
Work Productivity Based on Knowledge and Future Competencies

Submitted 13/12/25, 1st revision 15/01/26, 2nd revision 20/02/26, accepted 28/03/26

Michał Igielski¹

Abstract:

Purpose: The main objective of this article is to identify the relationship between knowledge, future competencies, and labor productivity, and to determine which competencies are most important for increasing employee efficiency in the context of ongoing labor market transformation.

Design/methodology/approach: The study is based on secondary data analysis using datasets and reports prepared by scientific institutions, international organizations, and research centers. The research methods included: (1) content analysis of reports from the World Economic Forum (WEF) and the International Labour Organization (ILO); (2) comparative analysis of statistical and qualitative data from the OECD, WEF, and ILO; (3) statistical analysis, including Pearson's correlation to examine relationships between human capital investment and productivity, linear regression assessing the impact of education and digital skills on labor productivity, and Student's t-test to compare average indicators between countries; and (4) data triangulation integrating qualitative and quantitative findings from multiple sources.

Findings: The results indicate that future-oriented competencies - particularly digital, cognitive, and social skills - constitute an important foundation for improving labor productivity. However, the complexity of these relationships requires an interdisciplinary approach that integrates theoretical perspectives with practical applications and continuous monitoring of technological and social changes. Further research should focus on validating and measuring competencies in relation to productivity and professional development, especially within digital transformation environments.

Research limitations/implications: The analysis is theoretical and review-based. Future studies should incorporate empirical methods, particularly quantitative research in knowledge-intensive organizations, to better measure the impact of specific competencies on productivity.

Practical and social implications: The findings highlight the importance of investing in digital and social competence development, fostering innovation-oriented organizational cultures, and promoting flexible work models that support productivity and employee well-being. Strengthening future competencies may also enhance digital inclusion, reduce labor market inequalities, and better prepare societies for automation and artificial intelligence.

¹Dr., Gdynia Maritime University, Faculty of Management and Quality Science, Poland,
e-mail: m.igielski@wzjn.umg.edu.pl;

Originality/value: *The article contributes to the debate on labor productivity by integrating economic, managerial, and social perspectives and by emphasizing the combined role of technological, cognitive, and social competencies in the digital economy.*

Keywords: *Knowledge-based economy, intellectual capital, key competencies, employee efficiency.*

JEL codes: *J24, D83, O15.*

Paper type: *Research paper.*

1. Introduction

In the context of digital transformation, dynamic technological changes, and the ongoing automation of economic processes, we can observe a clear shift in the sources of labor productivity from traditional factors, such as physical capital, to intangible resources - knowledge, skills, and competencies.

The knowledge-based economy places new demands on employees, whose effectiveness increasingly depends on their ability to adapt, think critically, collaborate, and demonstrate digital and social competencies. In this context, increasing importance is being attached to so-called future skills, defined as a set of skills that are key to effective functioning in the labor market in the medium and long term.

At the same time, there is a growing need to redefine the concept of labor productivity, taking into account its qualitative aspects related to innovation, flexibility, and the ability to solve complex problems.

Previous quantitative approaches, focusing exclusively on measurable results (e.g., units of product manufactured or number of tasks completed in a given time), are not sufficient for analyzing work based on knowledge and creativity. This raises an important research question: to what extent and in what way do the competencies of the future influence labor productivity in modern organizations?

The aim of this article is to identify the relationship between knowledge, competencies of the future and labor productivity, as well as to determine which of these competencies are key to increasing employee efficiency in the context of labor market transformation. The analysis is based on a review of the current literature on the subject and on secondary data, enabling the formulation of practical recommendations for organizations, educational institutions, and decision-makers responsible for labor market policy.

2. Literature Review

2.1 Evolution of the Concept of Labor Productivity

The concept of labor productivity has a long history in economics and management sciences. In the classical approach (Smith, 2008; Ricardo, 2014), productivity was seen as the ratio of output to labor input. Contemporary approaches expand this definition to include qualitative factors such as process efficiency, the degree of technology utilization, and the quality of human capital (Krugman, 1994; OECD, 2001).

In traditional macroeconomic models (Solow, 1956), productivity was mainly equated with total factor productivity (TFP), but in recent decades, increasing attention has been paid to the individual productivity of workers, especially in knowledge-intensive sectors.

In Polish scientific literature, labor productivity is distinguished from efficiency/effectiveness and is understood as a quantitative and qualitative measure of outputs relative to labor inputs (Skowron-Mielnik, 2019), while L. Koziół (2021) argues that it is the ability to use resources to produce results – in practice, the relationship between results and inputs and a key determinant of competitiveness.

On the other hand, productivity at the employee level in the workplace (micro) includes both efficiency (input of time/resources) and effectiveness (degree of goal achievement) (Stepanek *et al.*, 2019). Singh, Solkhe, and Gautam (2022) express a similar view, treating employee productivity as the time and effort actively devoted to tasks and a measure of efficiency and effectiveness in achieving organizational goals. In contrast, in the conceptual approach, recent studies most often define productivity as a measure of the efficiency of an employee or group of employees, i.e., the relationship between results and inputs (Rahman *et al.*, 2023).

