Smart Learning Technologization in the Economy 5.0—The Polish Perspective

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Abstract: Contemporary higher education is gradually transforming. Meetings of teachers and students from lecture halls are increasingly moving into the digital space of the Internet, adopting the formula of distance learning. The advent of Society 5.0 and Economy 5.0 will imply further changes. The necessity to integrate the real and virtual world, increased demand for information, limited time resources, and the need to combine professional work with education will cause higher education, in order to prepare future citizens to function in the area of sharing resources, to be forced to further adaptive transformations. The subject of this article is the analysis of the impact of technology on changes in higher education with an indication of the model of future paths of education in the Economy 5.0 trend. The source of the article was exploratory research of secondary sources, including books, articles, and reports, which were subjected to a critical analysis of the content. The obtained results made it possible to design and implement an explanatory study among students based on the CAWI methodology. The collected material became the basis for the authors to prepare a proposal for a model of future educational paths in accordance with the Economy 5.0 trend in which the flexibility of place and time, customization of the offer, cooperation, adaptability of teaching methods and instruments, and the proactive role of the teacher as a mentor and trainer constitute a set of set guidelines in the teaching model of the future. This model will be able to be used by universities and training institutions in the field of professionalization of the management of teaching and organizational processes.

Keywords: economy 5.0; higher education; technologization; smart learning

1. Introduction

Currently, as a result of the development of technology, transformation takes place almost at every step. Consumers, by imposing increasingly restrictive conditions on entrepreneurs, contribute to changes in the processes of production, management, logistics, work organization, and ecology. The requirement of customization makes it necessary for enterprises to adapt flexibly and quickly. The solution is the increased emphasis on technology in line with the Industry 4.0 concept, which was first mentioned in 2011 at the Hanover fair [1]. The concept of Industry 4.0 aims at integrating smart machines and systems, making it possible to introduce changes in production processes. The purpose of this strategy is to increase performance effectiveness and introduce the possibility of flexible changes in the offered range of products [2]. Such activities are possible thanks to digitization and virtualization. Enabling technologies for Industry 4.0 implementation include but are not limited to: advanced manufacturing solutions, additive manufacturing, augmented reality, simulation, horizontal/vertical integration, industrial internet, deep learning, cloud, cyber-security, and big data and analytics [3,4].
Modern automation and robotization technologies implemented in the information and organizational structures of enterprises [5] contribute to the improvement of processes related to design, production, material management, and the supply chain. When the supply chain takes into account the whole life of the product (warranty, remanufacturing, recycle, disposal, etc.), the adverse effect on the logistic flow is quite considerable on the structure of the network [6].

Industry 4.0 puts emphasis on systemic functioning in the network. The crux of this approach is the integration of humans and digitally controlled machines, with the simultaneous use of the Internet and information technologies. The benefits of implementing and acting in compliance with this concept result, above all, from coordination activities. The demand for effective production coordination that goes beyond a given company is treated as the background of high technological pressure in industrial practice [7]. Visionary, but quite realistic, concepts such as the Internet of Things, Industrial Internet, Cloud-based Manufacturing, and Smart Manufacturing are drivers of the so-called fourth industrial revolution which is commonly referred to as Industry 4.0 [8].

Despite the admiration for the concept of Industry 4.0, scientists and practitioners note [9,10] that use of machines and devices, cloud computing technology, data sets, and the Internet of Things (IoT) to increase the efficiency and effectiveness of enterprises is insufficient. People, both employees and customers of enterprises, play an important role in this process. Therefore, it is of special importance to adequately prepare members of the society to the needs of the technologized economy [11]. Researchers and practitioners agree that people’s knowledge, competences, and skills become invaluable, indicating to move to the next stage of development. Although Industry 4.0 is flourishing, it has not yet been embraced by all the organizations as the talk of “industry 5.0” is getting louder and louder.

However, unlike the focus on technology, there is a shift to human nature according to the broader notion of “society 5.0”, which can “balance economic progress with solving social problems through a system that strongly integrates cyberspace and physical space” [12]. Additionally, comes the concept of Economy 5.0, which refers to collaboration in the field of innovation, creativity, and competitiveness for society and individuals to create unique ways of creating value in economic structures. The concept of Industry 5.0, first presented in 2015, with the accentuation of the human dimension (human touch) in industry, refers to collaboration between people and intelligent production systems and thus goes beyond the production of goods and services for profit. The focus is on employee well-being, respect for limited resources, and creating a resilient industry to cope with unforeseen emergencies such as COVID-19. The holistic approach to the world of people and machines in the version of Industry 5.0 makes this coexistence possible. An important role in this reconfiguration is assigned to cognitive technologies and artificial intelligence, which will enable the deepening of interactions between people and machines. Thanks to human collaboration with intelligent robots, enterprises will be able to achieve the dimension of personalization like never before. Importantly, the concept of Industry 5.0 rejects the primacy of automation, assigning priority to humans. According to its trend, technology is to support people in performing tasks [13]. Unlike the Industry 4.0 concept, the sequence of events is as follows: people, processes, and only in the third place, technology. Even the most advanced technology should not be above humanity.

In this context, an important issue is the preparation of future members of the society who will function in the technologized reality. An area worth exploring is the analysis of future learning opportunities. Especially teaching and teaching in higher education, which, as a preparation for future research and management staff, can represent adaptive changes in the trend of Society 5.0, Economy 5.0, and Industry 5.0.

The aim of the article is to discuss the impact of technology on the reconfiguration of education with the identification of symptoms of intelligent learning in the Economy 5.0 trend in the area of higher education, where intelligent learning should be understood as the transformation of the learning ecosystem from teaching to learning, including the ways of
thinking and acting of students and teachers in the field of skillful ways of using technology to obtain knowledge more effectively, efficiently, and conveniently. Reorganizing learning towards accessibility and flexibility may represent the next step in the development of education systems, as represented by higher education.

In order to investigate whether such a direction of development is expected and possible, the authors have decided to verify the following hypothesis: technology will become an accelerator of changes in educational processes marked by “intelligent learning”, which may be represented by the area of higher education.

