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PERCEPTION AND USE OF NEW TECHNOLOGIES IN CRAFTS EDUCATION AND CRAFTSMANSHIP AMONG YOUNG CRAFTSMEN: A STUDY OF SUSTAINABLE PRACTICES

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ABSTRACT: The research aims to learn the opinions of students enrolled in first- and second-cycle vocational schools in the Opole province (Poland) regarding the utilisation of new technologies in the field of craftsmanship. It covered a number of key issues, including job changes, improvements related to the production and management processes in craft enterprises, activities that accelerate the adoption of new technologies in crafts, and their relationship with sustainable development and building the resilience of craft communities and economies. New technologies in crafts are perceived and applied with a focus on either production or management processes, aiming to either increase profits or promote sustainability and align with either environmental or economic responsibility within the context of sustainable development. During the study, content analysis, linear classification model with L2 regularisation, and verification of the strength of mutual influence using the Spearman rank correlation coefficient were performed. The findings indicate that traditional skills associated with craftsmanship are being transmitted to younger generations, who are growing up in a rapidly evolving technological, social, and economic environment. The application of modern technologies is a crucial factor in the development of crafts and the enhancement of in the market. Vocational education in Poland is in need of reform, and the implementation of modern tools is essential for more effective preparation for the workforce. These technologies facilitate the advancement of production and competitiveness, yet their utilisation must align with the tenets of ecological responsibility.

KEYWORDS: craft, new technologies, cultural economy, sustainable development, craft resilience

Introduction

The term 'technology' etymologically comes from Greek. This concept combines a form of tekhnē "art, skill, craft in work; method, system, an art, a system or method of making or doing," (Online Etymology Dictionary, n.d.). According to the encyclopedia definition, *technology* is related to the development and implementation of the most advantageous processes under specific conditions of the production or processing of raw materials, semi-finished goods as well as products (Encyclopedia PWN, n.d.). On the other hand, the concept of new technologies is associated with technological knowledge, subsuming, among others, the results of research and development work enabling the manufacturing of new and improved products or services entering the market. For example, according to the definition included in the Polish Act of 15 February 1992 on corporate income tax, the aspect of the aforementioned 'novelty' is specified for the last 5 years (Chałubińska-Jentkiewicz, 2019). New technologies are currently treated as the driving force of the economy and even as the foundation of economic development.

'Technology' encompasses direct references to 'craft', both from the point of view of etymology and logically ordered activities, the result of which is the product or service offered. Contemporary craft is undergoing transformations, and the ensuing changes also concern the use of specific tools and machines by craftsmen. Klekot et al. (2022) observes, among other things, that craft can be divided into the following identity groups: i) incumbent and entrant craft, ii) craft enterprises bent on profit and large scale, and iii) technological craft – craft oriented on innovation.

Another category used, among others, in the texts by Toran et al. (2017) is digital craft, showing, among other things, that modern technologies are becoming not only a part of craftsmanship but also its "great ally". The scope of virtual craftsmanship surpasses traditional art genres and forms of creation, leaning towards, among others, spatial design and social networks (Kim, 2023). Craftsmanship in the 21st century is also referred to as a 'revitalised space' and a developing industrial sector (Jakob & Thomas, 2017). In addition, as an increasingly globalised market (Toran et al., 2017) and as "modernity and progress, new technologies and bold solutions, innovation and promotion of entrepreneurship" (Zabłocka, 2018) and as a strong attractor for migrant students (Kubiciel-Lodzinska & Ruszczak, 2016). According to Song (2022), since 2000, craftsmen have been increasingly implementing, among others, digital production technologies in their work.

New technologies are availed of in crafts in multiple ways. The subject areas recurring in academic papers are those related to the 3D environment as used, among others, in museums dedicated to cultural heritage, including crafts (Arapakopoulos et al., 2022; Okanovic et al., 2022; Partarakis et al., 2022). This environment includes activities related to, among others, 3D printing, scanning, carving and milling. Another example is computer-aided design and craft manufacture (Unver et al., 2008; Violino et al., 2020; Musić et al., 2023; Särmäkari, 2023; Zhao & Chen, 2022). Ocular optics is mentioned here as a specific instance (Kołaczek, n.d.). Another area is related to mobile applications created for small and medium-sized enterprise clients to facilitate business activities (project management, digital marketing, e-commerce, communication with clients – including customer relationship management systems [CRM], branding, payment processing, etc.). Social media, e-learning platforms, virtual reality technologies and artificial intelligence are useful for educating young generations of craftsmen. Moreover, they are an indispensable tool for sharing knowledge with craft recipients (Lasala et al., 2019; Sung & Chin, 2023; Kim, 2023; Vartiainen & Tedre, 2023). Their usage is not only related to contemporary crafts but is also connected to the preservation and cultivation of the cultural heritage of past generations (Bekele et al., 2018; Sylaiou et al., 2020; Zidianakis et al., 2021; Hauser et al., 2022), including micro-heritage (Nadbałtyckie Centrum Kultury Gdańska, 2022).

Another area is energy-saving technologies and the development of renewable materials – selected in a more sustainable approach to craft production (Dai & Hwang, 2019; Thorisdottir & Johannsdottir, 2020; Luckman & Andrew, 2020; The Luxembourg Government, 2022). Among the issues of crafts and new technologies, there also begin to appear e-materials (Posch & Fitzpatric, 2021), as well as designs made with the use of new technologies, nonetheless, fully manufactured by hand. Moreover, the procedure of combining elements of mass production with handwork is gaining momentum. As Temeltaş (2017) notes, the collaboration of craftsmen with other disciplines is associated with three features such as: risk-taking, holistic approaches in practice and prototyping.

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The main goal of this article is to try to answer the following questions:

- Are new technologies in crafts perceived through the prism of the production process or the management process?
- Is the application of new technologies in crafts taking place with the view of the possibility of increasing generated profits or with a view of a more sustainable approach?
- Are new technologies in the context of sustainable development related mainly to environmental or economic responsibility?

The authors first present the results of considerations as well as previous and existing research on new technologies in crafts. Subsequently, the results of the first stage of research are presented, which consisted of conducting surveys among the young generation of craftsmen who are preparing to enter the labour market and are educated in the Opole province in vocational schools of the first and second degree.

Research methods

In the initial phase of the research, the desk research method was used to facilitate a comprehensive understanding of the considerations put forth and the state-of-art of the latest research on new technologies in crafts. Then, in the period April – June 2024, a survey was administered to students of vocational schools of the first and second degree – the largest centres of vocational education in the Opole province. The online questionnaire under URL to a Google form was sent twice to the management of seven schools: i) Akademia Rzemiosła i Przedsiębiorczości (the Academy of Crafts and Entrepreneurship) at the Opole University of Technology, ii) Centrum Kształcenia Zawodowego i Ustawicznego (the Center for Vocational and Continuing Education) in Nysa, iii) Zespół Szkół nr 1 im. Powstańców Śląskich (the School Complex No. 1 named after the Silesian Insurgents) in Kędzierzyn-Koźle, iv) Zespół Szkół im. Jana Pawła II (the School Complex named after John Paul II) in Zdzieszowice, v) Zespół Szkół Budowlanych im. Księcia Jerzego II Piasta (the Construction School Complex named after Prince Jerzy II Piast) in Brzeg, vi) Zespół Szkół Nr 2 Centrum Kształcenia Ustawicznego (the School Complex No. 2 Center for Continuing Education) in Kluczbork and vii) Centrum Kształcenia Zawodowego i Ustawicznego (the Center for Vocational and Continuing Education) in Prudnik. The subsequent stages of the research are planned for the period October 2024 – February 2025.

As a result of the aforementioned factors, the initial selection and preparation of data for the first data set yielded 166 valid responses. The survey consisted of 10 questions focusing, among others, on a number of key areas, including the perception of new technologies in crafts among the younger generation, the reasons for the use and the benefits that new technologies offer craftsmen, changes in the workplace due to the introduction of new technology, the impact of new technologies on the increase in productivity and/or efficiency in crafts, and improvements that new technologies introduce to the production process and/or the management process of a craft enterprise/workshop. The respondents were also queried about their gender, age, place of education, vocational school level, education profile (type of craft), place of residence, and family craft traditions. The research process is delineated in Table 1. During the analysis of the results, content analysis, a linear classification model with L2 regularisation (Tikhonov–Phillips regularisation), and verification of the strength of mutual influence using the Spearman rank correlation coefficient were performed.

Two hypotheses were selected, linking the use of new technologies in crafts with:

- H1: 'A more thoughtful production process', or
- H2: 'A more thoughtful management process'.