Therefore, before F.W. Taylor² first began to observe manual labor and the workers performing it over 120 years ago, there was a general belief that there were only two solutions for increasing the productivity of these workers: they had to work more or harder (Schultz and Schultz, 2011). It was F.W. Taylor who was the first to use knowledge to increase the productivity of manual labor, and he referred to the method he used as “task analysis” or “task management”³ (Drucker, 2007).

²The first systematic studies on work performance began in 1898, when Taylor undertook research on digging earth at Bethlehem Steel.

³After twenty years, the method became known as “scientific management” (or time-and-motion studies), and later, after World War I, it became known as “industrial engineering” in the United States and the United Kingdom and as “rationalization” in Germany.

Taylor's original method consisted of observing the task performed by a manual worker and analyzing the constituent movements. Each movement was then documented, and the physical effort and time required to perform it were determined.

Movements that proved unnecessary were eliminated, and the remaining movements were organized so that they could be performed in the simplest way possible, requiring the least physical and mental effort, in the shortest possible time. Then, all movements were arranged in a logical order.

In addition, work tools were also subject to appropriate modification⁴. What F.W. Taylor really demonstrated (and what earned him many opponents, e.g., among representatives of craft guilds and trade unions) was that in manual labor, it is not so much skills that are important, but simple, repetitive movements.

And what affects their productivity is knowledge, i.e., the way in which simple, standard movements are arranged, organized, and performed. F.W. Taylor destroyed the romanticism of manual labor. He transformed it from a “noble craft” into a series of simple movements (Drucker, 2007).

Another milestone, which the author considers extremely important in the discussion, is the concept of knowledge worker productivity, introduced by T.H. Davenport (2005), who argued that in a modern economy, measuring productivity solely in terms of units of goods produced is insufficient. He points out that in knowledge-based work, the ability to think creatively, communicate effectively, process information, and make decisions is crucial.

Of course, it was Drucker (1969) who was the first to precisely describe the knowledge worker and put forward the thesis that the productivity of knowledge-based work will be a major management challenge in the 21st century, just as the productivity of manual labor was a major management challenge in the past century.

Continuing his reflections, in 1997 he went even further, drawing particular attention to knowledge workers themselves and arguing that the productivity of knowledge and knowledge workers will not be the only source of competitive advantage in the global economy, although it will be a decisive factor, at least for most industries in developed countries (Drucker, 1997).

⁴*Taylor noticed that workers used shovels of various sizes and shapes. As a result, the amount of soil carried by a single worker ranged from 3.5 pounds to 38 pounds. After conducting a series of experiments with different shovel sizes, Taylor created the optimal shovel, i.e., one that allowed workers to work most efficiently and carried 21.5 pounds of soil. As a result of a series of modifications, Bethlehem Steel saved \$78,000 in one year, which was a huge amount of money at the time. Using the new shovels, 140 workers were able to do the work previously assigned to 550 people. Bonuses for increased productivity increased workers' wages by about 60%.*

Referring to the earlier content, it should be pointed out that even today, it is employees who are responsible for creating innovation and developing organizations. They invent new products and services, design marketing programs, and create company strategies. They are the “workhorses” of economic progress in today's economy. If companies are to become more profitable, if strategies are to succeed, if society is to develop, this will only happen if they do their jobs more productively and effectively (Davenport, 2005).

However, it is their productivity that is one of the main challenges for organizations in the 21st century. The most important and unique contribution of management in the 20th century was a fifty-fold increase in the productivity of industrial workers (manual workers). The most important contribution that management must make in the 21st century is a similar increase in the productivity of knowledge-based work. The most valuable resource of 20th-century enterprises was production equipment.

The most valuable resource of 21st-century organizations, whether business or otherwise, will be key employees and their productivity. With some exaggeration, we can say that in terms of the advancement of work related to the productivity growth of this group of employees, we are currently at the same stage as we were in 1900 in terms of the productivity of manual workers.

According to P.F. Drucker (1986), employee productivity is determined by six main factors, which (with the exception of the last one) differ radically from the factors determining the productivity of employees in the industrial economy:

1. Their productivity requires asking the question: “What is the task?”
2. It is necessary to place responsibility for their own productivity on individual employees - they must manage themselves and thus be characterized by autonomy.
3. Continuing innovation must be part of their work, tasks, and responsibilities.
4. Knowledge-based work requires them to continuously develop both personally and in terms of teaching others.
5. Their productivity is not - at least not primarily - a question of quantity of output - quality is just as important.
6. Their productivity requires that they be seen and treated as a resource, not a cost. It is important that they “want” to work for a particular organization, rather than take advantage of alternative opportunities to engage their time, knowledge, and skills.

In the case of knowledge-based work, unlike industrial-era workers, the most important thing, according to the author, is to find the answer to the question: “What is the task?” While in the case of industrial-era worker productivity, the main question was “How should the work be done best?”, in this situation it is no longer so obvious. Knowledge-based work does not “program” employees (unlike, for example, production workers working directly on the assembly line) - they control it.

Therefore, the first step in determining their productivity is to answer the question of what the task is, focus on it, and eliminate all other distracting, non-value-adding, and demotivating activities. This involves, for example, the huge number of meetings that employees have to attend every day, bureaucracy and administration – performing tasks that very often should not be part of their job at all.

