

ECONOMIC PREPARATION OF YOUNG PEOPLE FOR ECONOMY 4.0 – MULTI-COMPETENCY OR SPECIALIZATION?

Sylwester BIAŁOWAŚ^{1*}, Anna WALIGÓRA²

¹ Poznan University of Economics and Business; sylwester.bialowas@ue.poznan.pl,
ORCID: 0000-0003-4575-5346

² Poznan University of Economics and Business; anna.waligora.ue.poznan.pl, ORCID: 0000-0003-1361-4709

Purpose: Paper is an attempt at theoretical and practical answer to the question about the economic preparation of young people for Economy 4.0.

Design/methodology/approach: The paper consists of a literature study relating to research findings on multicompetence vs specialization of youth attending secondary schools and a review of own research with young people carried out as part of the project "New Generation in the New Economy" carried out at the Poznań University of Economics and Business in 2021-2022.

Findings: The results confirm high correlations between competencies. Authors calculated also the Competencies Index, as the arithmetic mean from normalized results of all measured competencies. This lead to the recognition of inconstant variabilities of competencies along the Competencies Index results. The variability of competencies levels is much bigger among students with average lower multicompetencies index.

Research limitations/implications: The results of the conducted own research seem worth carrying out on subsequent groups of respondents and on a larger population of them. Particular attention should be paid to the research sample - panel studies taking into account cultural differences, age, gender and the type of school attended by the respondents seem particularly interesting in the future. The undertaken research topic is undoubtedly worth exploring and more extensive research.

Practical implications: As indicated by literature research, the competences analyzed in the paper are the subject of interest of various stakeholders (including scientists, institutions and organizations responsible for education or the future of the labor market).

Originality/value: The novelty of the paper comes from unique research consisting all the most important competencies. This allowed to measure the relations between them, calculate the multicompetencies index and check if inter-competency differentiation is different in the group of people well prepared for Economy 4.0 and in the group of people with worse preparation.

Keywords: competences in the New Economy, Economy 4.0, the Index of Competencies, competencies of Youth.

Category of the paper: Research paper.

1. Summary

The competences of school youth, with particular emphasis on the competences of secondary school students, are of interest to various environments. The issues are dealt with both by the sphere of education, as well as labor market institutions and employers for whom today's student is the employee of tomorrow.

The discussion around the specialization of education has been going on for many years - educate for the needs of the economy and its diverse expectations or educate in general, putting emphasis on shifting responsibility for specialization to the next levels of education (studies) or the beginning of a professional career?

Paper is an attempt at theoretical and practical answer to the question about the economic preparation of young people for Economy 4.0. The paper consists of a literature study relating to research findings on multicompetence vs specialization of youth attending secondary schools and a review of own research with young people carried out as part of the project "New Generation in the New Economy" carried out at the Poznań University of Economics and Business in 2021-2022.

The results confirm high correlations between competencies. Authors calculated also the Competencies Index, as the arithmetic mean from normalized results of all measured competencies. This lead to the recognition of inconstant variabilities of competencies along the Competencies Index results. The variability of competencies levels is much bigger among students with average lower multicompetencies index.

2. Introduction

The topic of economic preparation of young people to function in the 4.0 Economy returns regularly during secondary school-leaving examinations or other exams that have a cross-sectional dimension to check the results achieved by young people. As indicated by the results of the Program for International Student Assessment (PISA) for 2018, i.e. a study used to measure the mathematical skills of 15-year-olds in the use and interpretation of mathematics in various contexts in order to describe, predict and explain various phenomena, Polish youth includes in the European rate. The result of the study is the average number of points obtained by one student in a given country. For 2018, students from Poland achieved an average score of 503.0 points, being behind the best: Finland, Switzerland, the Netherlands (520.0-528.3 points) and Germany, Denmark, Belgium, Estonia and Slovenia (503.1-519.9 points) (OECD, 2018).

The results of the study say a lot not only about the mathematical skills of students, but also about their ability to communicate, the so-called associating facts using mathematics. This skill will become more important once students enter the job market and will no longer be asked for test results. Then it will be their ability to solve real professional problems, which is undoubtedly facilitated by the development of mathematical skills.