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Table 1. The research process

1. Research	
Desk research	Materials devoted to craftsmanship/ craftsmen AND new technology AND sustainable development
Survey (research questions)	• How does the young generation perceive new technologies in crafts? • What benefits do new technologies offer to craftsmen? • How are craft-related jobs changing due to new technologies? • Can the use of new technologies in crafts provide an increase in productivity and/or efficiency? • Are new technologies chosen due to their pro-ecological attitude? • What strategies can be used to accelerate the adoption process of new technologies in crafts in the enterprise management area?
2. Appraisal	
Qualifying areas	• Detailing the ways of perceiving new technologies in the context of crafts • Detailing the ways of perceiving new technologies in the context of crafts as an action aimed at sustainable development • Detailing if new technologies improve the production process or rather the management process of a craft enterprise
3. Synthesis and Analysis	
Results and Discussion	• Approximation of seven ways of perceiving new technologies in the context of crafts, one of which is striving for sustainable development • Verification of the strength of mutual influence using the Spearman rank correlation coefficient towards the highly correlated variables elimination • Modelling of investigated hypothesis with linear classification models with L2 regularization
4. Effects	
Conclusion	• The relationship between the use of new technologies in crafts and sustainable development and building the resilience of craft communities

For both hypotheses, a linear classification model was performed to verify the accuracy with which H1 or H2 can be determined based on the prepared form. Both models were verified using a 3-fold cross-validation process, coupled with the utilisation of a linear classification model with L2 regularisation (Tikhonov–Phillips regularization). For both models, promising accuracy was obtained using test data, confirming the direction of the conducted research and the need to provide further research cases. For the model for hypothesis 2, the obtained accuracy above 75% for the actual test data means that this hypothesis is confirmed for at least 3 out of 4 people tested. Models for the hypotheses were made using variables (data from the survey), for which their impact on determining this relationship was also examined, which was summarised in Figure 11. It is noteworthy that the impact of particular variables on this relationship exhibited differentiation.

The following variables were isolated for the study: [(0, 'Vocational school'), (1, 'Education profile (type of craft)'), (2, 'Place of current education (city)'), (3, 'Place of residence'), (4, 'Gender'), (5, 'Nationality (national or ethnic affiliation)'), (6, 'Are there/were any craftsmen in the family (family craft traditions)'), (7, 'Plans to take up work in the learned profession'), (8, 'Plans to take up work in Poland'), (9, 'Age (years)'), (10, 'New technologies in crafts influence educational choices of young people'), (11, 'New technologies in crafts influence career choices of young people'), (12, 'New technologies in (13, 'New technologies in crafts contribute to increased competitiveness'), (14, 'New technologies in crafts affect the effectiveness of making management decisions'), (15, 'New technologies in crafts affect the effectiveness of making production decisions'), (16, 'New technologies in crafts are important from the point of view of improving the material situation of craftsmen (their standard of living)'), (17, 'New technologies in crafts are important from the point of view of improving the quality of life of craftsmen'), (18, 'New technologies in crafts are important from the point of view of choosing renewable resources'), (19, 'New technologies in crafts are important from the point of view of activities protecting cultural heritage'), (20, 'New technologies in crafts are used by both women and men'), (21, 'New technologies in crafts are important from the point of view of improving the quality of life of craftsmen ...), (22, 'New technologies in crafts are important from the point of view of activities protecting cultural heritage'), (23, 'New technologies in crafts are important from the point

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of view of improving the quality of life of craftsmen'), (24, 'New technologies in crafts are important from the point of view of activities protecting cultural heritage'), (25, 'New technologies in crafts are used by both women and men'), (26, 'New technologies in crafts are important from the point of view of improving the quality of life of craftsmen'), (27, 'New technologies in crafts are important from the point of view of improving the quality of life of craftsmen'), (28, 'New technologies in crafts are important from the point of view of activities protecting cultural heritage'), (29, 'New technologies in crafts are crucial from the point of view of activities protecting cultural heritage'), (30 crafts are conducive to innovation'), (22, 'New technologies in crafts are associated with more responsible production and consumption in terms of environmental responsibility (including saving natural resources, reducing the carbon footprint, eliminating harmful substances from production processes, recycling, circular economy), (23, 'New technologies in crafts are associated with more responsible production and consumption in terms of social responsibility (including ethical treatment of employees, ensuring equal opportunities, access to education, decent working conditions).'), (24, 'New technologies in crafts are associated with more responsible production and consumption in terms of economic responsibility (including access to ensuring adequate means of living and stable operations in the future).')]

The strength of the mutual influence of the studied variables was also verified using the Spearman rank correlation coefficient, towards eliminating strongly intercorrelated variables from the models.

Results of the research

Characteristics of the respondents cohort

The division of respondents by gender was evenly distributed (51% were men and 49% were women). The respondents were between 14 and 19 years old, with the largest groups constituting approximately 1/3 of the respondents consisting of 16-year-olds (36%) and 17-year-olds (28%). More than half of the respondents came from rural areas (52%). In addition to the dominant Polish nationality (92%), students also indicated origins from Ukraine (5%) and Germany (1%). The majority of the respondents were educated in vocational schools of the first degree (96%), which are located in three cities in the Opole province: Kędzierzyn-Koźle (80%), Opole (19%) and Nysa (1%). Their educational profile was very diverse and related to the broadly understood group of craft professions covering 20 profiles, of which the largest groups included car mechanics (23%), hairdressers (20%), chefs (16%) and salespeople (15%). Within the surveyed group, 1/3 had craftsmen in their family (32% of responses), and almost half were not aware of whether they were continuing the family tradition of crafts (49% of responses). The demographic profile of respondents is characterised in Table 2.

Table 2. Demographic profile of respondents

Demographic factor		Frequency (n=166)	Percentage (%)
Gender	Male Female	85 81	51 49
Age	14 years 15 years 16 years 17 years 18 years 19 years	7 23 59 46 28 3	4 14 36 28 17 2
Place of education	Kędzierzyn-Koźle Opole Nysa	133 31 2	80 19 1
Vocational school	I degree II degree	160 6	96 4

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Demographic factor		Frequency (n=166)	Percentage (%)
Education profile	Baker	1	1
	Car painter	1	1
	Sheet metal worker	1	1
	Waiter	1	1
	Photographer	1	1
	IT technician	1	1
	Electrical technician	1	1
	Installation and sanitary network fitter	2	1
	Tailor	2	1
	Logistics warehouse worker	2	1
	Hotel service worker	2	1
	Carpenter	3	2
	Confectioner	4	2
	Fitter of construction and finishing works in construction	4	2
	Interior finishing	5	3
	Locksmith	10	6
	Salesman	25	15
	Cook	27	16
	Hairdresser	34	20
	Automotive mechanic	39	23
Place of residence (number of residents)	Village	86	52
	City <50k	30	18
	City 50k-150k	41	25
	City 150k-500k	7	4
	City >500k	2	1
Nationality	Germany	2	1
	Ukraine	8	5
	Poland	156	94
Family craft traditions	Yes	53	32
	No	32	19
	I don't know	81	49

The surveyed students studying crafts were mostly not sure whether they would take up work in their learned profession (45% of responses). 42% of respondents are studying to become craftsmen (see Figure 1). Almost half of the students are not sure whether they will manufacture products or provide craft services in Poland or abroad after completing their education. 41% of them plan to take up employment in crafts in the country of education (see Figure 2). Among the target countries mentioned, there were countries within the European Union: Germany (9%), the Netherlands (4%), Austria (3%), Spain (2%), Denmark and Sweden (1% each) and from outside the EU: Switzerland, Norway and the United Kingdom (also 1% of the totality of responses each).

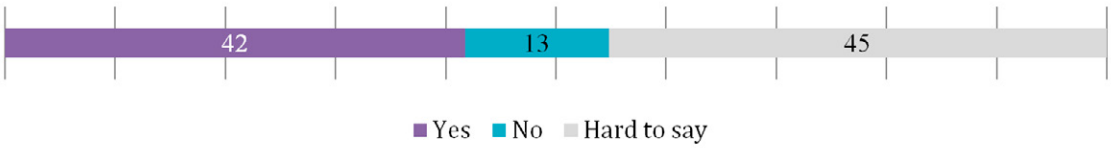

Figure 1. Plans related to work in craft profession [%]

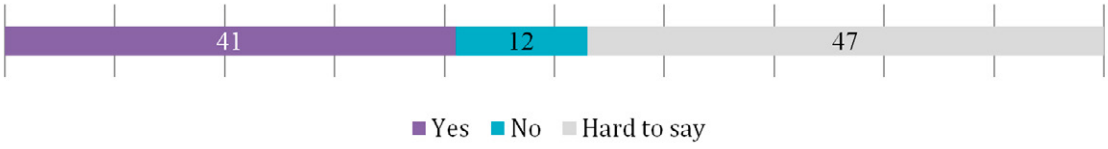

Figure 2. Plans to start working in crafts in Poland [%]

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New technologies in crafts: the aspect of vocational education

The research results indicated that only 1/5 of respondents (21%) use new technologies during the education process, 1/3 could not specify this (33%), and almost half (46%) stated that new technologies are not used during the classes they participate in – Figure 3.

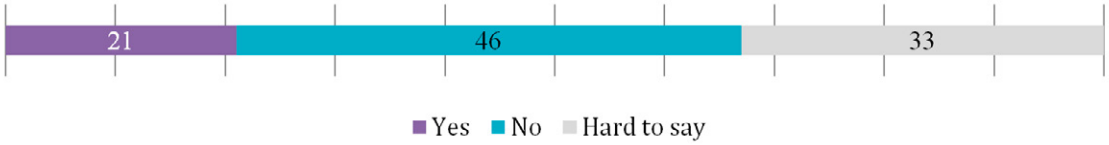

Figure 3. The use of new technologies in craft education [%]

Among the advanced and innovative technical solutions used in education, the respondents encountered primarily multimedia/interactive/electric boards (5% of responses), tablets (2%), chromebooks, 3D printers, laser printers, e-books, e-journals, tools supporting active learning (such as Kahoot), lathes, milling machines and a new grading system (1% each). Among the subjects in which new technologies should be appropriate were mentioned: vocational subjects (11%), mathematics and computer science (4% each), catering/catering technology (3%) and programs for selling goods, professional accounting, computer drawing/graphics, mechanics, safety education, English language, welding and carpentry technology (1% each). 5% of respondents expect that new technologies will be used in all subjects taught in their school.

