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STEM Education Policies and their Impact on the Labour Market in Latvia

Abstract

This paper explores the results of implementing the state education policy aimed at satisfying the labour market demand for engineering and medicine specialists via strengthening STEM (science, technology, engineering, mathematics) education both in schools and higher education.

Keywords: OECD PISA, STEM education, higher education, labour market

Introduction

Education serves the development of society, state and economy, therefore education policy has far-reaching consequences for all citizens. However, it is important to ensure that government education policies are based on the results of research and education quality assessment. Thus they have a large potential for implementing effective reforms in education (Slavin, 2008).

Since the late 1990s the acronym STEM has been widely used in policy papers to describe studies in science, technology, engineering and mathematics in a context of educational policies aimed to strengthen these fields of study. It was introduced in the United Sates, a country that historically has been amongst the leaders in technologies. However, it was found that fewer students have been focusing on these topics recently: only 16 percent of high school students are interested in a STEM career (Hom, 2014). Gaps between STEM education and labour market demands have been widely discussed. Research however focuses more on a student's skills and competencies (Jang, 2015), leaving state education policies and their impact unexplored.

In Latvia, awareness of the increasing gap between the demand and supply of engineering, construction, medicine and other STEM educated specialists on the labour market increased in the mid-2000s. At that time the Ministry of Welfare concluded that due to constant changes and rapid development it is impossible for the education system to meet the labour market demands exactly. However, the education system faces the need to be much more flexible and open to changes as it permanently lags behind the technological progress (MW, 2007). Our previous research (Gravite, 2015) showed that a permanent interaction between education and the labour market exists – driven by the needs and interests of stakeholders (educators, students, employers) – despite the lack of official policy documents and activities.

To avoid potential labour shortages in medicine, technology and engineering, several policy steps have been taken in Latvia in the past ten years to stimulate STEM education at all levels. The aim of this research is to establish whether education policy aimed at strengthening teaching of science and mathematics in schools and higher education institutions has resulted in a decrease of engineering and health vacancies in the labour market.

Research methods

In order to find out whether the education policies applied had an impact on students' achievements in schools, research results of OECD PISA were used. PISA (OECD Programme for International Student Assessment) assesses to what extent fifteen year old students, who are about to finish lower secondary education (in Latvia – basic education), have acquired the knowledge and skills necessary for a full participation in the civil society, and the ability of students to use the experience gained at school and to apply it to different life situations outside school and in further education. The objectives of PISA are to help develop and introduce evidence-based education policy and national education reforms while fostering the labour market. Therefore, the cycles of studies are regularly implemented, fully internationally verified, and comparable databases are created for analysis generating recommendations applicable to education (Kangro, 2015). To analyse changes in the Latvian students' achievements, results from PISA 2006 and PISA 2015 were used as these two research cycles were focused on science. PISA research does not simply evaluate a student's competencies in the particular subject; it also allows for judgement on his or her attitudes, motivation and values. The attention in Latvian education policy documents is focused on students' interest in continuing their education and career path related to sciences as well as developing their research skills. Therefore value changes of indexes related to the contextual factors are analysed using descriptive statistics and regression analyses. These contextual factors are:

- Science related career expectations – students were asked what kind of job they expect to have, when they are about 30 years old;
- Inquiry-based science teaching and learning practices – students reported to what extent they agree that:
  - a good way to know if something is true is to do an experiment;
  - scientific ideas sometimes change;
  - good answers are based on evidence from many different experiments;
  - it is good to repeat an experiment more than once to become sure of your findings;
  - sometimes scientists change their minds about what is true in science;
  - ideas in science books sometimes change.

To clarify whether education policies had an impact on the higher education and the labour market, i.e. whether the number of those studying and taking jobs in areas related to STEM education increased, two sets of statistic data were analysed and compared covering the period from 2006 till 2016. The Latvian Central Statistics Bureau databases were used to track changes in the labour market: rates of employment and vacancies in two areas corresponding to science and mathematics in education; engineering and health. Data on the number of students and graduates and the level of state finance support in both fields were found in the statistical annual reports on higher education prepared by the Department of Higher Education of the Ministry of Education and Sciences.

