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The Impact of Education on Innovative Economy
Polish Experiences

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Methods and concepts of innovation performance are widely analyzed, discussed, and evaluated. The influence of educational management on the creation of innovative economy is not widely described in literature, however, procedures of innovation performance include the measures of educational elements. The paper discusses the methodology of European Innovation Scoreboard (EIS) and Innovation Union Scoreboard (IUS) in the aspect of education for innovative economy. Educational indicators in EIS/IUS methodology are quantitative and do not include information about the quality of education. Researchers agreed that innovation processes and economical growth require well-educated and skilled workforce and they assume that skilled workers are on output of the educational system. The measurement system of innovations in Europe includes various economical aspects, allows to observe trends and gives opportunity to improvement for countries and is directed on future educational effects. Quantitative indicators allow to observe trends, educational needs, desires of pupils, and their parents. The efficiency of these indicators is presented on the example of Poland. Educational indicators to improve innovation performance should be very synthetic, but cannot lose important information. The article presents author's research on graduate career paths and suggests to include elements of this methodology in the measurement system of innovation economy.

Keywords: measurement system of innovative economy, Innovation Union Scoreboard (IUS) methodology, efficiency of education, educational strategies, education for labour market requirements, educational management

Introduction

Economic crisis in Europe, especially in Greece, Portugal, Spain, and Italy inclines towards research on areas of economic development, firms' competitiveness, and related determinants. Innovation performance methods and tools are widely analyzed, discussed, and evaluated. The discussion about those problems omits many important aspects connected with education. It seems that only education at tertiary level has an influence on the innovation economy, which is absolutely not true. Only the necessity of high quality of education on university level is analyzed as one of the elements of innovative climate. The role of education on the secondary level is not mentioned in discussions about development of economy at all. One of well-known and popular methodology is the Innovation Union Scoreboard (IUS)—analyzed in this article.

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The impact of educational management on innovative economy is not widely described in scientific literature, however, procedures of innovation performance include measures of educational elements but they are connected only with aspects of higher education.

All processes in the educational area play a great role in preparation of graduates to enter the labour market. Career development of young people cannot be accidental, especially in the difficult economical situation in Europe and should be supported by specialists and experts. Educational researches mainly are focused on teaching and behavioural problems. Projecting and modelling of educational processes and activities can adjust education to economies' needs and requirements. This is connected mainly with school nets planning, structure of vocational and general education, system of vocational advisory, and evaluation of educational performance methods.

The research questions in this article are[1]:

(1) What educational aspects are included in the measurement system of innovative economy?

(2) Are the IUS indicators effective and reliable in educational area?

(3) How to improve performance of innovations by performance of education?

The article argues research questions on the basis of:

- Analysis of educational indicators in European Innovation Scoreboard (EIS) reports from 2006 till 2009 and IUS reports of 2010 in the aspects of education;
- Analysis of information given in EIS and IUS reports for educational systems and for the economy. Discussion of role and the influence of educational indicators in the creation of innovative economy and for competitiveness of countries;
- Research on graduates' careers of post lower secondary schools and secondary schools and research on labor market. Methodology and research preparation were divided into following stages: sampling, choose of forms and measurement methods, creation of measurement tools, and evaluation of tools. Research population of graduates: 649 last year pupils in lower secondary school and all types of secondary schools (basic vocational school—BVS, technical and vocational secondary school—TVSS, general secondary school—GSS, and general secondary school with profile—GSSP). The population of employers of graduates—216 firms.

Basic information on population is included in Table 1.

Table 1

Number and Percentage of Surveyed Pupils

Lower secondary school	GSS	GSSP	TVSS	BSV	Together
159	123	25	132	210	649
24.50%	18.95%	3.85%	20.34%	32.36%	100.00%

Note. Source: The author's own study.

As the data were also used the results of the author's study on educational strategies and on organization of vocational education in Poland carried out from 2009 to 2012.