New technologies in crafts: aspects of work in craftsmanship

The young generation of respondents in crafts perceived modern technologies mainly as an obvious consequence of progressive development (46% of responses) and a tool for the young generation of craftsmen and recipients of crafts (43% of responses). Almost 1/3 of respondents also associate new technologies in crafts with the increasing price of the final product, key tools in connection with striving for sustainable development and useful, although not essential for the craftsman (30% each). The smallest number of responses (17%) associated new technologies with grants and subsidies (see Figure 4).

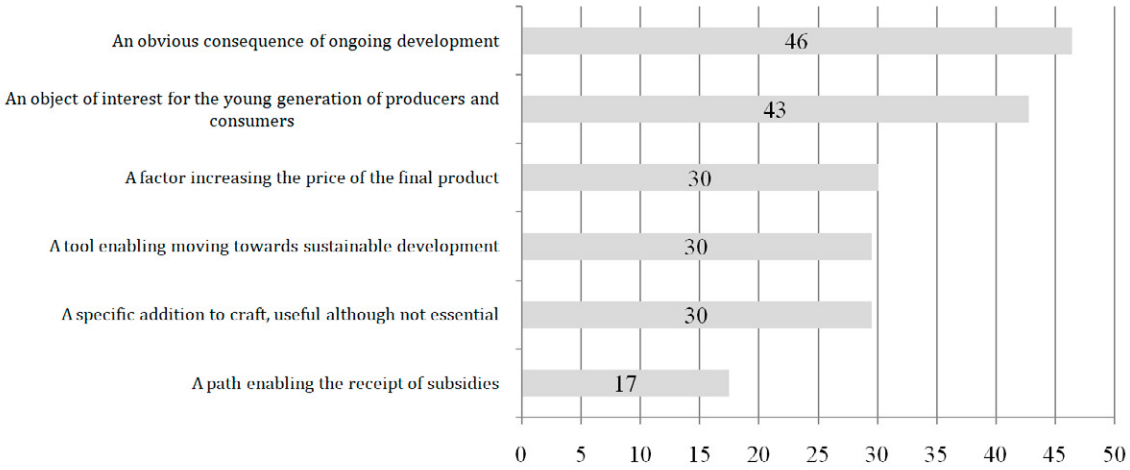

Figure 4. Associations linking new technologies and crafts [%]

The use of new technologies in craftsman's labor is associated by the surveyed cohort both with benefits (Figure 5) and threats (Figure 6). The perceived positive aspects were concerned primarily with their impact on productivity/efficiency (60% of responses) and a more thoughtful production process (51%). More than 1/3 of respondents pointed out that their use in crafts increases the possibility of adapting the offered products and services to the requirements of customers (Polish [domes-

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tic] and foreign) and influences the selection of materials that are less burdensome for the natural environment or minimises the use of rare materials (36% each). The negative aspects included high costs related to the need to purchase equipment/software/licenses (64% of responses), problems related to the need to introduce changes in the workplace (40%), concerns related to the need to cut jobs (36%) and employees' reluctance to change and to the necessity to learn new things (33%).

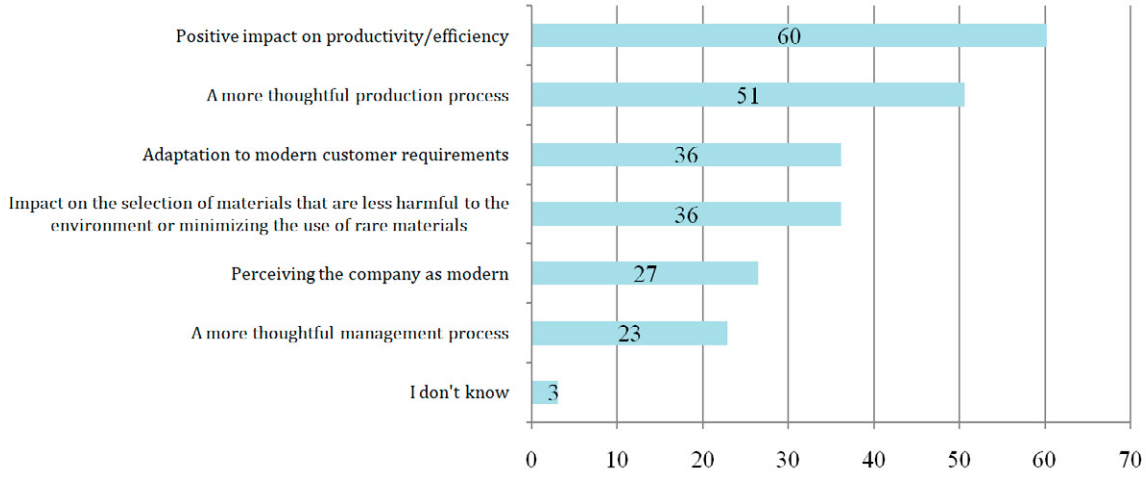

Figure 5. The benefits of using new technologies in crafts [%]

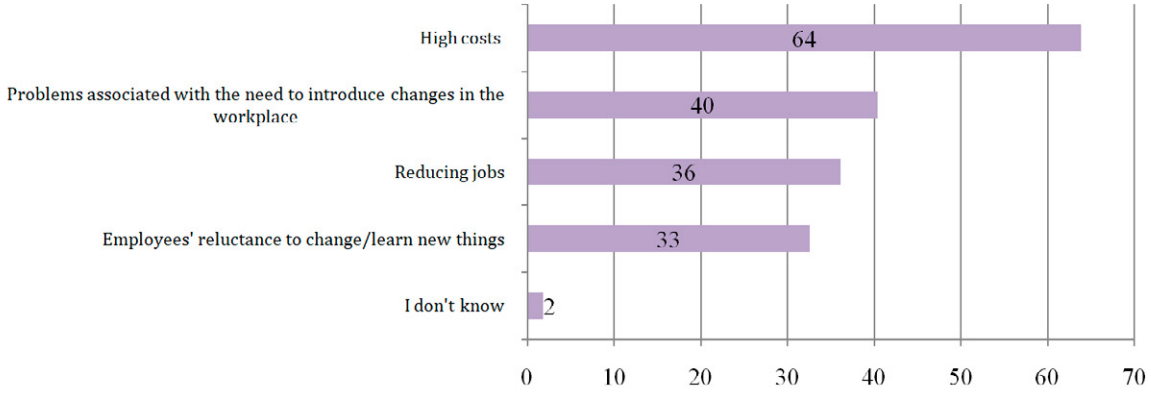

Figure 6. Disadvantages of using new technologies in crafts [%]

The changes taking place in the workplace because of the introduction of new technologies in crafts, which were mentioned by respondents, are the following:

- an increase in the number of electronic devices (including IT equipment) – over half of the responses,
- the aspect of saving time – both faster performance of tasks (activities/works) – 43% of indications, and greater flexibility of working time (flextime- including the possibility of using 24/7) – 37% of responses,
- communication improvements – both within the company/workshop – 29% of choices, and the company with the external environment – 28% of responses.

Aspects related to the impact of new technologies on the natural environment were noted by slightly over 1/10 respondents. Details are presented in Figure 7.

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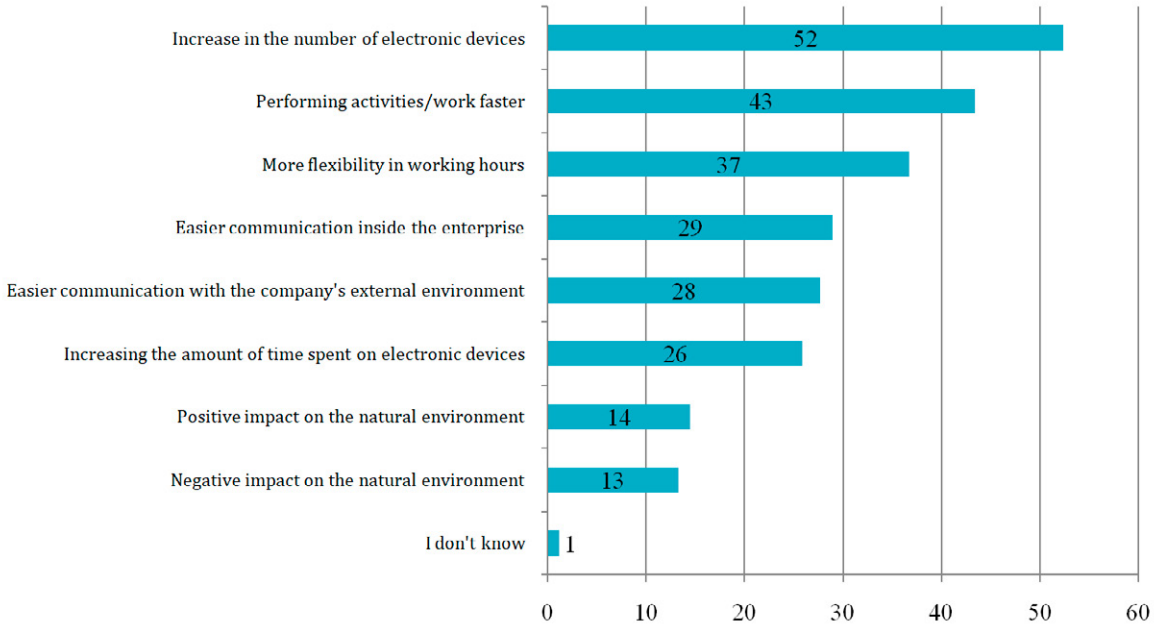

Figure 7. Changes perceived in the craft related to the introduction of new technologies [%]

Among the methods that can accelerate the process of adopting new technologies in crafts, education was deemed to be the most important, including training in new technologies (62% of responses). Approximately 1/3 of respondents also mentioned study visits to modern craft enterprises in Poland and abroad, obtaining grants (national/EU/other) to improve the infrastructure of workplaces/schools, and participation in fairs dedicated to new technologies (Figure 8).