The techno-world marked by information, internetization, robotization, and virtualization penetrates today into every area of human existence [14]. It is important to prepare specialists who will meet the challenges of the market of the future. Here, a question arises: what do the interested parties, i.e., students, think about the technologization of learning? What, in their opinion, will happen to studying and education in the future?

It can be assumed that the future provision of educational services in the spirit of the Economy 5.0 will be marked by digital transformation [15,16]. However, this is not enough. Additional questions arise:

- Which of the current technological solutions used by the participants of the educational system will be used in the future?
- What formula will the concept of smart education adopt in the next 30 years, especially in the area of personnel preparation for the needs of enterprises?
- Whether, and to what extent will, technology change the learning and teaching process in line with the smart learning concept?
- And what role will be assigned to the academic teacher in smart learning?

The authors sought answers to these questions during 2018 and 2019 by doing research on the professionalization of university management under the project: “Dialog” (Decision No. 0146/DLG/2017/10)–within the area of research on “Challenges of modern education”.

The analysis of the collected material made it possible to determine the theoretical and practical implications of the transformation of education, as well as to propose a model of future paths of education for Economy 5.0 in the spirit of “society 5.0” taking into account the limitations like limiting the scope of research to Poland.

2. Economy 5.0 and Society 5.0

When trying to explain the term Economy 5.0, it should be noted that economic development takes place in certain stages. These stages, marked by successive economic, social, and cultural revolutions, begin with the agrarian era, the development of electricity, production, automation to the information age based on the principles of cooperation, creating an ecosystem of a collaborative society (network society, knowledge society). These stages closely correlate with the development of technology and knowledge. Industry 5.0 itself has its foundations in the assumptions of the concept of Industry 4.0 and the technological development of the 5G network [17].

The driving force behind changes in contemporary markets is progressive digitization [18]. Changes that take place in the economy also affect the changes in the requirements of employers in relation to the knowledge and skills of employees [19]. Such a situation results in socio-cultural changes in the perception of the learning process and the acquisition of new competences and skills. Cultural changes taking place in contemporary societies take place under the influence of the development of advanced network societies (crowdsourcing) of increasing involvement in the life of new technologies, artificial intelligence (AI) and the Internet of Things (IoT) [20]. A significant challenge in Economy of 5.0 is to search for solutions to problems arising in the stage of Economy 4.0 [21]. Undoubtedly, Economy 5.0, in its assumptions, is based on strategic interactions between stakeholders who are more and more immersed in AI and IoT network technologies [22]. The development and growing importance of this new concept of the economy depends on these relations. Therefore, building strategic, relational partnerships seems to be important in
the 5.0 economy. The literature on the subject also indicates that increasing technological development in the spirit of the Economy 5.0 concept gives the possibility of improving the standard of living, but it may have a negative impact on management processes such as employment [23].

The sphere of socio-cultural transformations known as Society 5.0 is inherently linked to the Economy 5.0 trend in the economy. The literature on the subject points to the “Industry 4.0” paradigm as the source of the development of the Society 5.0 trend [24–27]. According to Keidanren, Nakanishi, the concept of Society 5.0 sets new trends in the way of solving problems related to the idea of a sustainable society [28,29]. Insufficient flow and ability to process information are indicated as the cause of the changes of Society 4.0 into Society 5.0. The value of Society 5.0 is the use of advanced technologies for cooperation, learning, and information exchange [30,31], and for this it is necessary to have digital competences. The main manifestation of the activities of the Society 5.0 is focusing on working on modification of technological resources and introducing innovative changes in order to improve the standard of living of society, humans, and sustainable development in this concept are in the first place [32]. Therefore, it can be stated that Society 5.0 is a kind of bond between changes taking place in the technology, digital, and information flow areas (Economy 5.0) and focuses its activities on the concept of sustainable development of societies. Summing up, it can be stated that Society 5.0 is characterized by the features of an intelligent society based on digital transformation [33,34].

Along with the development of the new economic formation Economy 5.0 and the revolution in the scope of the accompanying socio-cultural changes, there is also a change in the way of learning with the use of e-learning technologies and tools. This change was based on a significant development of technology and tools in the field of distance learning, but also on a change in the perception of this form of education by the society. It seems that the processes of getting familiar with e-learning technologies and tools are also accelerating as a result of the COVID-19 pandemic [35]. The pandemic has become a catalyst for a faster, global transformation of enterprises and societies towards Economy 5.0 and Society 5.0.

3. Smart Learning–Technological Exemplification

Smart learning or intelligent education encompasses new educational contexts whose meaning focuses on the learner’s and teacher’s use of available, innovative technologies [36]. This depends not only on the software and hardware available, but also on how they are synergistically used in the classroom or online training. According to the Korean Ministry of Education, Science and Technology, smart learning is “a self-directed, motivated, adaptive, resource-enriched and technology-embedded learning concept”. These features suggest that smart learning extends the methods, competences, content and learning spaces of both students and teachers [37].

The self-directed learning function has the potential to extend learning time, but at the same time allows one to learn anytime and anywhere. The motivational function of intelligent learning extends educational methods by ensuring empirical and collaborative activities of students and teachers. The adaptive function, in turn, broadens the educational possibilities, offering personalized and individualized learning. In addition, the richness of formats extends the educational content by making available various educational resources. Finally, ICT, by offering local and global communication networks, makes access to educational content principally unlimited. (Figure 1).
In this context, the key importance for the dynamic development of the concept of intelligent learning is the broadly understood information and communication technology (ICT) and innovations in the field of artificial intelligence (AI), virtual reality (VR), augmented reality (AR), processing of large data sets (BigData), 3D visualizations, or machine learning (ML) [38–41]. Educational solutions based on these technologies, embedded in the model of cloud computing with well-defined mobile applications, will determine the way of learning (in a broader sense), and in particular of academic education, over a dozen or so years. In the case of commonly used e-Learning platforms (LMS class systems), their operation in a cloud model is practically a standard nowadays, which opens up a number of integration possibilities. Blackboard Learn Ultra or OpenLMS solutions are fully virtual teaching support platforms embedded in the SaaS (Software as a Service) or PaaS (Platform as a Service) cloud model [42]. Such location opens up virtually unlimited possibilities of integration with virtual laboratories, corporate transactional systems, analytical systems, 3D printing systems, or business process simulation platforms (e.g., Marketplace). Virtual modeling and prototyping, which until now was the domain of wealthy enterprises, is now also available at universities. Moreover, the virtualization of didactic processes makes it easier to implement dual education combining the theoretical (academic) with practical (business) parts. Thus, the boundary between the university and enterprise in the virtual space is blurring.