Performance of Innovations

Methodology of performance of innovation was introduced in 2000 year by European Commission and has been constantly evaluated (EIS 2006-2009 and IUS 2010). The advanced proposal is based on various, integrated indicators including educational aspects, activity of researchers, financial support, business activity

[1] The main thesis of the article was presented on 52th ERSA Congress in Bratislava (August 2012)

in creation: the innovations, transfer of technology. In EUS report 2010, indicators are grouped into three areas and eight dimensions (see Table 2).

Table 2

IUS 2010

Areas of innovation	Dimension	Indicator
Enablers	Human resources	New doctorate graduates
		Population completed tertiary education
		Youth with upper secondary level education
	Open, excellent, and attractive research systems	International scientific co-publications
		Scientific publications among top 10% most cited
		Non-EU doctorate students
	Finance and support	Public R&D expenditure
		Venture capital
Firm activities	Firm investments	Business R&D expenditure
		Non-R&D innovation expenditure
	Linkages & entrepreneurship	SMEs innovating in-house
		Innovative SMEs collaborating with others
		Public-private co-publications
	Intellectual assets	PCT patent applications
		PCT patent applications in societal challenges
		Community
		Community designs
Outputs	Innovators	SMEs introducing product or process innovations
		SMEs introducing marketing/organisational innovations
	Economic effects	Employment in know ledge-intensive activities
		Medium and high-tech product exports
		Know ledge-intensive services exports
		Sales of new to market and new to firm innovations
		Licence and patent revenues from abroad

Note. Source: IUS (2010).

The complete and advanced methodology allows to measure innovations, compared particular countries and indicates those elements which are important in the creation of innovative climate.

Analysis discusses the effectiveness of the indicators in the educational area of IUS methodology demand to summarize particular measures. In 2006 and 2007 educational indicators were following (EIS, 2006, 2007):

(1) New science and engineering (S&E) graduates per 1,000 population aged 20-29 (post-secondary education graduates in life sciences, physical sciences, mathematics and statistics, computing, engineering and engineering trades, manufacturing and processing and architecture and building);

(2) Population with tertiary education per 100 population aged 25-64;

(3) Participation in lifelong learning per 100 population aged 25-64. Lifelong learning means participation in any type of education or training course during the four weeks prior to the survey;

(4) Youth education attainment level (percentage of population aged 20-24 has completed at least upper secondary education).

In 2008 and 2009 educational indicators were following (EIS, 2008, 2009):

(1) S&E and social sciences and humanities (SSH) graduates per 1,000 population aged 20-29 (first stage

of tertiary education). In comparison with 2006 and 2007, the indicator includes additional information of SSH graduates;

(2) S&E and SSH doctorate graduates per 1,000 population aged 25-34 (second stage of tertiary education). This indicator did not appear in 2006 and 2007 years;

(3) Population with tertiary education per 100 population aged 25-64;

(4) Participation in lifelong learning per 100 population aged 25-64;

(5) Youth education attainment level.

Indicators 3, 4, and 5 are repeated from previous reports.

In 2010 educational indicators were following (IUS, 2010):

(1) New doctorate graduates per 1,000 population aged 25-34 (border definition than EIS 2009);

(2) Percentage of population aged 30-34 has completed tertiary education;

(3) Percentage of youth aged 20-24 has attained at least upper secondary education.

Table 3

A Comparison of the Indicators in the EIS 2009 and IUS 2010

EIS 2009	IUS 2010	Comment
S&E and SSH graduates per 1000 population aged 20-29		EIS 2009 indicator has been used only once
S&E and SSH doctorate graduates per 1000 population aged 25- 34	New doctorate graduates per 1000 population aged 25-34	IUS 2010 has broader definition than EIS 2009
Population with tertiary education per 100 population aged 25-64	Percentage of population aged 30-34 has completed tertiary education	In IUS 2010 age group is more precisely defined than in EIS 2009
Participation in lifelong learning per 100 population aged 25-64		EIS 2009 indicator has been used only once
Youth education attainment level	Percentage of youth aged 20-24 has attained at least upper secondary level education	IUS 2010 and EIS 2010 have different names but are identical

Note. Source: The author's own study on the basis of EIS 2006-2009 and IUS 2010.