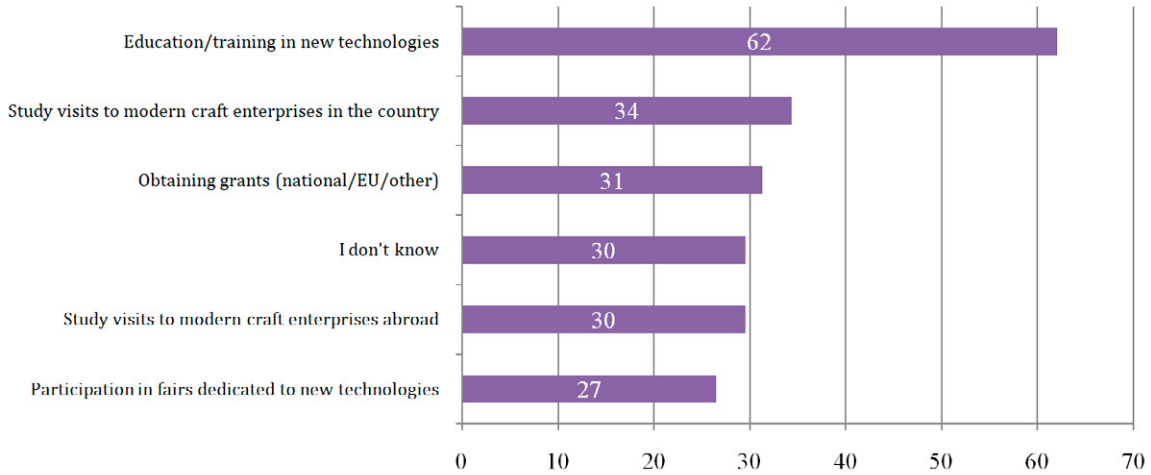

Figure 8. Actions that can accelerate the adoption of new technologies in the craft profession [%]

Respondents were also asked to relate to 15 statements using a five-point Likert scale (see Figure 9). The largest group of positive responses (as the sum of 'strongly agree' and 'agree' responses) concerned the statements that new technologies in crafts: i) influence the career choices of young people (39% of responses), ii) are used by both women and men (36%), iii) foster innovation (35%), iv) support increased competitiveness (34%), v) influence the educational choices of young people (33%), vi) are important for improving the quality of life of craftsmen (32%), vii) influence the efficiency of production decisions (31%) and viii) are important for improving the financial situation of craftsmen (30%). With regard to the statement that new technologies are important from the point of view of activities protecting cultural heritage, exactly the same percentage of respondents (27%) chose the positively and negatively evaluated answers (respectively: the sum of answers 'strongly agree' and 'agree' and the sum of answers 'strongly disagree' and 'disagree'). On the other hand,

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slightly more negative than positive answers appeared as a response to the statement concerning the connection between new technologies and environmental responsibility 25% as a positive reaction compared to 23% of negatively valued answers).

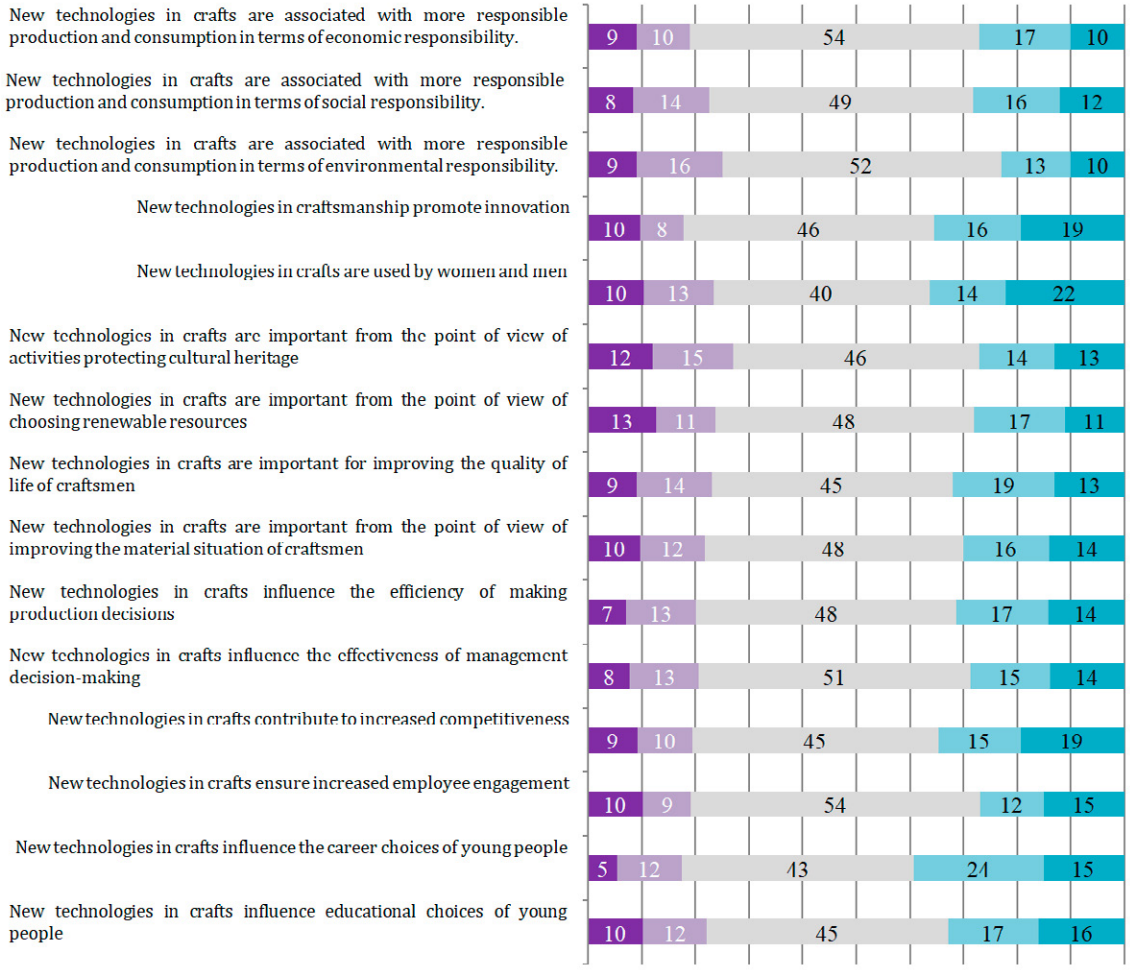

Figure 9. Perception of new technologies in crafts [%]

Based on the questions asked in the survey, it can be shown that the respondents indicate the impact of new technologies on:

- H1: 'More thoughtful production process', or
- H2: 'More thoughtful management process'.

For the variables tested (1-24), the strength of mutual influence was also verified, using the Spearman rank correlation coefficient (due to the presence of ordinal variables indicated in the surveys). For the tested set of variables, the formation of dependencies is presented in Figures 10a-b.

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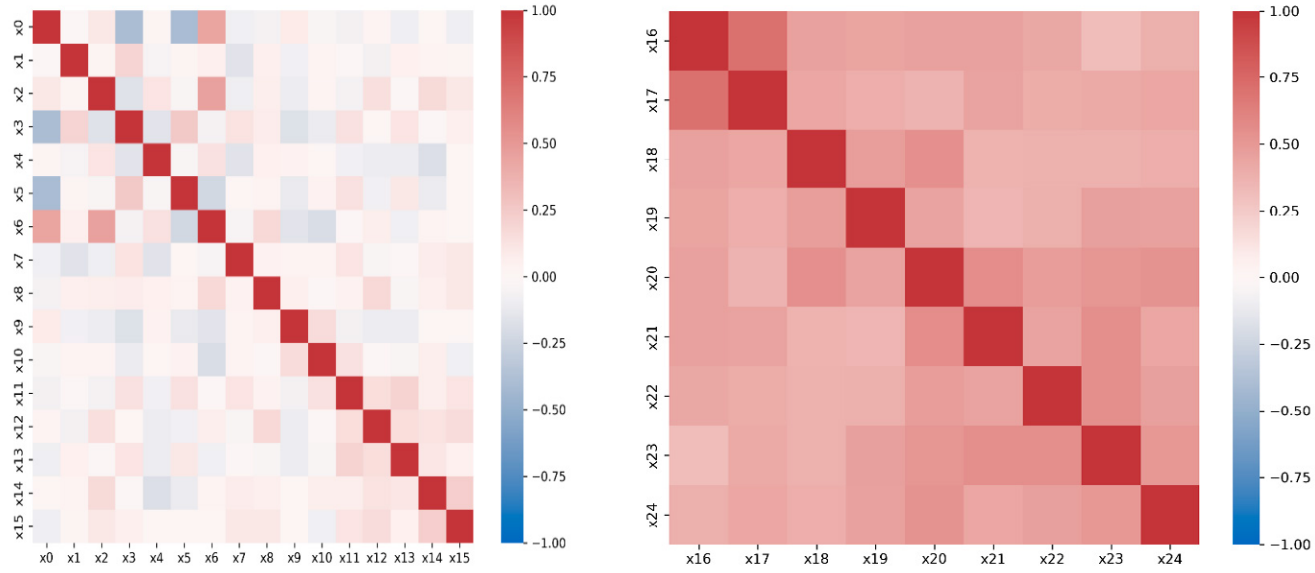

a) Coefficients for variables x0 : x15

b) Coefficients for variables x16 : x24

Figure 10a-b. The relations between models variables investigated using the rank Sperman correlation coefficient for x0:x15 (a), and separately for the variables x16:x24 that correspond to the questions with categorical answers, that have been preprocessed differently to the first group (b), where x0:x24 aggregate the data reflecting the questions listed on pages 4-5