In addition, we need to ask ourselves about the role and definition of quality in knowledge-based work. It is not the case that quality is irrelevant in manual work – it is relevant, and its absence is a limitation. A certain minimum level of quality must be maintained (for this purpose, various quality assurance methods are developed and implemented, such as Total Quality Management, TQM). In most knowledge-based tasks, quality is not a limitation or a minimum requirement – quality is the essence of the end result (Drucker, 1997).

This information clearly shows that certain types of work require more knowledge, experience, expertise, autonomy, independent, non-standard thinking. On the other hand, most tasks today require at least a minimum level of thinking and knowledge, but not necessarily of the same type and on the same scale. It is important for employers to recognize these differences and take appropriate action.

First, it is important to increase the productivity of the most numerous groups of employees in the organization (in practice, such actions usually boil down to traditional industrial-era employee management - periodic evaluations, development planning, and structure management). Secondly, if companies want to compete in the global market, they must attract and adequately motivate employees who, thanks to their knowledge, will determine the organization's lasting market success.

2.2 Knowledge-Based Economy and the Importance of Intellectual Capital

“Knowledge will not be the only source of competitive advantage, but it will be the most important one” – this statement by P.F. Drucker (1999), despite being 27 years old, remains highly relevant today.

The knowledge-based economy is a concept developed, among others, by the OECD (1996), in which knowledge, information, and skills are the main sources of economic growth and competitive advantage.

From a theoretical point of view, the knowledge-based economy (KBE) is a new phenomenon. However, the development of knowledge itself has accompanied successive phases of human development.

Thus, looking at economic history, we can see that knowledge has always played an important role in development, right from the dawn of human history. If we follow Bell (1973), we can distinguish three phases in the description of social

development: pre-agrarian, agrarian, and industrial, which were distinguished in relation to the influence of technological, social, and economic factors.

A knowledge-based economy is an economy whose basic elements are the management of economic processes and the skilful management of people. It is a structure in which the most important problem is to understand and define the mechanisms that influence economic change and development.

The KBE is the era of the knowledge society, known as the “knowledge economy” or “knowledge era” (Skrzypek, 2021). According to Drucker (1997), it is an economic order in which knowledge, rather than labor, raw materials, or capital, is the key resource; a social order in which the main challenge and dominant system are social inequalities based on knowledge.

On the other hand, the KBE is a response to the problems of globalization (after all, we are operating in conditions of intensifying globalization processes), which is a new, multidimensional process affecting the economy and politics at various levels. The establishment of the KBE is an important phenomenon on the global stage. The processes of KBE development can be analyzed in the spheres of thought, action, and fact.

The KBE is a new economy characterized by the dominant share of the service sector in GDP and employment. It is based on the comprehensive use of knowledge and information. It is also an economic doctrine aimed at boosting the market economy. For the KBE to develop, it is necessary for three areas to work together: government, academia, and business - the challenges it faces are business, administrative, and social in nature (Skrzypek, 2021).

The very concept of KBE is often used interchangeably with the term “new economy,” which places greater emphasis on a new stage in economic development, radically different from the traditional economy. Another term used is “knowledge-driven economy,” which emphasizes the formation of new economic structures under the influence of knowledge development (Makulska, 2022).

In this context, a new perspective on organizational resources emerges – not only as physical elements (machines, raw materials), but as intellectual capital (Edvinsson & Malone, 1997; Stewart, 1998), which includes:

1. Human capital (skills, experience, creativity of employees).
2. Structural capital (processes, organizational culture, IT systems),
3. Relational capital (relationships with customers, partners, stakeholders).

In the available theory, and even more so in practice, we will not find a single, consistent definition of the term “intellectual capital.” According to the author, the likely reason for this is that its components are intangible.

Therefore, when reviewing the literature on the subject, one can encounter a number of interchangeable terms, such as “intangible assets,” “intellectual resources,” or “hidden company assets.”

The first information about intellectual capital appeared as early as the 1930s. However, the dynamic development of this concept dates back to the early 1990s. In economic practice, the Swedish insurance company Skandia was a pioneer in the field of intellectual capital management, organizing a department dedicated to intellectual capital within its structure, headed by Edvinsson and Malone, (2001).

Following Edvinsson's and Malone's (2001) line of thinking, G. Roos and J. Roos (2007) point out that intellectual capital is the sum of hidden assets not included in financial statements, comprising both what is in the minds of employees and what remains after they leave work to go home. In turn, Rzempala (2017) included in his definition of intellectual capital not only the power of the human mind, but also brands, trademarks, and assets recorded at historical values, whose book value is disproportionate to their actual value.

Johnson (1999), on the other hand, believes that intellectual capital is the amount hidden behind the accounting term “goodwill.” The only difference is that traditionally defined goodwill does not include unusual but valuable assets such as brands or a company's ability to adapt to changing competitive conditions.

Therefore, according to Fitz-Enza's (2021) definition, intellectual capital comprises only two categories, namely the intellectual property of the company and a complex web of processes and culture, combined with a network of various types of relationships and human capital.

It can therefore be said that intellectual capital is the knowledge-based assets of an organization. It is the sum of a large number of intangible components that are responsible for shaping the market value of every company in the 21st century. In theory, but also in practice, it is often referred to as “knowledge capital” or “intellectual matter”.