Economy 4.0 sets even more complex assumptions for students-future employees. Economy 4.0 is described as an issue concerning not only new technologies, but also new ways of working and the role of people in industry. It becomes important to reflect on the expected competences of people operating on the labor market, especially those who will contribute to the new economy - that is, the young generation (New Generation in the New Economy, 2021).

Of course, a change in human resources in the economy is not only a simple generational change. Therefore, joining the staff of Economy 4.0 requires young people not only to have skills conducive to functioning in Industry 4.0, but also developed communication and cultural skills that allow them to communicate effectively with employees/superiors representing other generations, as well as colleagues from other cultures (Biernat, 2015).

An attempt at a comprehensive study of the competences of young people with regard to functioning in the economy 4.0 was made as part of the research project "New Generation in the New Economy" carried out at the Poznań University of Economics and Business. Over 500 students from the Wielkopolska region participated in the study. Students participating in the research study at a vocational school, technical secondary school and general secondary school.

As part of the study, the following competences were measured: (1) mathematical literacy competences, (2) ethical and civic competences, (3) communication, (4) creativity, (5) self-organization of work, (6) creating digital content and the ability to seek information using IT, (7) learning new issues and (8) teamwork. Based on the obtained results, the Competence Index in the New Economy was developed. The Competence Index is the arithmetic mean from normalized results of all measured competencies.

Certainly, studying the competences of young people heading towards participation in Economy 4.0 requires constant reflection and careful observation. Firstly, because young people are constantly changing (Wiktorowicz et al., 2016). Secondly, due to the fact that the economy is constantly changing, and the effective combination of these two worlds is a success on the labor market in relation to individual biographies (Szymańska et al., 2014). It also determines the success of the labor market as a coherent work and management environment prepared for 4.0 changes.

3. Literature review

Various sources - both scientific studies and research reports indicate relationships between students' competences (Karwowski, 2013; Szymańska et al., 2014; Przybył et al., 2014; Oberrauch, Kaiser, 2018; OECD, 2018). The general conclusion on the subject of dependence comes down to the fact that the balanced development of various types of skills - from mathematical to social competences - is conducive to balanced participation in education and then in the labor market.

An analysis of the challenges posed by participation in the modern economy, and especially in the Economy 4.0, brings the conclusion that the competences expected from young people do not change; however, the way they are combined and then used changes (Przybył, 2014; Kwiatkowski, 2018; Lase, 2019; Grenčíková, Kordoš, Navickas, 2021).

For the purposes of the paper, a review of the results of research on the competences studied in the project "New Generation in the New Economy" was made. The analysis is oriented towards showing the relationship between competences. The analysis shows that the dominant approach among other researchers is the group approach to examining the competences of young people. Even if one competence is dominant, it is analysed through the prism and in a sense "in the company of" other competences.

Mathematical literacy competences

As mentioned in the Introduction, an extensive study of mathematical competences is carried out periodically as part of the pan-European study Program for International Student Assessment (PISA) (OECD, 2018). The study showed that math skills correlate with communication skills. Thus, mathematical competences are widely treated here, as a component necessary to shape the imagination, and thus also creative abilities.

Another study referring to the PISA test is the Test for International Comparisons of Knowledge and Skills (TICKS). In addition to math skills, it focuses on testing reading comprehension and reasoning in natural sciences. TICKS implemented during the pandemic (Jakubowski, Gajderowicz, Wrona, 2022) brings less optimistic results than PISA regarding the skills of Polish youth, nevertheless, it indicates relationships similar to PISA.

Mathematical literacy competences are connected with communication and creativity, and if you take into account the way of solving both tests, also with the competence to learn new things and self-organization of work.

Ethical and civic competences

An example of research devoted to ethical and civic issues is The International Civic and Citizenship Education Study (ICCS) (ICCS, 2022). As part of the research carried out by the International Association for the Evaluation of Educational Achievement in 38 countries,

the knowledge of, inter alia, democracy, democratic institutions, and awareness of threats to civil society was examined with high school students. The entire study is oriented towards the Sustainable Development Goals set out by the United Nations. Ethical and civic competences are one of the most important competences of the future (Kwiatkowski, 2018) because they are a kind of compass for navigating in the social and digital world. Ethics also sets a common communication platform conducive to dialogue attitudes.