Table 3. The selected pairs of analyzed variables

Demographic factor	Frequency (n=166)	Percentage (%)	Demographic factor	Frequency (n=166)	Percentage (%)
a)			b)		
x2 – x6	positive	0.46	x16 – x17	positive	0.70
x6 – x0	positive	0.44	x21 – x20	positive	0.56
x0 – x5	negative	-0.41	x23 – x21	positive	0.55
x3 – x0	negative	-0.40	x23 – x22	positive	0.55
x5 – x3	positive	0.25	x18 – x20	positive	0.55
x15 – x14	positive	0.23	x24 – x20	positive	0.53
x5 – x6	positive	-0.23	x20 – x23	positive	0.51
x11 – x13	positive	0.21	x23 – x24	positive	0.50
x3 – x1	positive	0.20	x22 – x20	positive	0.48
x10 – x6	negative	-0.20	x19 – x18	positive	0.47

We present the pairs of the most significant relation, that we selected using the using the rank Sperman correlation coefficient the relations between models variables investigated using the rank Sperman correlation (for the variables x0:x15 (a), and separately for the variables x16:x24 (b).

We studied the relations between models variables separately for x0:x15 (a), and the variables x16:x24 that correspond to the questions with categorical answers. These variables have been preprocessed differently to the first group (b), where x0:x24 aggregate the data reflecting the questions listed on pages 4-5. In the Table 3 we selected and provide the variable pairs, for which we read the strongest relationship was identified. These 10 pairs were selected based on the calculated coefficient's absolute value, indicating the strongest association. Additionally, the direction of the relation-

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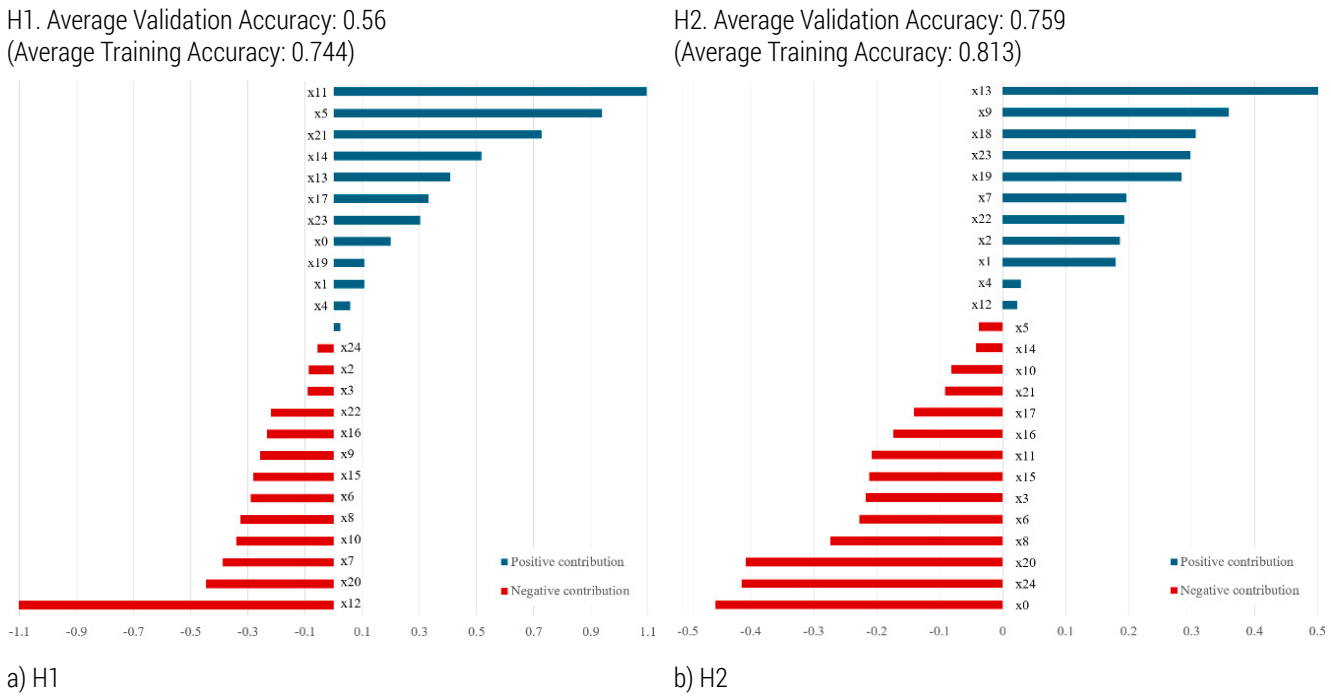
ship is indicated, distinguishing between variables that grow in conjunction or in opposition to one another. This additional step of the investigation allowed us to ascertain whether the model contains any variables that are strongly related to others. However, as evidenced in Table 3, this was not the case.

The variable that is verified using the model is a combination of the listed variables (see Figure 11 for the variables utilized for two models for both tested hypothesis). This combination should allow for modeling this tested variable with some accuracy. For the research hypothesis H1, a promising result of the prepared models was obtained, however, it was not verified using data from the test set (see Figure 11a).

The results for the hypothesis H2 were markedly superior. In addition to a fairly high degree of accuracy in the classification results (81.3%), the model also demonstrated an average result for cross-validation (75.9%). This indicates that the hypothesis was validated based on the analysis of at least three out of four collected survey forms (see Figure 11b).



a) H1 b) H2

Figure 11a-b. The influence of the utilised variables for the model builds for the H1 hypothesis (a) and for the H2 hypothesis (b). We indicated positive (marked in blue) and negative contributions to the models' answers

Additionally, the analysis determined which questions and variables most significantly impacted the outcome. For the verified preliminary linear model, variables 13, 9, and 18 demonstrated a positive influence, while variables 0, 24, and 20, when subtracted from the final result, also exerted a notable impact on the final result.

The analysis allowed for the following observations indicating that the use of new technologies in crafts:

- Promotes an increase in competitiveness: it enables the improvement of production processes, reduction of production costs, and improvement of the quality of offered products. Innovative solutions allow craftsmen to respond faster to changing market needs, offering more personalised services and products that better meet customer expectations. Additionally, supports sustainable development by optimising the consumption of raw materials and energy, which is becoming an increasingly important element of competitiveness.
- It is popular among young people (age aspect): combining traditional techniques with modern solutions, creating innovative, more advanced, and creative products. Young people use digital tools such as 3D printing, design software, or laser technologies, providing greater precision and flexibility in their work. Thanks to them, they can, among other things, introduce new products to the market faster, meet individual customer needs, and develop their skills more effectively.

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- It is important from the point of view of choosing renewable resources: enabling, among other things, more efficient use, monitoring and optimisation of processes related to obtaining energy and raw materials. Modern technologies support the development of renewable energy sources, such as solar, wind or geothermal energy, which contributes to the reduction of greenhouse gas emissions and reducing the negative impact on the environment. In addition, thanks to advanced analytical tools and management systems, it is possible to effectively plan, forecast, and integrate renewable resources with the existing energy infrastructure.
- Is expected by students of first-degree vocational schools: in connection with, among other things, acquiring practical skills necessary in the modern labour market, modern tools and technologies allow for better preparation for professions in which innovations play a key role, facilitate the acquisition of theoretical knowledge and provide access to modern devices and software, increasing their visibility against the competition. Additionally, technology supports an interactive and attractive way of learning.
- It is related to more responsible production and consumption in terms of economic responsibility (including access to ensuring adequate means of living and stable operations in the future), enabling more effective resource management, waste reduction, and optimisation of production processes. Modern solutions allow craftsmen, among other things, to better control production costs, minimising losses of raw materials and energy, which supports the sustainable development of the business. Additionally, these technologies enable the creation of products of higher quality and longer durability, which limits overproduction and reduces overconsumption. In the long term, such a model of operation can support building lasting relationships with customers and strengthening market position while promoting responsibility towards future generations.
- It is used by both women and men: pointing out its wide availability and universality in various aspects of life and that the joint involvement of both sexes in the world of technology promotes equal opportunities, diversity of perspectives, and better cooperation in teams.