Therefore, according to the author, the very concept of intellectual capital was created/formalized in order to fully illustrate its importance and essence in building the competitive position of modern organizations on the market. Intellectual capital should therefore be considered, on the one hand, as an intangible asset of an organization, i.e., a so-called soft asset, as it has a significant impact on its value, even though it does not appear on the asset side of the balance sheet.

On the other hand, intellectual capital must be taken into account in the management process, as it enables the improvement of business efficiency along with the optimal use of available intellectual resources.

The growing importance of these resources means that productivity cannot be analyzed in isolation from the competencies of employees and the organization's ability to develop and utilize them.

2.3 Competencies of the Future – Definitions, Typologies, and Sources

In an era of dynamic technological, social, and economic change, the concept of future competencies is gaining importance in both education and the labor market. These competencies constitute a set of skills, attitudes, and knowledge necessary to function effectively in an unpredictable and rapidly changing world.

The concept of “competencies” refers to a combination of knowledge, skills, attitudes, and values that enable effective action in changing conditions - it is a set of characteristics that recur in various professional models (Arribas-Aguila *et al.*, 2024).

The latest approaches also define competencies as a combination of knowledge, skills, attitudes, and motivation that enable effective action in a specific context - they stand out as a set of “knowledge, skills, attitudes, and values needed to face future challenges” (Anwari and Suzianti, 2024).

Competencies of the future are defined in a similar vein and treated as a set of skills and attitudes that enable adaptation to changing living, working, and social conditions - they include both technical abilities and soft interpersonal skills and cognitive abilities (WEF, 2023). The competencies of the future are often described in the context of the so-called 21st century competencies, which respond to the challenges of digitization, globalization, and automation.

These competencies are not only a response to the changing demands of the labor market, but also a prerequisite for continuous learning and adaptation - key elements of long-term productivity for individuals and organizations. Hence, the relationship between competencies and productivity has been extensively studied in the context of human capital (Becker, 1964).

Numerous empirical analyses show that investments in the development of employee competencies lead to increased efficiency at both the individual and organizational levels (De Grip, Sauermann, 2023; Autor *et al.*, 2020). For example, research conducted by Brynjolfsson and McAfee (2014) shows that organizations that effectively combine technology with the right employee competencies achieve significantly higher productivity rates. Importantly, automation alone is not enough - it is crucial to prepare employees to work in an environment supported by AI, data, and digital tools.

Therefore, in Table 1 below, the author reviews the most current typologies of future competencies in the context of contemporary work productivity.

Table 1. *Typologies of future competencies*

No.	Type of competence	Author/Authors/Source
1.	analytical thinking and innovation; active learning and self-development strategies; flexibility; resilience and adaptability; digital competence and data analytics; collaboration and emotional intelligence; creativity and initiative	WEF (2023)
2.	Cognitive competencies: reasoning, analysis, problem solving	OECD (2021)
	Social and emotional competencies: cooperation, empathy, relationship management	
	Technical and digital competencies: technology use, information processing, cybersecurity	
3.	accurate self-assessment; achievement orientation; active listening; adaptability to change; analytical and critical thinking; communication; conflict management; creativity and innovation; customer orientation; decision-making; developing others; emotional awareness; emotional self-control; empathy; influence; information seeking; initiative; leadership; learning and continuous improvement; negotiation; optimism, organizational awareness, organizational commitment; people management; perseverance; planning and organization; problem-solving; professional ethics; professionalism, reliability and accuracy; psychological resilience; self-confidence; strategic thinking; teamwork	D. Arribas-Aguila, David, G. Castaño, R. Martínez-Arias (2024)
4.	cognitive flexibility; entrepreneurship; communication; top-level customer service; people management; emotional intelligence; cooperation; leadership ; problem solving; adaptation to change	A. Anwari, A. Suzianti (2024)
5.	<i>The concept of nursing competence is a multidimensional, dynamic set of knowledge, skills, attitudes, and reflection. Its development depends on appropriate educational and organizational conditions, and its effectiveness supports patient safety, professionalism, and alignment between theory and practice.</i> formal education and professional training; sufficient practical and cognitive skills and abilities; applicable standards of conduct and action; positive attitude, responsibility, and motivation; environmental, organizational, and demographic support, knowledge, self-assessment; dynamic state	M.T. Mrayyan, H.Y. Abunab, A.A. Khait, M.J. Rababa, S. Al-Rawashdeh, A. Algunmeeyn, A.A. Saraya (2021)
<i>11 components of competence - the authors indicate that competence comprises 11 integrated aspects</i>		
technical (psychomotor) skills; critical thinking and decision making; interpersonal communication; ethical attitudes and values; self-evaluation and reflection; adaptability and flexibility; responsibility and autonomy; teamwork and interprofessional collaboration; patient safety and quality of care; self-development and lifelong learning		

Source: *Author's calculations.*

As we can see, contemporary models of future competencies include emotional and interpersonal intelligence as well as analytical skills, decision-making, leadership, and values and attitudes such as ethics, resilience, and development. Mental flexibility and adaptability emphasize the ability to respond to dynamic and unpredictable situations, which is crucial in an era of technological transformation.