Ethical and civic competences are combined with communication skills, and in the context of future challenges related to, for example, the development of democracy or ecology, also with the learning new issues, mathematical literacy competences and creating digital content and the ability to seek information using IT.

Creating digital content and the ability to seek information using IT

Young people's digital competences are subjected to various types of tests. The knowledge of modern teenagers is almost intuitively combined with a high level of digital skills. This is due to the technological conditions of the present day and the high availability of various types of IT tools - from computers to tablets to telephones (Sijko, 2013). An example of testing the digital competences of young people is the IT Fitness Test (IT Fitness Test, 2022), carried out cyclically in the Visegrad Group countries. It consists in completing an online test in which creative tasks are solved (e.g. related to determining the route of an autonomous vehicle) and tasks testing resistance to data fraud on the Internet and broadly understood digital security.

Digital competences are therefore connected with both communication skills, the ability to learn new things, as well as creativity, and also as well as ethical and civic competences.

Learning new issues, Communication, Creativity, Self-organization of work

The indicated competences belong to the group of competences that mostly accompany mathematical literacy competences, ethical and civic competences, creating digital content and the ability to seek information using IT. They are used to create test issues. However, this does not mean that they are important to me, and the fact that the way they are tested often depends on the methodology of testing other competences (OECD, 2018, TICKS, 2022, ICCS, 2022, IT Fitness Test, 2022).

The indicated competences are also connected with various approaches and methodologies in the study of group work competences (Kwiatkowski, 2018).

The competence to learn new things and to communicate is more often linked in research with mathematical literacy competences. Competences: Communication, Creativity and Self-organization of work - with Ethical and civic competences and Creating digital content and the ability to seek information using IT.

Teamwork

Competencies related to working in a group remain one of the most valued by employers and pass the so-called the trial of time and the resulting changes in working conditions (Szymańska et al., 2014). Teamwork, especially related to collaboration in diverse teams, is widely taught in schools, under various methodologies (Chorst ,2012). As practice shows, however, this skill is developed mainly in non-school environments. Research conducted by the Zwolnieni z Teorii Foundation shows that the ability to work in a group is best shaped in the context of the implementation of civic projects (Odporność..., 2021). Thus, broadly understood extracurricular involvement determines the level of this competence.

Due to its complexity and mainly the qualitative dimension of analyses related to the competency of group work, it should be stated that it is related to virtually all analysed competences. Mostly, however, with ethical and civic competences, but also with mathematical literacy competences, communication, creativity, self-organization of work, creating digital content and the ability to seek information using IT and learning new issues.

The above mentioned research clearly show the competencies correlations. Instead of naming single hypotheses we decided to summarize the above mentioned relations in the table, and compare it with the results of our research.

Table 1.

Literature review based research stated competencies correlations

	Learning new issues	Creating digital content/ ability to seek information using IT	Mathematical literacy competences	Self-organization of work	Creativity	Ethical and civic competences	Communication
Learning new issues		x	x			x	
Creating digital content/ability to seek information using IT	x			x	x	x	x
Mathematical literacy competences	x			x	x	x	x
Self-organization of work		x	x			x	
Creativity		x	x			x	
Ethical and civic competences	x	x	x	x	x		x
Communication		x	x			x	

Source: own preparation.

According to the literature review and summarizing table we also expect, that dispersity of competencies is rather low and stable along the values of Competence Index.

4. Research methodology and sample

For our analysis we took subsample of 336 students, which have finished all the tasks carried out as part of the catalog of tasks provided for the examination of competences under the project. The catalog consisted of measuring tasks related to the following competences: (1) mathematical literacy competences (analytical competency), (2) ethical and civic competences, (3) communication, (4) creativity, (5) self-organization of work, (6) digital content creation and the ability to search for information with the use of IT, (7) learning new issues. The analyzes omitted the results on competences (8), group work due to the qualitative nature of the analyzes (the indicated competence was the only one analyzed on the basis of workshops with students). Dominant were the lyceums students (49%), technical school students are 31%, and the vocational school students are 20% of the sample. Females are 66% of the sample. Median of the age is 17 years.