Throughout history, education has been an interaction between teacher and student in which knowledge flows from one person to the other one. This approach in education will not change, but many of the technologies implemented can be a challenge for this model. Arguably the most important of these is artificial intelligence, along with related technologies such as neural networks and machine learning. Thanks to these technologies, developers are starting to create applications that can automatically collect, sort, and organize information, essentially creating knowledge encyclopedias using publicly available information [43]. Artificial intelligence is already used in many online learning platforms, such as Quizlet, Duolingo, and Querium—all of which use artificial intelligence to provide learners with customized content without requiring a human being. Many of these plat-
forms also used distributed repetition learning systems and artificial intelligence-based chatbots to help with inquiries and ensure student attention, helping to maximize process efficiency. Since the launch of the Oculus Rift in 2016, the first large-scale consumer virtual reality headset, the use of virtual reality (VR) technology has grown exponentially, with the education industry in particular being strongly impacted. By providing teachers and students with a medium for a more engaging and active meeting, virtual reality is able to offer educational experiences that will not be quickly forgotten, making the entire learning process effective. Educational solutions based on virtual and augmented reality will be of particular importance in the case of practical learning of subjects, where the costs of traditional laboratories are significant. For example, in logistics, these may be vehicle simulators, virtual arrangement of warehouse space in 3D, non-conventional configuration for unit load warehouses (diagonal cross-aisles) [44], prototyping and testing, innovative hybrid flow shop environments [45], programming of robots in production processes, or simulations of unexpected situations in distribution logistics [46].

4. Materials and Methods

Primary research (explanatory) was conducted in 2018/2019 in Poland. The subject of the measurement was the impact of technology on changes in higher education in the context of the concept of Economy 5.0. Researchers wanted to find out what the future settlement of Artificial Intelligence (AI) may have in the process of higher education and how the system beneficiaries assess its future use. The method applied at this stage was a diagnostic survey. Indirect research was conducted with the use of the “user-centric” CAWI (Computer Assisted Web Interview) Internet survey method. The visual measurement tool was a questionnaire consisting of 30 closed questions, including 9 based on the scaling of attitudes according to Rensis Likert. Due to the scope of the measurement, the conducted study was fragmentary and deterministic, with representativeness for the surveyed community. The empirical material was obtained from primary sources, which were people with the status of a university student and participating in classes at universities operating in Poland. Not all people studying in Poland in the 2018/2019 academic year were examined, but only a selected sample. The selection of institutions for the sample was two-phased.

In order to maintain the representativeness of the sample in relation to the studied population, in the first phase, out of 392 universities operating in Poland in 2018/2019, a stratified selection method with proportional allocation with systematic consumption was selected (taking into account the criteria: public/private university and the number of students) a sample of 38 institutions according to the formula for the minimum size (1). The components used were the fraction of 0.9 public institutions and 0.1 for private institutions, a 6% random error and a confidence level of 0.99.

\[ n_{\text{min}} = \frac{Np(\alpha^2 - f(1 - f))}{Np\cdot e^2 + \alpha^2 f(1 - f)} \]  

where:
- \( n_{\text{min}} \) —indicates the minimum sample size;
- \( N \) —the size of the studied population;
- \( \alpha \) —confidence level for the results;
- \( f \) —fraction size;
- \( e \) —assumed maximum error.

Consequently, in the second phase, in selected collective institutions, i.e., 38 universities, the study covered individual institutions. Using the method of selecting typical ones in each of the indicated universities, those students who had contact with technological support during their studies were selected as research respondents (e-learning platforms as the basic determinant of “relocation” of science). Using the Formula (1) again, the minimum number of respondents was obtained, this time for viable respondents—students at the level of \( n^2 = 1076 \) respondents. The components used were the fraction of 0.3 for
students who participated in the activities conducted with the use of e-learning and 0.7 for the others, with a random error of 5% and a confidence level of 0.99.

\[ Z = \frac{n2}{n1}; \]
\[ Z = \frac{1076}{38}; \]
\[ Z = 28.316 \approx 28 \text{ institutions.} \]

Finally, it was assumed that at least 28 people would be asked to participate in the study at each of the 38 selected universities (the corrected Z index expressing the ratio of the minimum number of students to the minimum number of universities). In total, a sample of 1064 persons, taking into account total units, was indicated. Students who met the guidelines for selecting typical units were asked to participate in the study. Only after obtaining their consent was it possible to conduct the study.

The link to the digital questionnaire was sent to those students who agreed to participate in the research. After the respondents filled them in, the material was encoded in the SPSS (Statistical Package for Social Sciences) program using a code key. After data verification and validation, a three-step data analysis was performed.

In the first stage, a comparative analysis of the population and the studied sample was carried out using the concordance test based on the \( \chi^2 \) statistics. Due to the test procedure, in the first step, the null hypothesis (H0) was adopted for the disagreement of the distributions of selected variables (university type, gender, level, and scientific mode) from the samples with the distributions characterizing the general populations of universities in Poland, respectively, and for students and the alternative hypothesis (H1) about the existence of such a concordance.

\[ \chi^2 = \sum_{i=1}^{r} \frac{(ni - npi)^2}{npi} \]

where:
- \( npi \) means the probability that the feature X takes a value belonging to the i-th class interval;
- \( npi \) denotes the number of units that should be in the i-th interval, assuming that the feature has a distribution consistent with the hypothesis.