Education policy

Advanced research, innovation and higher education has been prioritized as one of the key courses of action in National Development Plan of Latvia for 2014-2020 (CCSC, 2012). The main aim of STEM policy is to shape science and technology as bases for the sustainable development of the civic society, economy and culture. The plan considers the development of science and technologies to be a determining factor for economic sustainability, prosperity of the Latvian society and the preservation of environment and natural resources (MK, 2015).

STEM has been prioritized in policies of all levels of education in Latvia. During the past ten years a number of reforms were implemented:

- new state standards were developed for all levels of education;
- state budget financing in the higher education was redistributed in favour of STEM areas;
- mandatory centralised exam in mathematics was introduced for the secondary education graduates;
- a project ‘Sciences and Mathematics’ (funded by the European Structural Funds) was carried out in both primary and secondary schools in order to:
  - encourage children’s interest in natural sciences and mathematics;
  - exercise activities to change approaches to STEM education;
  - develop students’ research skills;
  - create and deliver new electronic and printed teaching materials to schools;
  - provide professional development to teachers.

Changes in students’ performance (PISA results)

PISA research evaluates students’ performance in three fields, mathematics, reading and science. One of them is singled out as the main field in each research cycle. Science was outlined for the first time in PISA 2006. Therefore the results of PISA 2006 are used in this research as a point of reference for establishing how students’ performance has changed in 2015 as all significant reforms in STEM education in Latvia took place after 2006. PISA 2015 focused on science as the major domain too, and defines science literacy as ‘the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen’. This requires the competencies to explain phenomena scientifically, to evaluate and design scientific enquiry, and to interpret data and evidence scientifically (OECD, 2016, p. 50).

The metric for the overall science scale is based on a mean for OECD countries of 500 points and a standard deviation of 100 points that were set in PISA 2006. The items that are common to both the 2006 and 2015 test instruments and were found to measure science literacy comparably in the paper and computer-based modes, form a link with the earlier scale.

The average Latvian student’s performance in science is measured as 490 points both in PISA 2006 and PISA 2015 and they are not statistically significantly different from the OECD average. The average three-year trend for the mean, used in PISA to track changes in students' performance, is the average rate at which a country's mean score in science has changed over consecutive three-year periods throughout its participation in PISA assessments (OECD, 2016). In Latvia the average three-year trend in science performance is 1.1 points, which means that our students' performance has not changed statistically significantly during last the ten years.

In order to be successful in science students need to have research skills and also knowledge of the role of research and connection with the development of science and innovations. PISA 2015 allows the definition of these skills using an index of inquiry-based science teaching and learning practices. For Latvian students the value of this index is 0.16. This means that our students have given concurring answers more often on formative questions of this index than students in OECD countries on average, determined as 0. However, a negative correlation has been found between the index of inquiry-based science teaching and learning practices and students' performance: if the value of index increases by one point, a student's performance in science decreases by 12 points. This means that either students' research skills or their ability to apply these skills in practice are not sufficient. Thus it is evident that the goals of ESF project 'Science and Mathematics' have been reached only in part.

Students' interest in science influences their willingness to build a carrier path in science in future. A question about their future profession asked students to imagine where they will be working at age 30 was included both in PISA 2006 and PISA 2015 questionnaires. Professions related to science were grouped as:

- science and engineering professionals;
- health professionals;
- information and communication technology specialists;
- science-related technicians and associate professionals.

Only 20% of Latvian students have expressed interest in choosing their career in these professions in PISA 2015. Comparing with PISA 2006, there is a slight increase from 17%, however, as on average in all OECD countries, it was caused by increased interest in health professions. In Latvia willingness to choose a career in health has risen by 5.4 percentage points (from 3.9 in PISA 2006 to 9.4 in PISA 2015), whereas interest in science and engineering has decreased (from 8.5% in PISA 2006 to 7.2% in PISA 2015).