Methods of calculating the EIS and IUS indicators in the area of education have not evaluated much since 2006.

Other new concepts of measurement of innovations supplement the IUS methodology with a wide range of indicators and determinants, but also do not pay a big attention to educational tasks. Laforet (2011) proposed a framework of organisational innovation and outcomes, including drivers of innovations, positive and negative outcomes of product, process and ways of working, innovation and impact of innovation on the business financial performance. Laforet (2011) investigated that innovation capacity is determined by resource, collaborative structures and processed, skilled workforce. Especially employers with higher education level and clear growth objectives can create innovation with their knowledge and experience. Accordingly to Murat Ar and Baki (2011), there are seven drivers of innovation described creative capability, connected with employment creativity—an effect of additional trainings for employees. Zientara (2008) proved that knowledge-based economy requires well-educated and skill labor. Barro and Sala-I-Martin (1995) highlighted the role of investment in human capital and education on economical growth. Prystrom (2012) analyzed the Swedish system of innovation. In this system education at each level is a very important element with a great impact on culture and society, especially quality of education, innovations and creativity, rick and tolerance, entrepreneurship, knowledge of D&R activities—other elements of system of innovations.

The big role of human capital in the innovative economy is widely analyzed and understood. Researchers

are agreed that innovation processes and economical growth require well-educated and skilled workforce and they assume that skilled workers are on output of the educational system. However, all educational indicators are quantitative and do not include any information about the quality of education. The measurement system of innovations in Europe includes various economical aspects, allows to observe trends and gives opportunity of improvement for countries and is directed on future educational effects (e.g., number of patents or number of innovative companies). Indicators of number of graduates, population in a particular level of education allow to observe trends, educational needs, desires (dreams sometimes) of pupils and their parents.

The advantages of the EIS/IUS system belong to:

- Gathering the data to calculate indicators is easy;
- Objective entrance data for indicators are based on public statistics;
- Structure of indicators and the measurement system, divided into three complementary areas is clear and easy to analyse;
- Ability to compare indicators between countries;
- Ability to observe results in particular countries (improvement of innovation in comparison with other countries);
- Easy to use by governments and local authorities;
- Tool for governments and local governments that can support making decisions.

The disadvantages of the EIS/IUS system belong to:

- Containing only quantitative data;
- Do not include information about the quality of education;
- Do not refer to studies on quality of education;
- Do not present complex methodology of measurement of innovation;
- Provides general information about trends in education worth for making strategic decision on the governmental level but this will not support making decisions on local government.

EIS/IUS Educational Indicators on the Example of Poland

Efficiency of EIS/IUS educational indicators is presented on the example of Poland. Since 2006 Polish indicators in the area of education have improved, seem to be better (see Table 4).

Table 4

Comparison of EIS 2006-2009 and IUS 2010 of EU and Poland (PL)

	2006		2007		2008		2009		2010	
	PL	EU	PL	EU	PL	EU	PL	EU	PL	EU
New S&E, SSH graduates	9.4	12.7	11.1	12.7	52.9	43.3	56.5	40.4		
Population with tertiary education	16.8	22.8	17.9	22.8	18.7	23.5	19.6	23.5	32.8	32.3
S&E and SSH doctorate graduates					0.86	1.11	0.7	1.03	0.9	1.4
Participation in lifelong learning	5	11	4.7	9.6	5.1	9.7	4.7	9.5		
Youth education attainment level	90	76.9	91.7	77.8	91.6	78.1	91.3	78.1	91.3	78.6

Note. Source: The author's own study on the basis of EIS 2006-2009 and IUS 2010.

Author's researches draw a conclusion that despite the indicators have increased, the quality of education decreases: Employers state that graduates' knowledge, skills, and abilities do not meet their requirements and graduates very often plan their careers accidentally (see Table 5).

Analysis bring a new question: How to measure the educational area to improve innovation performance?