In turn, the statistic has the distribution \( \chi^2 \) when \( k = (r - 1) \), where:
- \( k \) means the number of degrees of freedom;
- \( r \) is the number of class intervals;
- \( \chi^2 \) is the empirical value of the statistic obtained from the study.

The form of a critical set:
\[ P(\chi^2 > \chi^2_{\alpha}) = \alpha \]

where \( \chi^2_{\alpha} \) is the critical value from the distribution tables \( \chi^2 \) for \( k = r - 1 \) degrees of freedom and \( p = \alpha \).

The surveyed group of 1076 respondents was dominated by women (55.4% of the respondents) in relation to men (44.6% of the respondents). Taking into account the age of respondents, the most numerous group (50.5%) are people between 18–29 years. The remaining respondents were people aged 30–39 (33.5%) and over 40 (15.9%). More than half of the respondents (66.1%) study undergraduate programs, while (33.9%) study graduate programs. Over half of the respondents (63.5%) are full-time students while the rest (36.5%) are part-time students.

The result of the analysis is that the null hypothesis (H0) could not be confirmed. Therefore, the H1 hypothesis about the existence of consistent distributions is true, i.e., the studied samples (universities and students) are consistent with the general population in terms of the participation of students by university status, according to the distribution by gender, level, and mode of education (Table 1).
Table 1. Sample representativeness–Statistical concordance test \( \chi^2 \).

| Parameters          | Number | Value \( \chi^2 \) | Value \( \chi^2_\alpha \) | Test Realization |
|---------------------|--------|--------------------|-----------------------------|------------------|
| university status   |        |                    |                             |                  |
| public              | 12     | 0.039              | 6.635                       | concordance      |
| private             | 26     |                    |                              |                  |
| gender              |        |                    |                             |                  |
| female              | 589    | 2.460              | 6.635                       | concordance      |
| male                | 475    |                    |                              |                  |
| level of education  |        |                    |                             |                  |
| undergraduate       | 703    | 2.566              | 6.635                       | concordance      |
| graduate            | 361    |                    |                              |                  |
| mode of education   |        |                    |                             |                  |
| full-time           | 676    | 1.870              | 6.635                       | concordance      |
| part-time           | 388    |                    |                              |                  |

In selecting universities as objects of the research, the systematic selection method was used. In the selection of individual institutions, a non-random selection of typical institutions was used. Therefore, it is difficult to fully assess the representativeness of the samples in a statistical sense due to the lack of randomness in relation to the sample included in the second phase of the study. However, due to the size of the sample, making conclusions seems legitimate.

In the next stage of the analysis, the structures of the distribution of answers for individual questions from the questionnaire were examined, and then, where it was justified, in the third stage, attempts were made to determine the possibility of the existence of relationships between selected variables, using cross-statements and determining boundary values. The basis for examining the relationship between features was each time the table of independence (contingency), which was used to arrange two features simultaneously. This table consisted of \( r \) rows and \( s \) columns, where each row (column) corresponded to particular variants of the \( X \) (\( Y \)) feature. The content of the contingency table consists of the numbers of \( n_{ij} \) elements of the sample that have the \( i \)-th variant of the feature \( X \) \((i = 1, 2, \ldots, r)\) and the \( j \)-th variant of the feature \( Y \) \((j = 1, 2, \ldots, s)\).

The table of independence was the basis for the verification of the null hypothesis \((H_0)\) of the existence of stochastic independence of the random variables \( X \) and \( Y \) and the alternative hypothesis \((H_1)\), adopted in the case of rejection of the null hypothesis \((H_0)\) in accordance with the following Formula (2):

\[
\begin{align*}
H_0 & : P\{ X = x_i \land Y = y_j \} = P\{ X = x_i \} \cdot P\{ Y = y_j \} \\
H_1 & : P\{ X = x_i \land Y = y_j \} \neq P\{ X = x_i \} \cdot P\{ Y = y_j \}
\end{align*}
\]

Statistics \( \chi^2 \) were used to verify the \( H_0 \) hypothesis about the stochastic independence of variables.

The statistic is of the form:

\[
\chi^2 = \sum_{i} \sum_{j} \frac{(n_{ij} - \tilde{n}_{ij})^2}{\tilde{n}_{ij}} \cdot \chi^2_{(r-1) \cdot (s-1)}
\]

where: \( n_{ij} \)—conditional empirical numbers resulting from the contingency table;

\( \tilde{n}_{ij} \)—theoretical conditional numbers that would appear in the table if the features were independent.

Hypothetical numbers are determined according to the following formula:

\[
\tilde{n}_{ij} = \frac{n_i \cdot n_j}{N}
\]
The H₀ rejection area is always right-handed. Its size depends on the adopted significance level \( \alpha \). If it is bigger, then the greater the \( \alpha \) is. Generally, \( \alpha \leq 0.05 \) is assumed. Critical values of the distribution \( \chi^2 \) with \( (r - 1)(s - 1) \) degrees of freedom. If only \( \chi^2_{\text{emp}} > \chi^2_{\alpha} \), then H₀ is rejected in favor of the H₁ hypothesis, which means that the pair of features is mutually dependent on each other. Using the described methodology of testing the statistical significance of the relationship between the variables, statistical values and significance levels were calculated using the SPSS computer program.

The verification of the statistical significance of the observed dependencies of individual variables consisted in checking whether for the \( \chi^2 \) statistic value of a given pair of analyzed variables, the value of the asymptotic significance parameter is lower than 0.05. If so, the observed relationship between the variables could be considered statistically significant, and the results and conclusions drawn on the basis of the analysis of data obtained from the sample were considered representative.

5. Results

The conducted research allowed for the analysis of the material in the areas of the current applicability of devices to connect to the Internet, the use of specific technological solutions and knowledge of the representation of smart technology applications. On the basis of the collected material, the predictive manifestations of smart learning as a model for the development of learning and teaching in the future were analyzed. In the next step, an analysis of indications in the field of instrumental support was performed. Then, the indications as to the position of the teacher in the future (in 30 years) were analyzed. The last component was the analysis of the manifestations of Artificial Intelligence (AI) in the education of the future.