5. Analysis - correlations

Seven competencies were measured as results of designed tasks. The ranges of measurement were different, so for comparisons all results were normalized. The descriptive statistics of the seven measured competencies are shown in the Table 2.

Table 2.
Descriptive statistics of measured competencies

	Learning new issues	Creating digital content/ ability to seek information	Mathematical literacy competences	Self-organization of work	Creativity	Ethical and civic competences	Communication
N	336	336	336	336	336	336	336
Missing	0	0	0	0	0	0	0
Mean	.5010	.4626	.7138	.6703	.7054	.6376	.3921
Median	.4994	.5500	.7500	.7000	.7692	.6667	.3333
Mode	.47a	.55	.81	.80	.96	.72	.00
Std. Deviation	.1106	.2242	.1883	.2094	.2530	.2120	.3217
Skewness	.089	-1.066	-.578	-.831	-1.181	-1.467	.229
Minimum	.10	.00	.19	.00	.00	-.44	.00
Maximum	.84	.85	1.00	1.00	1.00	.97	1.00

a Multiple modes exist. The smallest value is shown

Source: own calculations.

Students from Greater Poland region obtained the highest average values for analytical competences (0.71) and creativity (also 0.71). The lowest values were measured for communication skills (0.39).

It is worth paying attention to the particularly large dispersion of communicating competences. The coefficient of variation is as high as 82%. Other competences are characterized by less differentiation, the coefficients of variation range from 22% (competence to learn new things) to 48% (digital competence).

For normalized competencies we have measured Pearson correlation coefficients. This confirms our expectations about high correlations. The results are shown in Table 3.

Table 3.
Pearson Correlation Coefficient for measured competencies

	Learning new issues	Creating digital content/ability to seek information using IT	Mathematical literacy competences	Self-organization of work	Creativity	Ethical and civic competences	Communication
Learning new issues							
Creating digital content/ability to seek information using IT	.129*						
Mathematical literacy competences	.302**	.170**					
Self-organization of work	.314**	.527**	.301**				
Creativity	.327**	.399**	.398**				
Ethical and civic competences	.225**	.163**	.142**	.315**	.177**		
Communication	.046	.439**	.166**	.418**	.280**	.088	

* Correlation is significant at the 0.05 level (two-tailed).

** Correlation is significant at the 0.01 level (two-tailed).

Source: own calculations.

The correlation matrix indicates that competences are mostly positively correlated with each other. The strongest correlation is between self-organization and planning skills and the ability to create digital content (0.527).

On the other hand, we observe uncorrelated pairs only between communication skills and the ability to learn, and between communication skills and ethical-civic competences.

As many as 19 out of 21 possible competences turned out to be significantly correlated, including 18 at the level of 0.01. It is worth noticing, that Creativity and Self-organization are relatively highest correlated with other competencies.

We have decided to show the summarized version of the correlations coefficients calculated for every type of school. The Table 4. Includes only symbols in places of significant correlations, the symbols (L, T and BS) indicated significant correlation for given type of school. Full tables available on demand.

Table 4.
Summarized version of the correlations

	Learning new issues	Creating digital content and the ability to seek information	Mathematical literacy competences	Self-organization of work	Creativity	Ethical and civic competences	Communication
Learning new issues							
Creating digital content and the ability to seek information using IT	L						
Mathematical literacy competences	SB L	SB L					
Self-organization of work	L T	SB L T	SB L T				
Creativity	SB L T	SB L T	SB L T	SB L T			
Ethical and civic competences	T	SB T	SB T	SB L T	T		
Communication	-SB T	SB L T	T	SB L T	L T		

Source: own calculations.

The highest number of significant correlations was observed in technical school (17). The high school and vocational school have 14 significant correlations.

Summarized number of significant correlations counted for each competency confirms, that Creativity and Self-organization have tightest relations to other competencies (respectively 18 out of 18 possible and 17 out of 18 possible). On the other side we can find the ethical and civic competence (9 out of 18) and communication (11 out of 18).

6. Analysis – Competence Index

Based on the results of all competencies, we calculated the index. The index is the arithmetic mean of individual competences, so it takes values from 0 to 1.