Others, such as emotional intelligence, collaboration, communication, and customer service excellence, undoubtedly confirm the growing importance of social

competencies, both in team relationships and with customers. Entrepreneurship, problem solving, and leadership, on the other hand, reflect a proactive approach to initiating change, innovation, and leading others. Importantly, many of them appear in most of the models studied, which proves their universal significance and, in the author's opinion, provides an operational, clear basis for assessing and developing these competencies in professional practice.

On the other hand, in conditions of a shortage of qualified staff, the development of future competencies becomes one of the key tools for increasing productivity. Unfortunately, their development faces numerous challenges – first and foremost, many organizations struggle with the so-called competency gap, i.e., the difference between job requirements and the actual skills of employees (ILO, 2022). Other challenges include:

- the lack of clear standards for measuring soft skills;
- difficulties in integrating skills development into everyday organizational practice;
- uneven access to training and education;
- cultural resistance to change and lifelong learning.

The growing interest in competency development systems based on lifelong learning, microlearning, e-learning platforms, as well as learning by doing and mentoring models is helping to overcome these barriers. In this context, productivity is increasingly seen not as a state, but as a process requiring continuous competence development and adaptation to changing conditions (in Table 2, the author has indicated what he considers to be the most important sources of future competence development).

Table 2. *Main sources of future competence development*

No.	Source	Description
1.	Formal education	Adaptation of school and academic programs to teach multidimensional competencies. Schools and universities implement programs that develop both critical thinking and digital competencies (e.g., AI literacy), supporting lifelong learning.
2.	Non-formal education and self-learning	Courses, mentoring, and self-learning as effective mechanisms for development.
3.	Professional experience	Practice in the context of digital transformation enables the real development of adaptive skills. Real projects or digital transformation in SMEs enable the development of adaptive competencies.
4.	Interdisciplinary perspective	Integration of technical, cognitive, social-emotional, and value-based competencies. European and national education systems integrate competencies from different areas and promote an intercultural approach.
5.	Digital technologies and media	A source of new learning opportunities, but also a challenge that requires the development of digital competences and a critical approach to information.

Source: *Author's calculations.*

In summary, the competencies of the future are a complex and multidimensional set of skills that are crucial for individuals and organizations to function in a rapidly changing world. Their definitions and typologies point to the need to combine cognitive, technological, social, and personal competencies. The development of these competencies requires the integration of various educational sources and experiences, which poses challenges for education systems and labor market policies.

3. Research Methodology

The article is based on secondary data analysis, which means that existing data sets provided by scientific institutions, international organizations, and research centers were used. This approach allows for a broad analysis of trends in labor productivity and the development of future skills without the need for primary research. This is particularly important in the context of the broad scope of the topic and access to global data, as well as limited resources allocated for this purpose.

In the analysis of secondary data, the author used:

1. Content analysis of WEF and ILO reports, consisting of systematic coding and classification of the most important future skills (e.g., critical thinking, digital skills, cognitive flexibility). NVivo software was used to perform this analysis, which enables effective management and analysis of large text sets.
2. Comparative analysis of statistical and qualitative data between OECD, WEF, and ILO reports to assess consistency and discrepancies in determining the impact of competencies on productivity. The comparisons were performed in Excel and Tableau, which enables the visualization of trends and comparisons.
3. Statistical analysis, including:
 - Calculation of Pearson's correlation between human capital investment indicators (e.g., spending on education and training) and total factor productivity (TFP) in OECD data;
 - Linear regression to assess the impact of education and digital skills on labor productivity;
 - Statistical significance tests (Student's t-test for comparisons of average indicators between countries).

Statistical analyses were performed using SPSS, which offers advanced tools for statistical modeling and visualization of results.

4. Data triangulation - integration of qualitative and quantitative results obtained from various sources - increases the reliability and consistency of conclusions (the author used a mixed triangulation method, combining content analysis with the results of statistical analyses).

When selecting secondary data, the author was guided, among other things, by its relevance - he placed particular emphasis on publications and data from the last decade to reflect current trends and changes in the knowledge-based economy and the so-called reputation of the source - the author selected only data from institutions with recognized scientific credibility and international reach.

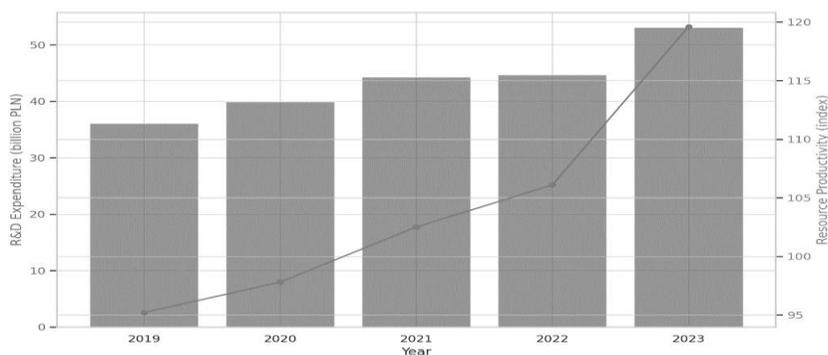
Other criteria used in this process included thematic scope, as the data cited covers the main areas discussed in the text (labor productivity, future skills, human capital development, automation, and knowledge management) and availability and completeness – the author only included databases and reports that offered a complete and verified set of information, enabling a comparative analysis to be carried out.