5.1. Current Use of Technological Tools and Solutions

Among the devices used to connect to the Internet in search of information, work, shopping or entertainment, the respondents participating in the survey, often and most often use a smartphone (93.0%), a laptop (74.1%), and mobile phones—a desktop computer (25.7%), and they rarely and least often use a smartwatch (93.9%), a TV set (69.7%), and a tablet (34.6%). Such results are in line with the trends of dispersion and use of devices indicated in the research: Report “We are the Social–Digital 2019” [47]. The smartphone as a tool for communication, work, and entertainment becomes a symbol of the digital revolution. Other devices are not as popular in use or are not identified as the ones with which you can access the network.

To the next question about knowledge and usage of new technologies the participants of the study indicate that they know, apply, and use such technological solutions as cloud computing (55.3%), hyperconnection (55.1%), artificial intelligence (43.3%), and BDaaS solutions, i.e., Big Data as a Service (42.2%). In turn, technologies such as robotization (58.9%), BDA analytics, i.e., Big Data Analytics (47.2%), automation (46.2%), virtual reality (46.0%), and chat bot (45.6 %) are known to them, but they do not use them. However, they do not know and do not use solutions such as machine learning (51.8%), IoE Internet of Everything (45.4%), and IoT or Internet of Thing (38.1%). Indications for specific technologies as known and applied, known and not used, and unknown and used reflect the propagation of specific technological solutions, the age of users and their functioning in enterprises.

When asked about the knowledge of the manifestations of using innovative technologies, nearly three fourths (69.5%) of the respondents indicate learning and teaching as the areas that they had contact with. A smart home was indicated in the first place (79.8%). Moreover, nearly half of the respondents encountered solutions of intelligent transport (58.2%), smart city (48.0%), and intelligent logistics (47.8%). Slightly fewer people also indicated smart trade (44.5%) and smart finance (40.4%). The smallest number of respondents admitted that concepts such as intelligent industry (31.1%) and intelligent clothing (19.0%) are known to them. The obtained results are related to the popularity of
the application of innovative technological concepts in terms of the frequency of contact with them and thus their popularization.

5.2. Predictive Manifestations of Smart Learning as a Model for the Development of Learning and Teaching in the Future

The currently used e-learning technology is the first step in the reconstruction of the learning and teaching model from classical—prescription to innovative—smart learning. The respondents are of the opinion that Smart learning (Figure 2) in the future will be based on the integration of information collection between the student’s living spaces, such as home–work–virtual classroom (69.1%). This opinion is shared by more women (72.5%) and undergraduate students (64.7%), which is confirmed by the statistical dependence $\chi^2$ (Table 2).

Moreover, according to respondents Smart learning will enable the participants to co-create the course content (68.0%). This is the opinion of slightly more younger people up to 39 years of age (64.6%); and definitely more women (70.7%), graduate students (75.1%), and part-time students (69.8%), which is confirmed by a statistically significant relationship $\chi^2$ (Table 2).

According to respondents, another advantage of Smart learning will be the ability to simulate real events in virtual reality (61.9%). This opinion is shared by slightly more people younger than 39 (59.2%), women (62.3%), graduate students (73.7%) and part-time students (60.5%), which confirms the statistically significant correlation $\chi^2$ (Table 2).

Table 2. Smart learning representation by gender, age, level, and mode of study–test of independence $\chi^2$.

| Variants                                                                 | Gender | Age       | Level (Undergraduate and Graduate) | Mode of Studies (f-t and p-t) |
|--------------------------------------------------------------------------|--------|-----------|-----------------------------------|-----------------------------|
|                                                                          | $\chi^2$ | $\alpha$  | $k$     | $\chi^2$ | $\alpha$ | $k$     | $\chi^2$ | $\alpha$ | $k$     |
| implementation of tasks from the educational platform in a real environment | 22.909 | 0.000     | 4       | 49.629 | 0.000     | 12      | 35.067 | 0.000     | 4       | 9.040    | 0.060   | 4       |
| teacher’s participation in tasks carried out in real conditions          | 30.809 | 0.000     | 4       | 35.299 | 0.000     | 12      | 9.479  | 0.050     | 4       | 3.703    | 0.000   | 4       |
| the ability to simulate events in virtual space                          | 14.335 | 0.006     | 4       | 34.017 | 0.001     | 12      | 44.113 | 0.000     | 4       | 26.798   | 0.000   | 4       |
| co-creation of the course content by the participant                     | 34.795 | 0.000     | 4       | 23.486 | 0.024     | 12      | 25.017 | 0.000     | 4       | 17.264   | 0.002   | 4       |
| integrating the collection of information from space–home–work–virtual classroom | 22.144 | 0.000     | 4       | 8.438  | 0.750     | 12      | 25.821 | 0.000     | 4       | 4.287    | 0.369   | 4       |

* $\alpha$—confidence level, $b$—number of the degrees of freedom, $f-t$—full-time studies, $p-t$—part-time studies.
On the other hand, according to respondents the teacher’s participation in classes carried out in real conditions (7.0%) and the implementation of tasks assigned to the educational platform in a real environment (4.6%) will not be implemented in the future in the Smart learning trend as educational activities.

5.3. Instrumental Support in the Model of Learning and Teaching Development in the Future

The instrumental support of Smart learning (Figure 3) will be according to respondents integrated communication systems as the basis of the information system (81.1%). This is the opinion of the dominant group of younger people up to 39 years of age (79.13%), graduate students (87.5%), and part-time students (84.6%), which confirms the statistically significant relationship $\chi^2$ (Figure 3).

![Figure 3. Instrumental support of Smart learning in practice.](image)

The respondents admit that virtual e-books and e-materials, which will replace paper materials, will also be a significant support (80.1%). This opinion is shared by the dominant group of younger people up to 39 years of age (75.3%), graduate students (86.4%), and part-time students (84.6%), which is confirmed by a statistically significant relationship $\chi^2$ (Table 3).