Table 5.
Competence Index

	Competencies Index
N	336
Missing	0
Mean	.5833
Median	.6086
Mode	.15a
Std. Deviation	.1361
Skewness	-.842
Minimum	.15
Maximum	.84

a Multiple modes exist. The smallest value is shown

Source: own calculations.

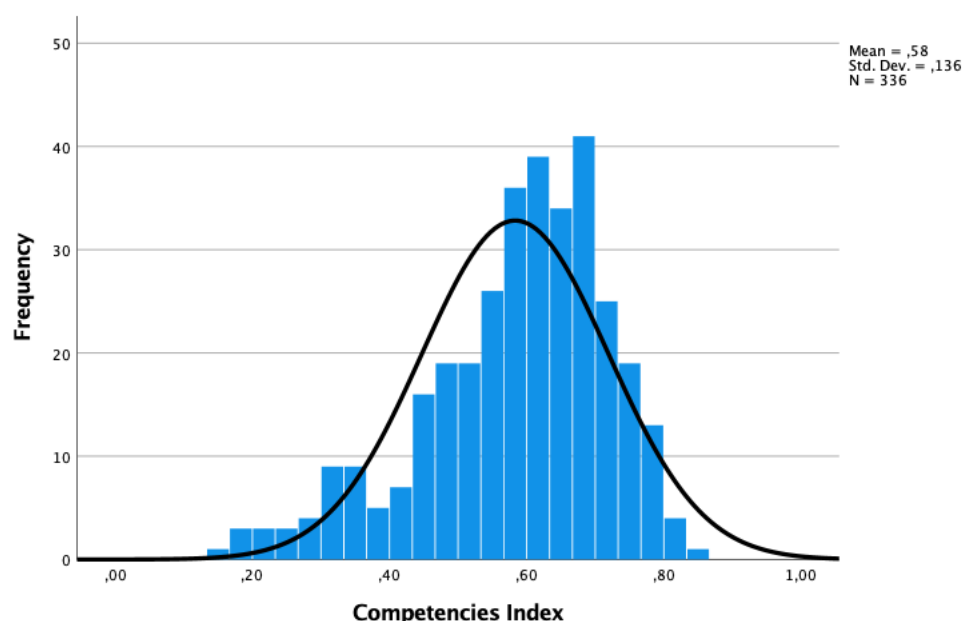


Figure 1. Competence index – histogram.

Source: Own calculations.

The index was used to check whether the inter-competency differentiation is different in the group of people well prepared for Economy 4.0 and in the group of people with worse preparation. We separated the groups on the basis of the 33rd and 67th percentiles, we compared the extreme groups. Therefore, in the first step, we calculated the variation measure, we decided to use the variation factor. The average differentiation was 42%, but due to the strong right-hand skewness of the distribution, the median of 35% is a better measure.

In general, it can therefore be concluded that the level of competences possessed by individual students varied only slightly. This confirms the thesis that at the level of secondary education, students' competences are not significantly differentiated, so most students generally have better all competences, or generally worse all competences.

In the second step, we checked how the differentiation of competences looks like in the group of students with generally less developed competences (low index values) and in the group with better developed competences. The Kolmogorov-Smirnov test indicated that the distribution deviates from the normal in one of the groups of interest to us, so we conducted the comparison using the nonparametric test - Kruskal-Wallis.

As predicted, the differentiation of competences decreases with increasing competences. Students with generally lower competences often have one or two competences much better developed. Students with a high general level of competence have all competences developed to a similar degree.