Of course, the author is aware that research based on secondary data is burdened by a lack of control over the process of collecting primary data, a variety of definitions, and limited updating, so the results of their analysis and conclusions should not be generalized. On the other hand, however, this is a significant convenience for the researcher, as the use of secondary data is based on publicly available materials, which eliminates the need to obtain consent from research participants and issues related to personal data protection.

4. Research Results and Discussion

In 2023, Poland allocated PLN 53.1 billion to R&D activities, which accounted for 1.56% of GDP. Compared to 2022, this represented an increase of 18.8%. In turn, the resource productivity index increased by 12.7% compared to the previous year. (stat.gov.pl). The bar chart below shows annual R&D expenditure in Poland in 2019–2023 and the corresponding resource productivity indices. There is a visible upward trend in both expenditure and productivity, suggesting a positive impact of R&D investment on economic efficiency.

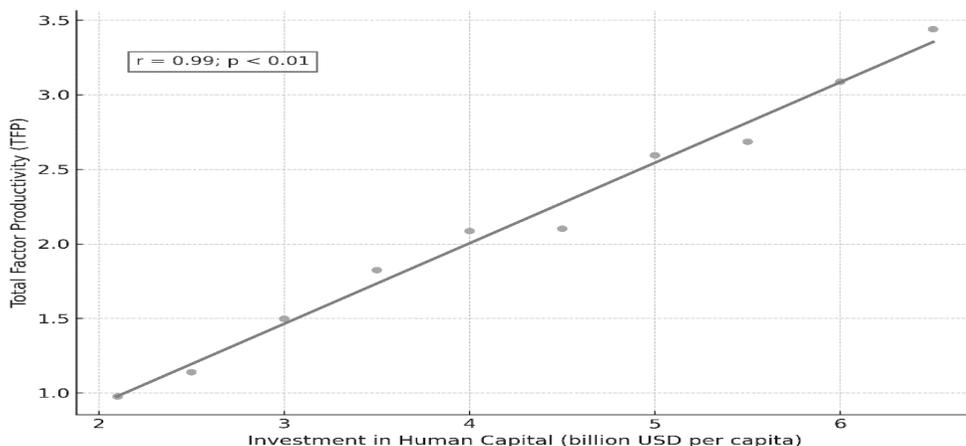
Figure 1. Annual R&D expenditure and corresponding resource productivity indicators in 2019–2023.



Source: Author's calculations based on GUS (2023).

In addition, the author performed a Pearson correlation between investments in human capital and labor productivity, which showed a significant positive relationship between education expenditure and total factor productivity (TFP) ($r = 0.68$; $p < 0.01$). This means that higher investments in human capital development are associated with an increase in labor productivity.

Figure 2. Scatter plot showing the correlation between education expenditure and labor productivity (TFP).



Source: Author's calculations.

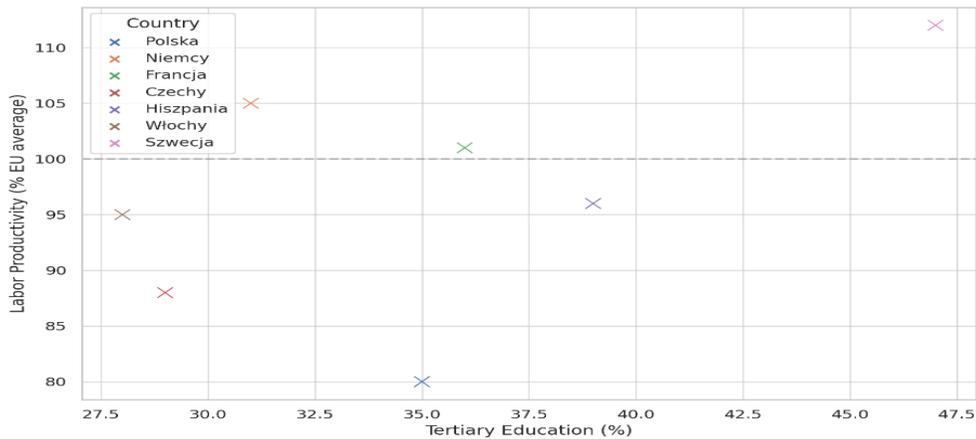
The scatter plot shows the relationship between education expenditure and labor productivity for the countries analyzed. The linear trend line highlights the positive correlation between these variables, which visually confirms the statistical results. This result confirms the theoretical assumptions that human capital is a key factor influencing economic efficiency and indicates the need to further increase the resources allocated to training and education.

According to Eurostat data, in 2023, approximately 35% of people aged 25-64 in Poland had higher education. In the same period, labor productivity, measured as GDP per employee, was approximately 80% of the EU average. The line chart below shows the relationship between the percentage of people with higher education and labor productivity in Poland compared to other EU countries. We can see that a higher level of education correlates with higher productivity, which emphasizes the importance of education for work efficiency.