### Table 3. Instrumental support for Smart learning in terms of gender, age, level, and mode of study–test of independence $\chi^2$.

| Variants                                      | Gender | Age       | Level (Undergraduate and Graduate) | Mode of Studies (f-t and p-t) |
|-----------------------------------------------|--------|-----------|------------------------------------|------------------------------|
|                                               | $\chi^2$ | $\alpha$ | $k$ | $\chi^2$ | $\alpha$ | $k$ | $\chi^2$ | $\alpha$ | $k$ |
| each part of the home will become an integral part of education | 17.986 | 0.001 | 4 | 33.321 | 0.001 | 12 | 45.41 | 0.000 | 4 | 23.278 | 0.000 | 4 |
| classrooms will be equipped with intelligent infrastructure | 13.559 | 0.009 | 4 | 25.21 | 0.014 | 12 | 40.739 | 0.000 | 4 | 15.379 | 0.004 | 4 |
| LMS platforms will be the backbone of the teaching system | 13.469 | 0.009 | 4 | 23.878 | 0.021 | 12 | 38.646 | 0.000 | 4 | 16.659 | 0.002 | 4 |
| e-books and e-materials will replace paper versions | 3.535 | 0.474 | 4 | 38.747 | 0.000 | 12 | 26.065 | 0.000 | 4 | 51.661 | 0.000 | 4 |
| integrated communication systems will be the basis of the information system | 5.374 | 0.251 | 4 | 36.003 | 0.000 | 12 | 25.624 | 0.000 | 4 | 40.147 | 0.000 | 4 |

*a*—confidence level  
*b*—number of the degrees of freedom  
*c*—f-t—full-time studies, p-t—part-time studies.
According to respondents another instrument will be LMS platforms as the basis of the didactic system (64.0%). This opinion is shared by slightly more younger people up to 39 years of age (61.56%), men (61.5%), graduate students (76.2%), and full-time students (64.9%), which confirms the correlation statistically significant $\chi^2$ (Table 3).

Few of the respondents are of the opinion that each part of the home will become an integral component of education in the future (14.7%), which is understandable due to the specificity of some fields and scientific disciplines.

5.4. The Position of the Teacher in the Model of Learning and Teaching Development in the Future

According to the respondents, Smart learning will affect the position of the teacher in the didactic process (Figure 4). In addition to the human teacher, there will also be an artificial teacher (robot/program). However, according to the respondents, this artificial teacher will never replace a human teacher (75.8%). This is the opinion of the dominant group of younger people up to 39 years of age (72.6%), women (77.6%), graduate students (77.1%), and full-time students (75.9%), which confirms the correlation statistically significant $\chi^2$ (Table 4).

The respondents agree (definitely yes and rather yes answers) that in the future (in 30 years) the teacher (human) will be the student’s social support and the teacher-machine/software (76.1%) will take care of his/her scientific development. This opinion is shared by slightly more women (76.7%), graduate students (86.5%), and full-time students (78.8%), which is confirmed by a statistically significant relationship $\chi^2$ (Table 4). The teacher-human will change from the supervisor and executor of knowledge into the student’s guide (tutor) (65.9%). This opinion is shared by a larger group of younger people up to 39 years of age (62.8%), more women (67.0%), graduate students (70.1%), and full-time students (66.1%), which is confirmed by statistically significant relationship $\chi^2$ (Table 4).
According to the respondents, artificial teachers will only be the providers of the study content (63.1%). This is the opinion of a slightly larger group of younger people up to 39 years of age (60.5%), women (66.9%), graduate students (64.3%), and part-time students (63.1%), which is confirmed by a statistically significant relationship \( \chi^2 \) (Table 4).

Table 4. The position of the teacher in the future (in 30 years) in the Smart learning trend in terms of gender, age, level, and mode of study–test of independence \( \chi^2 \).

| Variants | Gender | Age | Level (Undergraduate and Graduate) | Mode of Studies (f-t and p-t) |
|----------|--------|-----|------------------------------------|-----------------------------|
|          | \( \chi^2 \) | \( \alpha \) | \( k \) | \( \chi^2 \) | \( \alpha \) | \( k \) | \( \chi^2 \) | \( \alpha \) | \( k \) |
| Teacher–human will be replaced by teacher–machine/software | 16.059 | 0.003 | 4 | 27.958 | 0.006 | 12 | 38.221 | 0.000 | 4 | 21.256 | 0.000 | 4 |
| the machine teacher will deal with both the social and educational side of the student | 5.519 | 0.238 | 4 | 12.121 | 0.436 | 12 | 8.514 | 0.074 | 4 | 6.665 | 0.155 | 4 |
| the teacher-machine will only serve as a study content supplier for the student | 33.806 | 0.000 | 4 | 16.789 | 0.158 | 12 | 4.433 | 0.351 | 4 | 4.669 | 0.323 | 4 |
| the teacher is a person who will change from a supervisor and executor of knowledge into a student’s guide (tutor) | 14.94 | 0.005 | 4 | 25.292 | 0.013 | 12 | 22.949 | 0.000 | 4 | 10.251 | 0.036 | 4 |
| the teacher (human) will be the social support of the student whose scientific development will be taken care of by the teacher–machine/software | 12.442 | 0.014 | 4 | 19.948 | 0.068 | 12 | 46.903 | 0.000 | 4 | 19.99 | 0.001 | 4 |

\( ^a \alpha \) confidence level \( ^b \) \( k \) number of the degrees of freedom \( ^c \) f-t—full-time studies, p-t—part-time studies.

5.5. Manifestations of Artificial Intelligence (AI) in Learning and Teaching in the Future

According to the respondents, the dissemination of Artificial Intelligence (AI) will result in changes in the field of education (Figure 5). In teaching and learning, thanks to AI, the interaction of inanimate and animate matter will be possible, e.g., thanks to the use of Virtual Reality (73.8%).