The identified perception of new technologies by craft students may influence the design of vocational education programs by:

I. Adjusting the program content of individual subjects – primarily vocational subjects.
II. Introducing new technologies that make the content taught in other subjects more accessible: as tools that facilitate and make the acquisition of knowledge more attractive – introducing new teaching methods adapted to the needs of the young generation.
III. Placing greater attention on establishing partnerships with craft companies using new technological solutions and technology companies that go beyond the elements of professional practice and show the actual use of new technologies and the possibilities of their implementation in craft work, motivating greater individual exploration of the topic supported by good practices, as well as promoting the need to adapt to the constantly changing environment, continuous development of technology.

Within each of these steps, elements can also be introduced that encourage the integration of sustainable practices into crafts. Cooperation with technology companies, in particular, can influence the identification of good practices that combine the use of new technologies in terms of not only sustainable production but also sustainable management, the craft enterprise, and one's work. The use of new technologies by lecturers can also influence students' perception of the need for continuous adaptation to market needs, the expectations of the new generation of craft consumers, and the idea of lifelong learning, which also goes beyond vocational education.

Discussion

The role of new technologies in the context of craftsmanship

In a globalizing world, industry is based on highly advanced technology, thanks to which not only new goods and services are created, but also new branches arise. The new industry is located in metropolitan areas and is associated with craft activities and the small and medium-sized enterprise sector (Jałowiecki, 1993; Komitet do Spraw Pożytku Publicznego, 2021). New technologies in the context of craft are currently perceived in several ways, including as:

1. Something natural – an obvious consequence of ongoing development,

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2. A specific addition to craft, useful although not essential,
3. A factor increasing the price of the final product,
4. An object of interest for the young generation of producers and consumers,
5. A path enabling the receipt of subsidies,
6. A tool enabling moving towards sustainable development,
   and also:
7. Craft as an object of interest for companies specialising in new technologies.

New technologies and innovations – naturally!

The main goal of crafts is to meet needs. On the other hand, craft production is closely integrated with science and technology (Yu & Chung, 2023). The values that guide the nature of crafts, in addition to protection, care and self-development, also include innovation, which is associated not only with novelty and change but also with the introduction of new techniques and technologies (Schwartz, 2012; Walker et al., 2022). This view is in opposition to the one-sided ideas that have been rooted in the public consciousness, including the perception of every craft as outdated, uncreative and rather reproducible and as being on the "wrong side of history, the wrong side of technology and, more generally, the wrong side of globalisation" (Jones et al., 2021). In some craft sectors, the concepts of 'innovation' and 'craft' are seen as contradictory (Torán et al., 2017).

According to Ewa Klekot, there is no craft without technology, and the opposition of these two concepts is an artificial construct (Pluta, n.d.). Digital technologies in the context of craft are an "extension of the craftsman's hand" (Websensa, 2021), while the image of a craftsman using only simple tools without using business knowledge and modern marketing is already considered outdated. Craft workshops are also changing – from ancient ateliers to workshops. laboratories (PARP, 2021). Similarly, according to Yelavich (2022), the slogan "craft, design and technology" indicates the movement of starting with the hand, through the head to the machine and is naturally associated with progress. In the opinion of craftsmen respondents taking part in the study conducted by Klekot et al. (2022), new technologies play a very important role in contemporary crafts; they are even their permanent indispensable element. This role results from emerging market challenges (Klekot et al., 2022). On the other hand, research conducted by Alexandre et al. (2017) among craftsmen working with wicker in Madeira, Portugal, indicates, among other things, that due to the constant evolution of society, crafts must integrate innovations in order to survive.

New technologies – a secondary issue

The design scenarios in the field of fashion and crafts developed by Brown and Vacca (2022) allow us to observe that new technologies are not an end in themselves but are one of the tools to achieve the goal. The goal is not to passively adopt technologies but to redesign them and to apply exchanges within different disciplines so as not to lose uniqueness and not to squander the possessed heritage (Brown & Vacca, 2022). Research conducted in Poland indicates that the most important thing in craft is "tailoring", and the choice of craft tools is a secondary issue (PARP, 2021). The most important thing is to craft hands-on knowledge, an individualised relationship with the task performed – knowledge of tools and materials and the uniqueness of a given problem to be solved (Klekot et al., 2022).

The secondary importance of using new technologies can also be seen in the results of research conducted by Manosevitch and Tzuk (2017), who analysed the development process of Israeli craftswomen who initially blogged as a hobby and then ran start-up companies supported by blogs. These researchers point to the driving mechanism of such activity in building a community and strengthening the position for economic and personal development.

The scholars also emphasise the disadvantages of the work of craftswomen bloggers related to, among others, the need for constant updating of data, which is time-consuming, and the tension between art and business. These include the risk of losing work-life balance and the loss of joy from creating handicrafts due to business pressure. These studies indicate that in running a craft blog, establishing contacts with other craftswomen and improving the economic situation, basic knowledge of the Internet is enough (Manosevitch & Tzuk, 2017), so it is not necessary to work with the latest technologies.

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The accelerated digital transformation spurred by the emergence of the coronavirus has not only influenced the transfer of the professional sphere to the online space but also increased educational opportunities. The acquisition of new digital skills by Hong Kong artisans was the subject of research performed by Song (2022). This researcher pointed out that technology is not yet able to fully meet the requirements of craftsmen in the context of increasing their productivity and creativity, as well as the need for a high level of engagement in manual processes (Song, 2022). Not all work can be done using new technologies. Similarly, Grimshaw (2017), using the example of the production of digitally designed and manufactured wooden vessels, indicates the differences in products created as part of conventional and digital production.

New technologies – more expensive products

Not only producers but also consumers increasingly rely on new technologies, including digital tools. The key element, in this case, is the aspect of trust, built on the perception of a good price-quality ratio, a sense of security (including one's own data), and behaviour consistent with declared values (Rogers, 2023). The transition from manual to digital production has increased the price of the final product. Experimentation and improvement is a costly process. Moreover, despite the prevailing opinion that mechanised means cheaper, the aspect of time and investment in new technologies increases the price (Websensa, 2021). However, these are not the only elements influencing the value of the product. It is also worth remembering such components as 'proximity to the material, process and concept', i.e. elements independent of the location on the time axis and of the technological progress in place (Besch, 2019).

Research conducted by Erdmann et al. (2023) on consumer perception of prices of technological market disruptors indicates that social pressure increases the perceived minimum price, and price sensitivity can be reduced, causing the perceived ease of use. Digital technology has influenced, among others, the availability of information and thus played a large role in shaping consumer price sensitivity. It moreover influenced consumer behaviour through marketing tools, and as part of this, also on the willingness to purchase – spending available funds (Suarez et al., 2023). On the other hand, the study by Coutinho et al. (2021) shows that consumer interest in products created by using new technologies increases with the belief that they will not cause negative health effects and when their price is similar to a parallel conventional product. This tendency decreases with unfamiliarity with new technologies, emerging doubts related to information provided by the media and the lack of perceived quality compared to a conventionally manufactured product (Coutinho et al., 2021).

New technologies – a tool for the young?

In general, younger people not only have a higher sense of control over technology than older people but also have a more positive attitude towards new technologies (Rojas-Mendez et al., 2017; Paro et al., 2021). Despite the fact that younger generations generally adapt to new solutions faster, since 2012, there has been a significant increase in the use of technology also among older generations – including Generations X and BB (Vogels, 2019).

Among the concerns related to the use of new technologies, those related to the substitution effect (a negative impact on the labour market) are mentioned. Concerns related to the use of robots and software result from the prediction of the elimination of jobs in professions requiring repetitive, routine or optimisation tasks. On the other hand, concerns related to artificial intelligence (AI) usually refer to jobs requiring high qualifications and advanced technologies. AI can not only take over some decision-making power (have a positive impact, among others, on reducing the costs of prediction) but also improve work – increase efficiency, as well as complementarity compatibility between employees with high and low qualifications (Abrardi et al., 2022).

However, the Internet, as an advertising tool, is largely used for promotion by young people working in brick-and-mortar workshops", and only promoting and selling their products online, among others, through blogs, social media platforms (including Facebook, WeChat, Instagram), websites enabling the publication of short videos (including TikTok), etc. The increase in online sales of handicrafts took place already in 2014 when a global increase of 20-30% was recorded (Sławiński, 2016). Examples of online platforms specialising in the sale of crafts include Etsy.com and Pakamery.pl. In 2021, the Etsy.pl platform enabled small businesses to achieve an income of USD 4 billion, while

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the Pakamery.pl platform in October 2023 offered over 1.5 million products made available by 3.4 thousand handicraft designers. Access to crafts via the Internet is also related to the fact that new technologies penetrate various spheres of life, as well as the cultural space, with which contact is increasingly established via the Internet and mobile devices. Participation in culture and cultural events is becoming highly individualised, i.e. more independent (Lewandowska, 2016). Another category is the "new level of craftsmanship" – created by the young generation of designers using new technologies. In this case, the Internet is the CV of this generation of craftsmen-designers (Fashion-Post, 2015).

New technologies – the possibility of obtaining free and non-repayable financial assistance

The aim of subsidies focused on technical infrastructure is to finally adopt a given technology, to permanently adopt it by a given group of recipients, including craftsmen. Subsidies therefore play a motivational role and are intended to help avoid overpaying the first wave of users (Langer & Lemoine, 2022). Subsidies can encourage craftsmen, among others, to set up a business (Sławiński, 2016). Polish programs supporting crafts include, among others, Polski Inkubator Rzemiosła ('the Polish Craft Incubator'), under which organisations associated with Związek Rzemiosła Polskiego ('the Polish Craft Association'), Izba Rzemieślnicza (the Craft Chamber) and Craft Guilds can apply for subsidies for retrofitting with technical equipment (Sobczak, 2021). The second edition of this program, with a time scope of 2021-2030, is also linked to infrastructural support for craft organisations, as well as institutional support and the development and promotion of dual education in crafts (Serwis Rzeczypospolitej Polskiej, 2022).

