 1, p.88-101, ISSN: 1847-9375, 2019, DOI: 10.2478/bsrj-2019-0007.

[58] Malyarets Lyudmyla, Dorokhov Oleksandr, Koybichuk Vitaliya, Dorokhova Liudmyla (2019), Obtaining a generalized index of bank competitiveness using a fuzzy approach, Journal of Central Banking Theory and Practice, Vol. 8, No. 1, p.163-182, 2019, https://doi.org/10.2478/jcbtp-2019-0008

[59] Abdullayev Mubariz, 2021. New design of education: It is dictated by modern challenges, https://www.yeniazerbaycan.com/Sosial_e62786_az.html (Accessed Date: 19 April 2023)

[60] Han, Y., Liu, L., Sui, Q., Zhou, J., (2021). Big Data Spatio-Temporal Correlation Analysis and LRIM Model Based Targeted Poverty Alleviation through Education. ISPRS Int. J. Geo-Inf., 10, 837, https://doi.org/10.3390/ijgi10120837 (Accessed Date: 19 April 2023)

[61] Muradov Adalat. (2019), CALL from experts to parliament and government regarding distance education.

[62] UN CEPAL. (2021) Digital technologies for a new future (LC/TS.2021/43), Santiago, 2021, https://www.cepal.org/sites/default/files/publication/files/46817/S2000960_en.pdf (Accessed Date: 19 April 2023)

Contribution of Individual Authors to the Creation of a Scientific Article (Ghost-writing Policy)

- Afag Huseyn was responsible for maintaining the main body as well as conceptualization, visualization, writing—original draft preparation, writing—review and editing, supervision, and project administration.
- Elnura Shafizade and Tahmasib Huseynov were responsible for the methodology and carried out the analysis.
- Sugra Humbatova was responsible for compiling the manuscript, editing.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself
UNEC Grant Number 1466/22/1DM7X1Z/Y/A1

Conflict of Interest
The authors have no conflicts of interest to declare.