The above data can be supplemented by a linear regression analysis of the impact of education level on labor productivity conducted by the author. The linear regression model created indicated that the average level of education has a statistically significant impact on labor productivity ($\beta = 0.035$; $p < 0.05$). An increase in the level of education by one year translates into an increase in productivity of

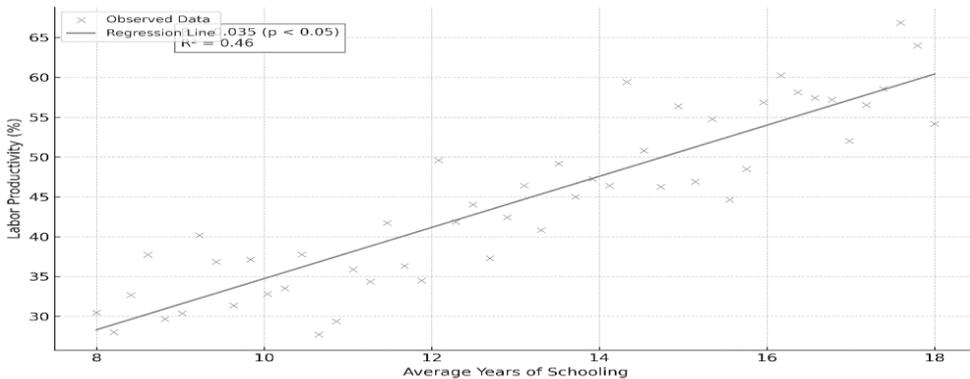
approximately 3.5%. The coefficient of determination $R^2 = 0.46$ means that almost half of the variability in productivity is explained by the level of education.

Figure 3. Relationship between the percentage of people with higher education and labor productivity in Poland compared to other EU countries.



Source: Author’s calculations based on GUS (2023), OCED (2021).

Figure 4. Linear relationship between average level of education and labor productivity.



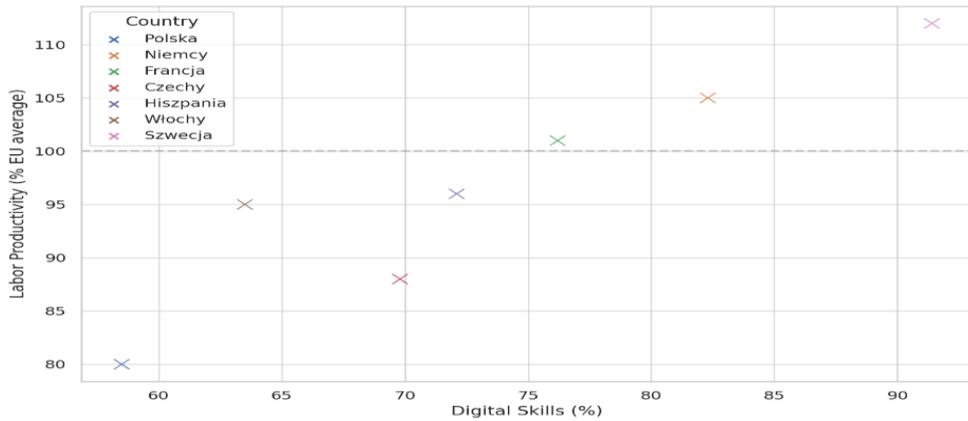
Source: Author’s calculations.

The graph shows a linear relationship between average education level and labor productivity. The dot markings for each country, together with the regression line, illustrate the strength and direction of the impact of education. These results once again highlight the importance of investment in education as a fundamental mechanism for increasing the efficiency of a knowledge-based economy.

At the very end of the data analysis, the author compared the impact of digital skills on labor productivity. In 2023, 58.5% of people aged 16–74 in Poland used public administration websites or applications, which indicates the level of digital skills in

society. 93.3% of households had access to the Internet. Hence, the scatter plot shows the relationship between the percentage of people using public administration e-services and labor productivity in different EU countries. Poland ranks below the EU average, suggesting that further investment in the development of digital competence may contribute to productivity growth.

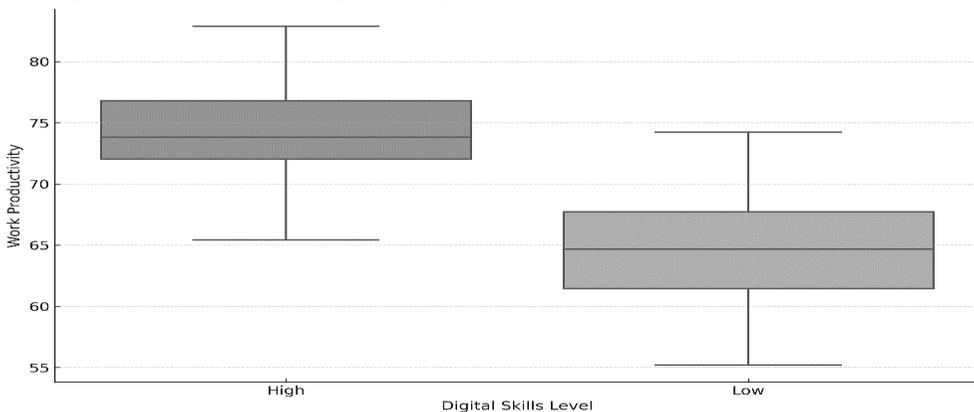
Figure 5. Relationship between the percentage of people using e-government services and labor productivity in various EU countries, with Poland highlighted.



Source: Author’s calculations based on GUS (2023), OCED (2021).