Examples of EU grants for activities integrating incumbent craft techniques/craft knowledge with entrant technologies are programs implemented under HORIZON-CL2-2022-HERITAGE-01-04, such as (European Commission, 2022):

- HEPHAESTUS – Heritage in EuroPe: new techHologies in crAft for prEserving and innovaTing futures,
- Colour4CRAFTS – Colour for Combining, Re-engineering, Applying, Futuring, Transforming, Stretching,
- Tracks4Crafts – Transforming crafts knowledge for a sustainable, inclusive and economically viable heritage in Europe,
- CRAEFT – Craft Understanding, Education, Training, and Preservation for Posterity and Prosperity.

Table 4 shows the most important characteristics of projects planned for 2023-2026/27.

Table 4. The latest projects funded by the European Union (EU) focusing on combining craftsmanship and new technologies

Project name	Main topics	Duration	Coordination	Country	Total cost/ EU Contribution
HEPHAESTUS	• knowledge mapping • digitization of cultural heritage	01.04.2023-31.03.2027	Copenhagen Business School	Denmark	€ 3.9 million
Colour4CRAFTS	• developing skills in textile dyeing • transforming traditional processes into sustainable processes	01.07.2023-30.06.2026	Helsingin Yliopisto	Finnland	€ 3 million
Tracks4Crafts	• developing new digital technologies • strengthening and transforming knowledge transmission • effective economic and social valuation of crafts	11.03.2023-28.02.2027	Universiteit Antwerpen	Belgium	€ 4 million
Craeft	• education • use of digital aids, telecommunications, simulators, advanced immersion and advanced digitalization	11.03.2023-28.02.2026	Idryma Technologias Kai Erevnas	Greece	€ 3.1 million

Source: authors' work based on European Commission (2023a, 2023b, 2023c, 2023d).

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New technologies – the path to sustainable development

Craft production was initially aimed at households, catering for the needs of the family. Then, specialisation within individual branches of production developed, characteristic of given settlement units. Craft workshops moved from villages to cities. In addition to competition in the form of other workshops, factories and industrial manufacture appeared on the market, which was the result of the ongoing industrialisation. The reaction to the progress of consumerism, abuse of resources and degradation of the natural environment was the implementation of more sustainable practices and craft programs. An example of new initiatives in this area is the activities of the Polish Cieszyn Castle and Stowarzyszenie Kraina św. Anny (the Association of the Land of St. Anna) within the project «Opolski ETNOdizajn». One of the effects of this project was the design of an application enabling contact and visits with craftsmen and creators operating in the region (Innovative craftsmanship, n.d.), therefore directly implicated with the aspect of sustainability within the framework of economic responsibility.

The connection between new technologies and crafts in the context of sustainable development is also visible in the example from China presented by Walker et al. (2022). Collaboration between craftsmen and designers using new technologies is undertaken to support production and develop new opportunities related to local crafts and developing innovations based on traditions (Walker et al., 2022).

New technologies also enable digital representation of the material and intangible dimensions of crafts in order to preserve them (Zabulis et al., 2022; European Commission, 2022). Another example where new technologies can promote the sustainable development of intangible cultural heritage products due to the shrinking group of practitioners is the craft of bamboo weaving. The team of researchers Sun and Liu (2022) noted the problem of division of labour between design and production, associated with the technical difficulties of expressing design concepts. The use of software in this craft indicates that technology significantly increases the interest and confidence of the designers themselves (Sun & Liu, 2022). In addition, access to instructional resources and materials through platforms and social media allows the sharing of skills and knowledge and gives the opportunity to participate in the culture of creation. Technology enables the engagement of recipients in both digital and analogue crafts.

For example, digital fabrication technology is influencing craft culture by changing the shape of craft identity and distancing itself from the traditional concept of craft associated with the lack of efficiency, assignment to a specific biological sex, locality, utilitarianism and technicality. Professional craftsmen – respondents of Song (2022) were not in favour of participating in a curriculum presenting all available digital tools. On the other hand, craftsmen with novice craft knowledge preferred instruction, including a step-by-step presentation of tools. This study also allowed for the identification of the digital craftsman perceived as a new type of creator-entrepreneur in the creative industry, combining traditional and digital skills (Song, 2022).

Also, artificial intelligence is sometimes used in the education of craftsmen, however, this topic is not one that is often discussed by the scientific community. The results of a study by Vartiainen and Tedre (2023) show, among other things that AI inspires craft teachers. On the other hand, it is also associated with a group of problems related to algorithmic bias, copyright infringement and the specificity of AI creativity, among others (Vartiainen & Tedre, 2023).

The team of Zhan et al. (2017), however, points out the importance of carefully approaching craftsmanship and technology along with their context. Cross-sector collaboration between traditional crafts and digital and material technologies can affect sustainability or even destroy many craft practices (Zhan et al., 2017).

New technologies – a turn to craftsmanship

Companies specialising in new technologies, especially those focused on innovation, when creating new products try to refer (including in advertising campaigns) to:

- the concept of craftsmanship and the contribution of unique skills to the creative process,
- craftsmanship's uniqueness and the luxury associated with it.

An example of this is luxury watches and the engagement in collaboration between Apple and Hermès in their creation (Cunningham, 2017). Another example is eTextilies/ Smart Textiles, i.e., electronic textiles that combine textile materials with electronic and computational functionality

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(Posch & Fitzpatric, 2021). Temeltaş (2017) points to a group of other examples of collaboration between craftsmen and designers:

- the use of artisanal techniques in the medical sector (creating a synthetic meniscus),
- Nokia's collaboration with craftsmen to create the phone of the future,
- the development of the "Home Bakery" Bread making machine by Matsushita Electric by obtaining tacit knowledge from master craftsmen,
- the creation of a "Face Saving" product by craftsman Matt Durran, specializing in working with glass and the surgical research department of Royal Free Hospital for nose prototypes,
- the collaboration between designer Michael Young and Furniture Company Coalesse to produce the 5MY Chair using lightweight material.

Other examples mainly refer to the observations of Mu et al. (2019), highlighting that consumers value technology in the context of sustainability, mainly through the use of mobile applications to facilitate transactional processes (Mu et al., 2019; Paro et al., 2021). Companies that have bet on the potential of craftsmen, i.e., have specialised in offering services dedicated to craftsmen, include, for example, JobProgres, which offers software related to managing businesses run by locksmiths, carpenters, sheet metal workers, pavers, plumbers, mechanics, electricians, roofers, printers, and, among others, 'handymen'– so-called multi-industry specialists performing repair and maintenance work. Similarly, Buildertrend, Craft.io, ServiceTitan, Procore, Jobber, and mHelpDesk are oriented towards purchasers who are specialist contractors, hailing from, for example, the construction and service industries, which also include craftsmen. Other examples are the Upwork and Houzz platforms aimed at freelancers, including artists and craftsmen, and people interested in their work and the services they provide.

A broader perspective, going beyond the regional focus

The results of our research are primarily intended for the Polish craft community and their surroundings. Their applicability in a broader international context is contingent upon the manner in which the term "craft:" is defined in a given country. For instance, in Portugal, this term is defined with considerably greater specificity than in Poland, and it primarily encompasses the production of goods and services using traditional manufacturing techniques[1]. In this case, the relationship between new technologies and crafts is analysed mainly from the point of view of preserving and promoting traditional crafts and aspects of cultural heritage using various methods that new technologies facilitate – including gamification (Marques et al., 2022; Marques et al., 2023). Research by foreign scientists and researchers of the phenomenon focuses mainly on the issues of using more activating pedagogical methods to teach craft skills in vocational schools. They emphasise, among others, the need to conduct training necessary to acquire skills in using new technologies in crafts and digital transformation, including modernising the entire education system in crafts (Kofler & Walder, 2024), educational programs to ensure responsible integration of new technologies (Ghosh & Ravichandran, 2024), the importance of technicians and institutions offering vocational education in innovation processes (Lewis, 2023) and the possibilities offered by educational technologies, the aim of which is to improve the efficiency of learning processes and support flexibility (Wuttke et al., 2020). In this respect, reviews of the subject literature dominate, to which our study is an important supplement.

Narrowing the subject matter to the borders of Poland, the results of the conducted research may also apply to the craft environment of regions other than the Opole province, where crafts operate, and research is conducted and related to the labour market, including craft education. The topic of technology is raised, among others, in publications of the Polish Craft Association (see: Zabłocka, 2020), Craft Chambers (see: WIR, 2011), the Voivodeship Labor Office (see: DWUP, 2023), and the Polish Agency for Enterprise Development/ PARP (see: Klekot et al., 2022; Kowalewska, 2023). These publications are based on more interdisciplinary research, while the topic of new technologies in these studies is mentioned in three ways:

- generally/in keywords, indicating a very large area for future research within all branches of Polish crafts,
- emphasising the fact that some craftsmen use new technologies (including digitally controlled CNC machines, lasers, 3D printing),

[1] Consultation within the KreativEU consortium in the Instituto Politecnico de Tomar in December 2024.