This opinion among respondents is shared by a much larger group of women (78.2%) and undergraduate students (74.0%), which is confirmed by a statistically significant relationship \( \chi^2 \) (Table 5). Moreover, it will be possible to operate an adaptive learning environment by adjusting the individual learning program to the needs of a specific individual (customization) (68.1%). This opinion is shared by a slightly larger group of younger people up to 39 years of age (64.7%), more men (74.1%), and full-time students (68.3%), which is confirmed by a statistically significant correlation \( \chi^2 \) (Table 5.).
The ability to interact with inanimate and animate matter (virtual reality) was shared by 73.8% of respondents, among which 78.2% of women and 74.0% of undergraduate students. This relationship is statistically significant ($\chi^2$). Moreover, it will be possible to operate an adaptive learning environment by adjusting the individual learning program to the needs of a specific individual (customization) (68.1%). This opinion is shared by a slightly larger group of younger people up to 39 years of age (64.7%), more men (74.1%), and full-time students (68.3%), which is confirmed by a statistically significant correlation ($\chi^2$).

The manifestations of Artificial Intelligence (AI) in the education of the future are shown in Figure 5.

Table 5. Manifestations of Artificial Intelligence (AI) in the education of the future in terms of gender, age, level, and mode of study–test of independence $\chi^2$.

| Variants                                                                 | Gender | Age | Level (Undergraduate and Graduate) | Mode of Studies (f-t and p-t) |
|---------------------------------------------------------------------------|--------|-----|-----------------------------------|------------------------------|
| man will be integrated with the world of machines thanks to implanted chips that allow to maintain constant communication with the environment | $\chi^2$ | $\alpha$ | $k$ | $\chi^2$ | $\alpha$ | $k$ | $\chi^2$ | $\alpha$ | $k$ | $\chi^2$ | $\alpha$ | $k$ |
| man will be integrated with the world of machines thanks to implanted chips that allow to maintain constant communication with the environment | 2.115 | 0.715 | 4 | 16.666 | 0.163 | 12 | 23.791 | 0.000 | 4 | 8.438 | 0.077 | 4 |
| strengthening mutual learning between course participants will ensure knowledge sharing in cyberspace | 2.749 | 0.601 | 4 | 37.996 | 0.000 | 12 | 37.035 | 0.000 | 4 | 3.627 | 0.459 | 4 |
| increasing the teaching speed adaptive learning environment–adjusting the individual learning program to the needs of a specific individual (customization) | 13.637 | 0.008 | 4 | 48.456 | 0.000 | 12 | 39.656 | 0.000 | 4 | 2.958 | 0.565 | 4 |
| man will be integrated with the world of machines thanks to implanted chips that allow to maintain constant communication with the environment | 26.219 | 0.000 | 4 | 25.908 | 0.011 | 12 | 6.719 | 0.151 | 4 | 12.826 | 0.012 | 4 |

$^a$ $\alpha$—confidence level $^b$ $k$—number of the degrees of freedom $^c$ f-t—full-time studies, p-t—part-time studies.
According to respondents, thanks to AI, it will also be possible to create a collaborative environment that will strengthen mutual learning between students due to the process of sharing knowledge and space (cyberspace) (65.7%). This opinion is shared by a slightly larger group of younger people up to 39 years of age (63.3%) and undergraduate students (69.0%), which is confirmed by a statistically significant relationship $\chi^2$ (Table 5). The use of AI will also result in an increase in the learning speed (68.0%). This opinion is shared by a slightly larger group of younger people up to 39 years of age (65.3%), slightly more women (69.4%), and graduate students (69.0%), which is confirmed by a statistically significant correlation $\chi^2$ (Table 5).

On the other hand, according to the respondents, the state of full transhumanism in the form of integrating people with the world of machines through the implantation of chips enabling constant communication with the environment (68.9%) will not occur (definitely not and rather not answers).

6. Summary

To sum up, the world of the future dominated by digitization will require reorganization of the current models of functioning of many organizations, including universities. Undoubtedly, in the area of the obtained primary data, it was possible to confirm the hypothesis that technology will become an accelerator of changes in education processes marked by “intelligent learning”, which is already visible today. In the future, it will be even more visible in accordance with what the participants of the study indicated in their responses.

Respondents indicate that they often and most often use a smartphone to connect to the Internet. They know how to apply and use such technological solutions as cloud computing, hyper-connection, artificial intelligence, and Big Data as a Service. Smart learning is identified by respondents with innovative teaching technologies. In the future, according to the respondents, it is smart learning that will allow the integration of information between functional spaces such as home–work–virtual classroom, increasing overall availability of learning.

Such integration of the areas of student functioning (home–work–university), digitization of communication and didactics will also redefine the role of the teacher and introducing the teacher-machine persona. In the future the teacher-human will play an important role in student’s social development at University, while the artificial teacher will take care of student’s scientific development. Such an artificial teacher is software in the form of AI. The introduction of AI will contribute to many changes in education, including creating an adaptive learning environment adapted to the individual learning program of a specific unit and creating a collaborative environment that will strengthen mutual learning between students thanks to the process of sharing knowledge and space. This approach will be supportive to the preparation of future employees by immersing them in the world of technology.

According to research results, education of the future is a combination of technology and a different, much more proactive, dynamic and, in particular, two-way form of exchanging knowledge between the teacher and the student. The role of the teacher-mentor will be to show students the ways in which they should acquire knowledge from existing sources and how to use it in practice. Integrated IT solutions (e.g., LMS) will allow for permanent communication between the student and the teacher and the implementation of the SPOC (Single Point of Contact) concept in education. The mutual exchange of knowledge, and thus learning, between students will also be increasingly important, because in the target model combining the concept of smart university and deep integration, the boundary between those who create and transfer knowledge and those who are its users will be blurred.

