ADULT MATHEMATICAL COMPETENCE IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT: CASE OF BALTIC STATES

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Mathematical competence is one of the eight basic key competencies which are defined by EU Directives. Mathematical competence includes the skills of applying basic processes and principles of mathematics in everyday contexts. The aim of current research is to identify the role of adult mathematics education and mathematical competence in sustainable development in case of Baltic States. We are continuing the investigations that began in the Nordplus research project “Cooperation to strengthen the citizens’ math skills in the context of sustainable development and welfare”. The main objective of the research is to highlight the role of mathematics in a lifelong context. We separate two aspects of mathematics role in sustainable development. The first considers mathematics as a tool in processional work, the second considers the role of mathematical competence in the development of person’s intelligence and personality. Both aspects are widely discussed in the scientific literature and in the programmatic documents of United Nations, United Nations Educational Scientific and Cultural Organization, Organisation for Economic Cooperation and Development. Through combining insights of theoretical goals of leading international institutions and actual survey data we can show the value of mathematical competence in adults in the Baltic States.

Keywords: employees, employers, mathematical competence, sustainable development

INTRODUCTION

The present paper aims to discuss contemporary theory on sustainable development, mathematical competence and show these alongside actual survey data from the Baltic States. In this paper we apply the concept of sustainable development defined as “… development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (UNESCO, 1987)

Sustainable development is a complex issue that many international agencies are working on, including the UN’s implementation of the Agenda for Sustainable Development (UN, 2016), which addresses important global challenges for the next fifteen years, and includes 17 goals that are crucial to sustainable development and covers economic, social and environmental development.

These 17 goals have 169 targets (UN, 2015) and they heavily focus on human rights of all people and gender equality. The UN understands the importance of education therefore the goal (the proposed Sustainable Development Goal (SGD) 4) that is the most applicable to the issue looked at in this paper is this :’’’Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” (SGD4) and its corresponding targets.” (UN, 2016) The data shown later in this paper show how mathematical education for adults impacts their work prospects and it could be assumed that all people in the Baltic States have access to various forms of education. Education is the key to sustainable development because it gives people a vision of future that focuses on equity, economy and ecology in all communities (Tillbury, Wortman 2004) and these are goals that should be important worldwide.

The OECD framework defines four types of “capital”: natural capital, economic capital, human capital and social capital. (OECD, 2017b) One aspect of human capital is education that UNESCO (2017) sees as a “.. public good, a global common good ..” and this shows that large international policy institutions see the importance of education in development. In 2012 UNESCO added a fifth pillar of education – learning to transform oneself and society to the four existing education pillars of learning to know, to do, to live together and to be (UNESCO, 2012).
In education mathematical knowledge plays a big role. The EU Recommendation on Key Competences for Lifelong Learning defines that: “Mathematical competence is the ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations.[...]. An individual should be able to reason mathematically, understand mathematical proof and communicate in mathematical language, and to use appropriate aids. A positive attitude in mathematics is based on the respect of truth and willingness to look for reasons and to assess their validity.” (EU, 2006)

A survey of people of the Baltic states about citizen’s math skills was carried out during the Nordplus project “Cooperation to strengthen the citizens' math skills in the context of sustainable development and welfare”.

In this paper we aim to give an insight into survey questions and the respondents' answers in a systematized, analyzed and interpreted way. The aim of the research is to identify the role of mathematics in the sustainable development in the lifelong learning context. We separate two aspects of mathematics role in sustainable development. The first considers mathematics as a tool in professional work, the second considers the role of mathematical competence in the development of person’s intelligence and personality.

RESEARCH METHODS

The research is based on analysing and evaluating scientific literature and documents of European Union (EU), Organisation for Economic Cooperation and Development (OECD), United Nations (UN), United Nations Educational Scientific and Cultural Organization (UNESCO), World Economic Forum (WEF). The econometric calculations are taken from the Statistical Office of the European Communities and part of the European Commission (EUROSTAT) and OECD.

We utilize the results of the Nordplus project “Cooperation to strengthen the citizens' math skills in the context of sustainable development and welfare” which were obtained during the survey of the inhabitants of the Baltic States: Estonia, Latvia and Lithuania in 2014. The basic issues of the survey emphasized the role of mathematics in everyday life and the significance of mathematical knowledge in the labour market, and the respondent's professional career. Some aspects of survey touched upon the evaluation of respondent's attitude towards lifelong learning, personality development, the role of mathematical knowledge in general and in particular. The research is based on fully-completed 878 respondents’ answers provided during the survey. 649 respondents’ completed employee questionnaire and 229 respondents filled out the employers’ questionnaire. (For detailed survey data see: Vintere, A., Balode, I., Čerpajeva, S., Rimkuviene, D., Aruvee, E., Ideon, E. 2014. Transnational Comparative Study on the Math Educational Needs in Baltic States).