Table 5

EIS/IUS Indicators in Author's Studies

Information from EIS and IUS	Conclusion of author's studies
Increasing number of S&E, SSH graduates	Studying is more and more popular, there is observed society's belief that "everybody can study". Industry, manufactures—generally labour market—are looking for qualified workers with particular skills, knowledge, behaviour, and attitudes. The increasing number of university graduates does not mean that their qualification has increased. Innovation economy need high skilled, qualified workers on each level of degree but not only graduates with a diploma.
Population with tertiary education	This is a trend and does not have direct influence on innovation. Youths' ambition increases, which is not always connected with their predispositions and labour market expectations.
S&E and SSH doctorate graduates	The more universities graduates in Poland—the more doctorate students and graduates. When the results of dissertation (conclusions, models, tools, or methods) can be implemented, it is the support or source of innovation. If it provides new studies, knowledge then there is an influence on innovation. The number of doctorate graduates without any additional information does not have an impact on innovation.
Participation in lifelong learning	This comes from economical requirements and can influence on innovation. The more flexible, creative, educated, and skilled are workers, the more innovative can be a firm and then entrepreneurs can introduce changes easily and quickly. Participation in lifelong learning presents the attitudes of workers.
Youth education attainment level	Monitoring of results of exams gives internal knowledge of quality of education. This is only effectiveness of teaching. This indicator can be more effective if compared with research on quality of education carried out among graduates and employers. This indicator can also be improved by additional measurement of self-employment. Methodology of Tyrowicz and Nestorowicz (2012) can be successfully implemented in measurement of "youth education attainment level".

Note. Source: The author's own study.

Methodology of Research on Graduates Careers

Quantitative indicators of IUS are useful but not sufficient. There is a necessity to complement them with qualitative indicators. Any indicator of the amount of graduates of a particular type of school does not give an exact information. We can observe particular trends connected with career planning of graduates of different types of schools. But we have not received an accurate knowledge on the subject of the decision process and data flows.

Author's research confirms the increasing tendencies of EIS and IUS indicators (see Table 6).

Table 6

Educational Aspirations of Lower Secondary Schools Graduates

Choice of school (first priority)	Percentage (%)
General secondary school (GSS)	36.48
General secondary school with profile (GSSP)	1.89
Technical and vocational secondary school (TVSS)	30.82
Basic vocational school (BVS)	10.06
Other	2.52
Undecided	21.38

Note. Source: The author's own study.

Educational aspirations of graduates of every type of secondary schools are connected with career paths. Most pupils are going to continue education (see Table 7).

Table 7

Educational Aspirations of Secondary Schools Graduates

Educational aspirations of graduate	BVS	TVSS	GSSP	GSS
Work in learnt occupation	35.80%	36.19%		
Work in any job	31.48%	37.14%	16.87%	20.00%
Emigration for work	20.99%	22.86%	12.05%	20.00%
No explicit plans of career	0.62%	3.81%	1.20%	0.00%
To begin own business	8.02%	13.33%	4.82%	4.00%
Continuation of education	36.42%	43.81%	96.39%	60.00%
Undecided	7.41%	8.57%	2.41%	16.00%
Other plans	3.70%	3.81%	3.61%	12.00%

Note. Source: The author's own study.

The tendencies are natural and understood in general secondary schools with the profile. The role of those schools is preparing pupils to continue education. Population of 96.39% pupils of GSS and population of 60% pupils of GSSP wish to continue education. A lot of pupils in both types of vocational school graduates are going to continue education. Despite the vocational schools are focused on preparing its pupils to enter the labor market, TVSS graduates choose universities and BVS graduates wish to continue education usually in their occupation in technical vocational schools.

Those processes demand changes. A population of 17.28% BVS graduates and 30.47% TVSS graduates are not intended to take up employment (see Table 8).

Table 8

Career Paths of BVS Graduates and TVSS Graduates

Educational aspirations of graduate	BVS	TVSS
Work and education	23.46%	38.09%
Education without taking up an employment	12.96%	5.72%
Not intend to take up employment	17.28%	30.47%

Note. Source: The author's own study.