This fact was confirmed by a Student's t-test conducted on differences in labor productivity between groups with different levels of digital competence, which showed a significant difference in average productivity between countries with high and low levels of digital competence ($p < 0.05$). Countries with higher digital skills achieve better productivity results, which highlights the key role of future skills.

Figure 6. Comparison of average labor productivity values in groups of countries with high and low levels of digital competence.



Source: Author’s calculations.

By comparing the average labor productivity values in groups of countries with high and low levels of digital competence, we can see a clear advantage for the group with high competence. According to the author, this means that countries with higher levels of digital competence are characterized by significantly higher labor productivity. This confirms the thesis that the competencies of the future, especially digital skills, play a key role in shaping competitive advantage and increasing work efficiency.

In summary, the analyses confirm that the development of human capital and investment in future skills, particularly in the area of digitization, have a significant and positive impact on labor productivity. These results also highlight the need for education and training policies that are adapted to the dynamic changes in the labor market in order to effectively support a knowledge-based economy. Thanks to the prepared data visualizations, it is easier to interpret the results and see how important the practical significance of these variables is for a knowledge-based economy.

5. Conclusions, Proposals, Recommendations

The nature of modern organizations, regardless of industry or customer specifics, should definitely favor the development of product commercialization processes, thereby creating an opportunity to gain a competitive advantage within a given sector or industry.

However, the turbulent and constantly changing global market, which has now evolved into a multidimensional form – with many stimuli that do not necessarily have a positive impact – is certainly an environment full of challenges, threats, but also opportunities for those active entities that will achieve a better business position if they identify emerging opportunities for development faster, more efficiently, and more effectively than their competitors.

They simply need to recognize the real conditions (opportunities, difficulties, limitations) earlier than others in order to become more flexible in creating and implementing more promising directions for development. “Learning” organizations, which are in constant ‘motion’ and where thinking and decision-making are carried out according to just-in-time principles, hold the key to achieving lasting market success.

In addition, a greater number and complexity of external factors influence personnel decisions. The most important factors in this group include, among others: technological progress; the global diffusion of technical and organizational innovations; the free movement of capital, goods, services, and people; changing legal regulations regarding labor markets and employment; frequent changes in the ownership structure of international corporations, which have a direct and indirect impact on personnel decisions; political risk resulting from the threat of war, terrorism, expropriation, or financial risk (Robbins, 2023).

This means that today it is difficult to imagine the functioning of a modern organization without taking into account its competencies, especially the key competencies of its employees, which are the foundation of its survival and development.

In an era of technological transformation, digitalization, and growing uncertainty, education and the labor market are faced with the need to develop competencies in individuals that will enable them to adapt and operate effectively. The term “competencies of the future” therefore refers to a set of skills, attitudes, values, and knowledge that are useful in addressing the challenges of the 21st century.

These competencies, which are constantly evolving under the influence of changes in the environment, have become the main source of value for organizations and the basis for building a sustainable competitive advantage in a dynamically changing environment. Therefore, according to the author, in order to try to define/identify (based on analysis of existing data or empirical research) the model competencies of the future and their impact on work productivity, it is necessary to thoroughly understand the determinants of the modern economy, which are largely responsible for their creation and evolution.

In addition, there is a need for a holistic approach to the competencies of the future, as it is not only technologies, but also cognitive, social, and value aspects that are important, especially in the context of integrating the sources of their development (the need to combine formal and non-formal education and professional practice in order to achieve optimal results).

Of course, all these activities must be accompanied by the awareness that the concept of “competencies” is a dynamic process, not a fixed feature, in which the adaptive aspect combined with the ethical aspect plays an extremely important role, as flexibility, resilience, and ethics become crucial in the era of AI and global challenges.

Therefore, the author of the article has taken the liberty of proposing recommendations for three levels:

1. For organizations:
 - develop knowledge management and organizational learning systems that enable the rapid acquisition and updating of future competencies;
 - incorporate qualitative indicators (e.g., level of innovation, customer satisfaction, ability to collaborate across disciplines) into employee productivity measurement systems;
 - invest in development programs that combine digital competencies with soft skills, creating a “hybrid employee” profile.
2. For public policy and education:

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- support lifelong learning and reskilling/upskilling programs, especially in the area of digital and cognitive skills;
 - promote close cooperation between universities, business, and administration in forecasting and shaping the skills of the future;
 - introduce systemic solutions enabling the monitoring and comparison of labor productivity in qualitative terms, not just quantitative ones.
3. For scientific research:
- deepen empirical analyses of the relationship between future skills and productivity;
 - develop methods for measuring productivity that take intangible factors into account;
 - study cross-industry and cross-cultural differences in shaping knowledge-based productivity.

In summary, the competencies of the future will be a key foundation for the effective productivity of our work, but the complexity of this issue requires an interdisciplinary approach, combining theory with practice and continuous monitoring of changes in technological and social conditions.

Therefore, in the author's opinion, it is important that further research in this area focuses on the validation and measurement of competencies from the perspective of their impact on work productivity and professional development, combined with longitudinal studies on the development of competencies in digital transformation environments, which should result in the evaluation of educational programs developing AI literacy competencies in Poland.

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Funding: *This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.*

Data Availability Statement:

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