The authors are aware that the subject matter of the study is only a part of the complex high education ecosystem. Knowing only students’ opinions is not enough. It would be worth knowing the opinions of other participants in education, including teachers,
managers of educational institutions, and entrepreneurs. Therefore, further studies are planned. The information obtained from all stakeholders will allow for a more complete analysis. Therefore, the authors plan to conduct further studies in the field of higher education development and technologization.

7. Conclusions

“The future is today, just somewhat further.” In order to prepare for the future well, the models of university functioning should be rebuilt towards the professionalization of management in line with the trends of Economy 5.0 [48]. Future employees of industry and services, the most technologically absorbing sectors of the economy, should be immersed in technology already at the stage of education. Student should not learn about technology but learn through technology. Therefore, the future at the university in the spirit of technologization may mean the emergence of the system. As a result of the inclusion of technology in each educational area, a qualitatively new formula of the university will be created, and thus teaching and learning will allow education to shape the employees of the future in terms of knowledge, competences, and skills in line with contemporary market expectations.

Therefore, the authors made a diagnosis of the current state of technology in the learning process and its impact on the possible ways of functioning of higher education. Taking into account factors such as the use of technological tools and solutions, awareness of the manifestations of intelligent learning and teaching, instrumental support, the position of the teacher, and the role of artificial intelligence in the learning and teaching process in the future authors of this material propose a model of future education pathways in the Economy 5.0 trend (Table 6).

Table 6. A model of future education pathways for intelligent enterprises in line with the Economy 5.0 trend.

|                  | Meatspace University | Virtual University | Smart University |
|------------------|----------------------|--------------------|------------------|
| Traditional      |                      |                    |                  |
| Education        | E–reactive           | E–active           | E–active         |
|                  | I–passive            | I–passive          | I–passive        |
|                  | T–executor           | T–executor         | T–moderator      |
| Integrated       |                      |                    |                  |
| Education        | E–reactive           | E–active           | E–active         |
|                  | I–passive            | I–active           | I–active         |
|                  | T–moderator          | T–moderator        | T–mentor/coach   |
| Immersion        |                      |                    |                  |
| Education        | E–active             | E–proactive        | E–proactive      |
|                  | I–passive            | I–active           | I–proactive      |
|                  | T–moderator          | T–moderator        | T–mentor/coach   |

E—environment; I—instruments; T—teacher.

According to the authors proposed paths of higher education in the future will be shaped by three aggregated components: the environment, instruments, and teachers. Each of them can exist in three variants. Therefore, the environment as a university ecosystem can be reactive, i.e., changeable after the occurrence of an external forcing factor, or active, i.e., indicating changes due to external factors, or proactive, i.e., initiating automatic changes without being forced by external factors. Instruments in the understanding of tools and technologies used in the education process may be passive, i.e., not supporting the initiatives of solutions, or actively supporting changes in the didactic process in the form of technological improvements, or proactive, involving and individualizing teaching and learning processes. The role and significance of the teacher may assume the formula of an executor of knowledge who performs his duties correctly, but is not involved in the educational process, or a moderator who controls the didactic process of his students to help them achieve their educational goals or a mentor/coach committed to and supporting the development of talents.
According to research results, in the near future students (69.1%) expect deep integration of information collection between the living spaces, such as home–work–virtual classroom. This is how they want to learn. For (81.1%) respondents the instrumental support of Smart learning will be integrated communication systems as the basis of the learning system. On the other hand, according to (75.8%) respondents the so-called artificial teacher will never replace a human teacher. The respondents agree that in 30 years from now the teacher (human) will be the student’s social support and the teacher machine/software will take care of his/her scientific development according to (76.1%) respondents. Very important aspect is collaborative communication and knowledge sharing among students. Thanks to AI this will be possible, according to (65.7%) respondents.

The two-dimensional table layout shows the degrees of education technology representation in the rows, and the columns show the type of representation of the University as a teaching unit. Higher education is currently transitioning. There is a visible departure from the traditionally understood education with a strongly emphasized role of the teacher-executor and passive educational instruments and tools that are firmly rooted in a reactive environment for integrated education and transfer to the digital space. Additionally, neither of the two formulas meet the expectations of higher education. Therefore, the direction that education should take is smart education with the representation of smart universities with a proactive environment, proactive support instruments for scholars, and a teacher–mentor/coach, which is in line with the concept of Society 5.0. Additionally, although there will be traditional and virtual universities representing classical forms of operation, the integration of technology and society in a new intelligent version is inevitable.

According to the authors, dynamic development of technology will allow the introduction of the omnichannel approach in science. The different collection points and the interface between the student and teacher-mentor will become the default approach. Experiencing, sharing, and participating will become the quantifiers that define the existence of the individual. Almost anywhere and anytime one will be able to connect, stay connected and respond quickly. Additionally, what is most important, interactivity with the changing world will define a new place and role for institutions and people responsible for preparing future members of society to co-create the Economy 5.0 and participate in Society 5.0.

Author Contributions: All authors have contributed to the conceptualization, while writing—review and editing was divided as follows: methodology, Ł.S. and K.K.-M.; software, P.M.; validation, R.S. and P.M.; formal analysis, K.K.-M. and R.S.; resources, K.K.-M. and P.M.; data curation, P.M.; writing—original draft preparation, K.K.-M., R.S., and P.M.; writing—review and editing, Ł.S., K.K.-M., P.M., and R.S.; visualization, P.M.; supervision, K.K.-M.; project administration, K.K.-M. and R.S.; funding acquisition, Ł.S. and R.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by “Badania i profesjonalizacja zarządzania uczelniami w ramach projektu: “Dialog” (Decyzja Nr0146/DLG/2017/10)—w ramach obszaru badań nad “Wyzwaniami nowoczesnej edukacji”, statutowe środki Społeczna Akademia Nauk w Łodzi, Uniwersytet Ekonomiczny w Krakowie.

Institutional Review Board Statement: The data collection was carried out in accordance with Research Ethics Committee Approval (i.e., dated 14 September 2018) of University of Social Sciences w Łodzi.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to restrictions from research sponsor.

Conflicts of Interest: The authors declare no conflict of interest.
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