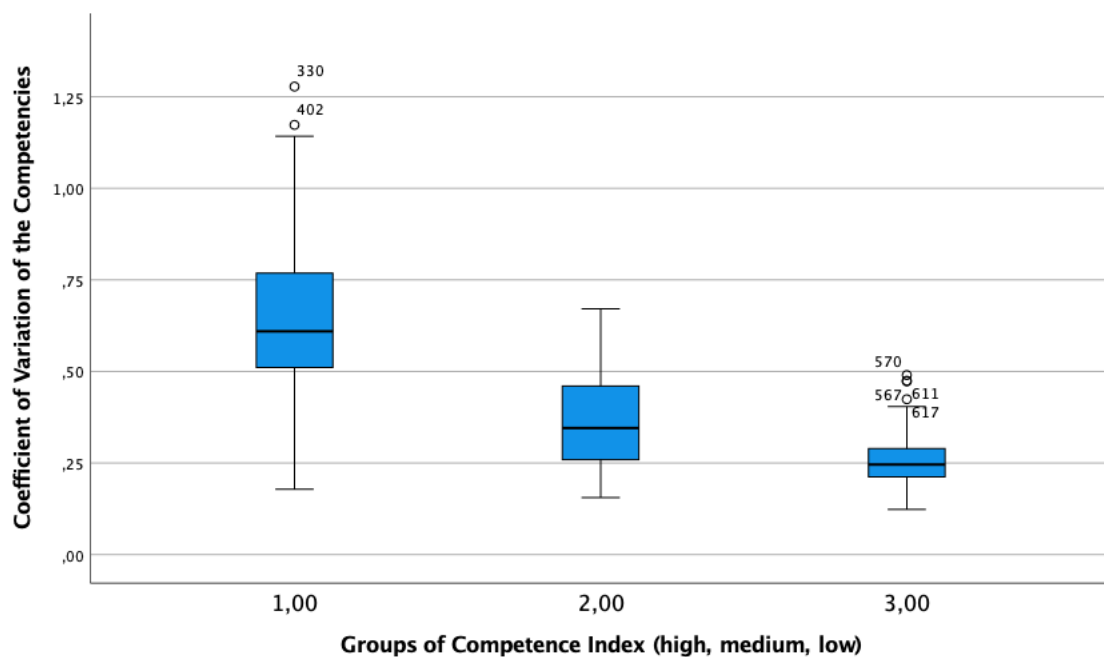


Figure 1. Differentiation of competences.

Source: Own calculations.

The differences are statistically significant, which was confirmed by the intergroup tests with Bonferroni's correction for multiple comparisons shown in Table 6.

Table 6.
Pairwise comparisons of Competence Index Groups.

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.a
low-high	-225.000	13.039	-17.256	.000	.000
medium-high	-112.500	12.953	-8.685	.000	.000
low-medium	-112.500	12.953	-8.685	.000	.000

a Significance values have been adjusted by the Bonferroni correction for multiple tests.

Source: Own calculations.

7. Conclusions

We have covered the matrix reflecting the literature research and the matrix containing results of our analysis. If the results confirmed the theory, we put the letter C (Confirmed). Correlations not mentioned in literature review, but confirmed in our research – are signed with letter E (Empirical).

And finally, the correlations confirmed by other authors, but not confirmed in our research are signed with letter T (Theory).

Table 7.
Confirmation of the correlation between competences

	Learning new issues	Creating digital content and the ability to seek information using IT	Mathematical literacy competences	Self-organization of work	Creativity	Ethical and civic competences	Communication
Learning new issues		C	C	E	E	C	
Creating digital content and the ability to seek information using IT	C		E	C	C	C	C
Mathematical literacy competences	C	E		C	C	C	C
Self-organization of work	E	C	C		E	C	E
Creativity	E	C	C	E		C	E
Ethical and civic competences	C	C	C	C	C		T
Communication		C	C	E	E	T	

Our research has confirmed all three correlations found in previous research for learning competence, additionally we have found two more correlations. In cases of digital content and mathematical competence we have confirmed all five previous research correlations, and one more was added (for each competence). All three self-organization competence correlations were confirmed, and another three were added. Same numbers for creativity competence. In case of ethic and civic competence we have expected all six correlations to be significant, but we have confirmed five, one theoretically mentioned was not significant in our research. And finally, two correlations of communication competence were confirmed, two not found in the literature were added, and one theoretical was not significant in our research.

8. Discussion and further research

As indicated by literature research, the competences analyzed in the paper are the subject of interest of various stakeholders (including scientists, institutions and organizations responsible for education or the future of the labor market). The results of the conducted own research seem worth carrying out on subsequent groups of respondents and on a larger population of them. Particular attention should be paid to the research sample - panel studies taking into account cultural differences, age, gender and the type of school attended by the respondents seem particularly interesting in the future. The undertaken research topic is undoubtedly worth exploring and more extensive research.

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