RESEARCH RESULTS AND DISCUSSION

The Technical Report of the Survey of Adult Skills (PIAAC) defines numerate behaviour as “…behavior founded on the activation of several enabling factors and processes: mathematical; knowledge and conceptual understanding; adaptive reasoning and mathematical problem-solving skills; literacy skills; beliefs and attitudes; numeracy-related practices and experience; context/world knowledge.” (OECD, 2016c)

34 countries/economies participated in the last PIAAC (The Programme for the International Assessment of Adult Competencies) survey including Estonia and Lithuania; Latvia did not take part in this survey. In Estonia and Lithuania the numeracy skills (273 and 267, respectively) are above the average level of OECD countries, which is 263 (mean score). In Estonia and Lithuania gender differences in numeracy skills are small (OECD, 2016a).

In this paper we have chosen to separate two aspects of the role of mathematics in sustainable development into two parts: mathematical competence in the development of the person’s intelligence and personality and as a tool in work environment.

Worldwide literature discusses the person’s intelligence and personality, its formation, development and progress; special emphasis is put on the role of mathematical education. Willy Servais (1957) pointed out that: “Amid the intellectual properties, which mathematics develops, most often are mentioned those referring to logical thinking, namely, it is ability to reason deductively, ability to abstract, generalize, classify, ability to think, analyze, criticize.” Today’s researchers agree with this statement, because mathematics is a unique construction of human thought and it has many connections to our daily world in both every day and advanced science. (Gustafsson, Mouwitz, 2004)

In World Economic Forum report “The Future of Jobs Employment” identified 10 top skills: Complex Problem Solving, Critical Thinking, Creativity, People Management, Coordinating with Others, Emotional Intelligence, Judgement and Decision Making, Service Orientation, Negotiation, Cognitive Flexibility (WEF, 2016a, 2016b). In our opinion these skills: Complex Problem Solving, Critical Thinking, Creativity, Decision Making, Cognitive Flexibility can be developed with help of mathematical education. From a professional point of view the mathematical skills can be considered as an absolutely necessary tool for fulfilling the tasks at job. Experts expect employment growth in the STEM fields and a significant decline in Office and Administrative roles. “Among tertiary-educated adults in OECD countries, an average of 25% have studied in STEM fields. However, there are big differences across countries, ranging from 20% or less in Costa Rica, Iceland and the Netherlands to 30% or more in Austria, Estonia, Germany and Spain.” (OECD, 2017a)

The further data research is based on statistics of 27 European countries: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom.

The Database of OECD Programme for International Student Assessment (PISA) was chosen for this research. PISA is aimed at testing literacy in three competence fields: reading, mathematics, and science. The results of PISA 2015 (OECD 2016b) are used: mean score in mathematics; share of low achievers in mathematics (Below Level 2); share of top achievers in mathematics (Level 5 or 6). The highest numbers of low achievers in 2015 were in Bulgaria (42.1).
At risk

Studying mathematics develops logical thinking, or personality development and for professional skills. The statement “A person, who understands mathematics, will easily master most jobs that require them” was allocated as mostagreeable for professional needs. Of the people surveyed, 95% in Estonia, 86% in Latvia and 90% in Lithuania agree in full or partly to this statement. In the private sector 89%, in state owned enterprises 96% and 93% in local government of people surveyed agree in full or partly to this statement. In private sector 87%, in state owned enterprises 96% and 92% in local government of people surveyed agree in full or partly to this statement. In the private sector 89%, in state owned enterprises 96% and 93% in local government of people surveyed agree in full or partly to this statement. In private sector 87%, in state owned enterprises 96% and 92% in local government of people surveyed agree in full or partly to this statement.

CONCLUSIONS

Both the earlier Nordplus research and its continuation show empirical evidence of the importance of the OECD, UN, UNESCO, EU and WEF documents quoted here. The research shows that adult mathematical competence encourages continuous education and makes it easier, thus support in a potential career change.

The research also shows that both employees and employers highly value mathematical competence both for personality and professional development.
However, it also shows that the adult mathematical competence in the Baltic states needs further improvements via modern teaching methods.

REFERENCES