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- presenting the results of more detailed research, but conducted among respondents already professionally active.

The research report of the Lower Silesian Voivodeship Labor Office indicates groups of concerns related to bearing the costs of investing in new technologies – the loss of traditional craft skills and competition from more automated enterprises. On the other hand, the actions to reduce these concerns include training in new technologies, creating financial support programs (reducing initial costs), conducting campaigns promoting the value of traditional crafts, and industry consultations providing the opportunity to exchange experiences and best practices in the use of new technologies (DWUP, 2023). Kowalewska's study (2023) also emphasises that investments in new technologies are covered by the craftsmen themselves, while the changes introduced by them concern modern design and automation of production processes, the use of information technologies and internet marketing, and circular economy solutions. The studies mentioned in this paragraph also refer to regional clusters, respectively the Silesian, Greater Poland, Lesser Poland, and Lower Silesian provinces, and indicate the relevance of the chosen research topics and confirmation of the research gap within the topics combining new technologies and Polish crafts, as well as both of these categories and aspects of sustainable development.

Conclusions

The term "craft" is identified with a specific set of knowledge and hands-on skills often passed on to younger generations entering the labour market. These individuals often emerge into an economic, social, cultural and, above all, a technological landscape that differs significantly from that of their predecessors. Furthermore, the term is associated with family-run businesses that produce distinctive merchandise with a broader appeal, catering to a diverse range of consumers. Without educated, qualified and open-to-change craftsmen/artisans who adopt new technologies to their activities, it is difficult to envisage the economic development of a country or region.

The findings of a study conducted among students of vocational schools in the Opole province indicate that:

- The educational profiles selected by young people are highly diverse yet remain popular. It is evident that this choice is not always influenced by familial tradition. It may result from trends prevailing in the labour market.
- It is worrying that a large percentage of students do not know whether they will work in their learned profession after completing their education. Another problem is the potential country of employment. The outflow of qualified employees means reduced consumption, poor development of enterprises, lack of opportunities to implement innovative solutions in craft practice, stagnation in the development of a given industry.
- Vocational propaedeutics, instruction in craft professions requires a thorough reform. Young people use basic multimedia tools in education, such as interactive boards or e-journals. As indicated by the students, the utilisation of contemporary digital tools in all academic disciplines is essential for optimal preparation for future professions. These are tools that affect sustainable development or effective management. Equipping enterprises with modern, innovative and ecological equipment also affects competition or the quality of products and services.
- New technologies in crafts imply an obligation of continuous improvement. They have a positive impact on the production process.
- They are a natural consequence of development, and they force changes that are assessed by students both positively and negatively. On the one hand, young people see that innovations affect the brand of a product or service; they can be adapted to the needs of customers, and on the other hand, they mean constant adaptation to global reality and reduction of jobs.

Another problem is the strengthening of crafts in the local, national and global markets. According to the government program "Polish Craft Incubator" for the years 2021-2030. The main goal of the program is to strengthen the organisation of craft economic self-government in the field of human and social capital and institutional potential. This can be achieved by implementing the following specific objectives:

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- development of the infrastructural and organisational potential of the craft's economic self-government,
- development of human and social capital resources of crafts,
- strengthening cooperation of craft organisations with entities from the public, corporate and non-governmental sectors (Ministerstwo Rozwoju i Technologii, 2022).

The use of grants, subsidies, and funds targeted at craftsmen is also an important aspect. New technologies in crafts affect production and competition and increase profits. They make it easier to enter the job market. For young people, the economic aspect is very important, but it is worth reinforcing students' knowledge of environmental responsibility related to the consequences of doing business that does not comply with legal or ethical standards. Customised products aimed at a specific audience, taking into account their style, interests, and creativity, will always be very popular. Therefore, the work of artisans and new technologies cannot imply mutually exclusive activities. Tradition and modernity should go hand in hand. According to Sarah Evans, "Craftsmanship and technology absolutely must be linked. Our beautifully crafted products are useless if they don't work, and for us, it's about providing an experience. All the technology in our products is hidden behind the design of the piece. Because you cannot see it, but it works so well, it creates that experience. Honestly, that is just part of the pride in what you do, and for us, there is no such thing as craftsmanship versus technology. They are together, and they have to be" (Websensa, 2021).

Crafts should relate to tradition and be connected to tradition, but this should be done in parallel with learning about and implementing new technologies into the work, this includes using social media to showcase the activities of individual entrepreneurs. These are the ones used by the younger generation of craftsmen whose products are aimed at an online audience. The development of crafts is beneficial to the economy of a country or region. However, it is also essential to ensure competitiveness. While new technologies may not replace human resources, they do offer a potential avenue for implementing innovative and creative solutions. The use of technology affects the resilience of the economy (Copestake et al., 2024; Homayoun et al., 2024). Increased technological complexity promotes innovation and can strengthen regional economic resilience (He et al., 2023). The aspect of modern infrastructure and an innovative workforce are furthermore cited as elements influencing regional economic resilience (Christopherson et al., 2010). Today, attention is being paid to the need to improve digital infrastructure, develop digital talent through education, and foster a collaborative digital ecosystem to stimulate innovation across sectors (Santoso et al., 2024), including the craft sector, enabling it to adapt to ongoing changes, including difficult and challenging situations.

The research conducted in selected vocational schools in the Opole Voivodeship should be of particular interest to key stakeholders, including decision-makers, directors, and teachers of vocational schools, as well as small and medium-sized enterprises.

Vocational education requires a thorough reform that would consider changes in the labour market, the introduction of new technologies (e.g. AI), and the issue of sustainable development. Without modifying the core curriculum and framework curricula, teaching methods, and conditions for young people to complete internships, it will not be possible to keep them in the local or national labour market. This also requires an analysis of the labour market in terms of professions of the future or ways of employing graduates of craft schools.

In the case of schools educating in craft professions, several issues seem particularly important. Firstly, such schools should cooperate closely with enterprises, which would mean modifying the curricula for individual industries. Secondly, cooperation with entrepreneurs should mean reliable implementation of vocational internships by students, appointing a mentor (and not just a supervisor of the internship) who would encourage them to take on new challenges and improve their qualifications and skills in craft professions. Thirdly, craft education will have a future, but only when there are practitioners with extensive experience in education, open to technological changes and adapting their companies to the challenges that the future will bring. Fourthly, training for teaching staff and internships in companies for teachers of vocational schools should be reflected in the conditions for professional advancement. Fifthly, vocational education should be characterised by great flexibility and openness to changes, increasing hours for practical vocational training, and modifying the directions of education. Choosing such an educational path by a young person cannot mean a worse societal status.

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Vocational schools are unable to educate the next generation of craftsmen without the involvement of small and medium-sized enterprises, which report serious difficulties in acquiring qualified employees, which in turn affects their efficiency and competitiveness. Close cooperation with schools could at least partially remedy these problems. Actively involving entrepreneurs in the life of the educational unit by co-organizing such events as school open days, initiatives promoting craft professions and vocational schools, paid internships for the best students or a guarantee of employment after completing education could prove to be a good way to retain graduates in the region and supply the local labour market with qualified employees.

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The contribution of the authors

Conceptualization, K.M.-W.; literature review, K.M.-W.; methodology, K.M.-W., A.R. and B.R.; formal analysis, K.M.-W. and B.R.; software, K.M.-W. and B.R.; visualisation, K.M.-W. and B.R.; data curation, K.M.-W. and B.R.; writing, K.M.-W.; conclusions and discussion, K.M.-W. and A.R.

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Katarzyna MAZUR-WŁODARCZYK • Anna RAJCHEL • Bogdan RUSZCZAK

POSTRZEGANIE NOWYCH TECHNOLOGII W RZEMIOŚLE PRZEZ MŁODYCH RZEMIEŚLNIKÓW: STUDIUM ZRÓWNOWAŻONYCH PRAKTYK

STRESZCZENIE: Celem badań było poznanie opinii uczniów szkół branżowych I i II stopnia zlokalizowanych na terenie województwa opolskiego na temat stosowania nowych technologii w rzemiośle. W badaniach poruszono problematykę zmian miejsc pracy, usprawnień związanych z procesem produkcji i procesem zarządzania przedsiębiorstwem rzemieślniczym, działaniami przyśpieszającymi proces adopcji nowych technologii w rzemiośle oraz ich związku ze zrównoważonym rozwojem i budowaniem odporności społeczności rzemieślniczych i gospodarek. Wykonano analizę treści, liniowy model klasyfikacji z regularyzacją L2 oraz weryfikację siły wzajemnego wpływu za pomocą współczynnika korelacji rang Spearmana. Do wniosków zaliczyć należy spostrzeżenia, że rzemiosło oparte na tradycyjnych umiejętnościach przekazywane jest młodszym pokoleniom, które dorastają w zmieniającym się kontekście technologicznym, społecznym i ekonomicznym. Nowoczesne technologie są kluczowe dla rozwoju rzemiosła i konkurencyjności na rynku. Natomiast szkolnictwo zawodowe w Polsce wymaga reform, z uwagi m.in. na to, że nowoczesne narzędzia są niezbędne do lepszego przygotowania do pracy. Technologie te wspierają rozwój produkcji i konkurencyjności, ale powinny być stosowane w zgodzie z zasadami odpowiedzialności ekologicznej.

SŁOWA KLUCZOWE: rzemiosło, nowe technologie, ekonomia kultury, zrównoważony rozwój, odporność rzemiosła