Reaching following levels of degree is very important. Well-educated graduate has more opportunities on the labour market. Employers are searching for qualified workers with particular skills, qualifications, and behaviours. Role of school is not only prepared to play a role in the economy. During many school years, young people learn to exist efficiently in society, to work, to actively participate in social and public life. Population of 17.28% BVSs and population of 30.47% TVSs graduates do not want to take up an employment. But, anyway, it is not a bad result in the situation on many difficulties with unemployment of young people. Studies pointed out that many interviewed in basic vocational schools work in their occupation in their free time.

To make educational management more effective in local governments, there is necessity to analyse not only graduates choices and educational needs but also the reasons and determinants of those decisions. They are made mostly independently. From 10% to 33% interviewed point out the role of family and friends in those decisions. Educational system helped in the area of vocational advisory (tutors, teachers, pedagogues, and vocational advisors) is small.

Education quality is impossible to measure only with EIS/IUS quantitative indicators. External examination results seem to be satisfied in Poland (see Table 9) and, so far, they are considered as the most

important indicator of education quality. But nobody discusses that completion of the matriculation exam covers 30% of right answers and, it is just easier to pass matriculation exam at the basic level.

Table 8

Results of Matriculation Exam in PL and in Silesia Region Between 2006 and 2010

	2006	2007	2008	2009	2010
Percentage of passed exams in Silesia Region	80.07%	89.99%	80%	81.18%	79.37%
Percentage of passed exams in Poland	79%	90%	79%	81%	81.50%

Note. Source: Reports of Central Examination Commission in Poland.

Ministries of education introduces a measurement system of value-added educational indicator, based on a comparison of the results of the beginning education and at the end of education in a particular school. But this is still internal measurement, which do not contain elements of labour market research. On the other hand, employers are now satisfied with graduates of secondary school qualifications, skills, and knowledges (see Table 10).

Table 10

School Graduates Skills and Competencies in Opinion of Employers

Category	Note					Average
	(5)	(4)	(3)	(2)	(1)	
Theoretical knowledge	4	22	30	6	2	3.31
Practical knowledge & skills	5	20	23	15	1	3.20
Additional skills—certificates	1	13	22	20	7	2.70
CV & others	2	14	22	16	6	2.83
Presentation	4	30	20	9	7	3.21
Independence at work	7	27	16	7	4	3.43
Motivation for work	8	26	23	6	1	3.53
Creativity	7	26	18	8	2	3.46
Teamwork	14	31	12	5	1	3.83
Ability to make decisions	4	23	16	13	6	3.10

Note. Source: Pradela, Wilińska, & Kaźmierczak (2012).

On the example of Poland, the IUS indicators of educational area do not give an exact and sufficient information about particular elements. IUS indicators present trends but they should be supplemented by genesis and determinants of them. The education has an impact on innovative economy and should be measured precisely and deeply.

Conclusions

The area of education cannot also be limited to the use of few quantitative indicators. Educational indicators improved innovation performance should be very synthetic, but cannot lose important information. Information on the quality of education for an innovative economy comes from both sides: graduates (they are students, workers, or employers—active participants of labor market and economy) and labour market. Research on graduates can be carried out in five cycles: The first internet questionnaire will be sent a year after completion the school and repeated three times every five years. Evaluation of educational process at school will be carried out in particular categories: evaluation of proper preparation to work at your occupation/evaluation of proper preparation to continue education; recommendations of the school, for younger

friends or for graduates' children; support of creativity, innovation at school; work in accordance with qualifications or below qualifications; level of salary and job satisfaction. Research among employers will help to get information about the firms' perspective of development and the opinion about graduate qualification in various categories.

Indicators based on answers for above question can supplement innovation performance methodology. The concept can be firstly develop and tested in local governments, responsible for educational management in their areas, however, it can be extended in every educational system.

Discussion on the level of innovation, development, competitiveness, entrepreneurship should not be limited to analysis of rankings and particular indicators. The real information for the improvement and development comes from research on reasons and sources of particular phenomenon or process.

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