Thereby PISA results show that the willingness of Latvian students to choose career paths in engineering, or related professions has not changed during the last decade. Only 7.2% of students expressed such interest, combined with those interested in information and communication technology, 10.1%, a fraction less than the average in OECD countries. However, the relative distribution of state funded study places in 2015 was intended to provide 42% for the combined study fields 'Science, mathematics and information technologies' and 'Engineering, industry and construction'. The comparison of students' willingness to study STEM and the distribution of state funds (i.e. public order) are evidence that a lot of creative efforts are needed to increase students' interest in STEM related studies and professions in secondary education level, as at the age of fifteen student's professional desires are far from education policy makers' expectations.

Changes in higher education

To establish whether policies in higher education aimed at improving the chances of better meeting the labour market demand in STEM fields has generated the intended outcome, statistical data on number of students and graduates in the following two fields, health as well as construction and engineering were analysed.

Health has always had prestige and has been a popular and competitive area of studies in Latvia. However, the demand for doctors and nurses has increased in recent years due to an aging population, leading to more demand for medical care. It has simultaneously also resulted in a brain-drain: as most EU countries face similar problems; young Latvian doctors quite often find more desirable positions abroad. Between 2006 and 2016 the number of state-funded study places in health have increased from 3848 to 6519, an increase by 70%. The total amount of medical students have increased even more, by 75% (from 6810 to 11 867). The number of students who gained qualifications in health also has risen from 1254 in 2006 to 2252 in 2016, an increase of 80%.

Engineering and construction had been a popular choice for studies in Latvia until the 1990s. After the collapse of the Soviet planned economy and the resulting loss of jobs for a large proportion of specialists with technological qualifications, engineering has lost its appeal. However, since the early 2000s economic analysts in Latvia have focussed on the need for a more increased share of high value-added domestic industrial production in the country’s GDP. This led to predictions of an increasing demand for engineers and technicians in the labour market. Therefore policy makers have responded by increasing the number of state funded study places in engineering and construction by 30% (from 6857 in 2006 to 9081 in 2016).

According to the Ministry of Education statistics, the total number of engineering students has not changed significantly (the figures show a slight decrease to 12535 in 2015 from 13945 in 2009). Engineering and construction is the only field of study in Latvia where a surplus of state funded study places occurs, i.e. there are less people willing to study engineering full-time than the provided state funded study places would allow. The number of students who gained qualifications in this field also has not changed significantly. It even shows tendency to decrease in recent years, from 2596 in 2013 to 1963 in 2016.

The drop-out rate in engineering studies is the highest in Latvian higher education, reaching an average of 57%. Although this trend tends to be explained by difficult studies and decreased standards of STEM education in secondary schools, the situation in health, where students’ knowledge is based on the same STEM basis and the study period is longer and even harder, the drop-out rate on average is only 11%, rendering the above explanation questionable.

Changes in the labour market

To establish whether education policies supporting STEM education resulted in a positive impact on the labour market, we compared the dynamics of average quarterly data of job vacancies during the last decade (2006-2016) in professions corresponding to the two study fields analysed above, health as well as engineering and construction, with the Ministry of Education statistics of graduates who gained qualifications.

In both fields a rapid decrease of vacancies was detected in the years 2007-2009, by 85% in health and by 92% in engineering and construction. The number of people gaining qualifications increased by 20% in health and remained unchanged in engineering and construction in the same period. From 2009 until 2014 the number of vacancies remained unchanged, and the total number of jobs decreased by 4% in health and by 30% in engineering and construction. At the same time the number of people gaining qualifications doubled in health and increased by 30% in engineering and construction. In 2014 new vacancies appeared in health, reaching 2% of total jobs in the field (back to the level of 2006) whereas in engineering and construction it remained unchanged at the level of 0.3%. The total number of jobs reached the level of 2007 in 2013 in health and in 2014 in engineering and construction. Since 2013 the number of jobs increase by approximately 2000 a year in both fields, and the number of people gaining qualifications roughly is the same.

Thus our research did not establish a strong interaction between the education policy and processes on the labour market in STEM-related fields. It is more likely that the dynamics observed in job vacancies were caused by the economic crisis of 2008 and a rapid increase of unemployment.

Since 2014 there is a growing demand for specialists both in health and engineering. In engineering and construction this demand statistically is covered by those gaining qualifications. This means that state funding provided for engineering and construction studies is sufficient, probably even exaggerated as 57% of engineering and construction students do not finish their studies. Fewer state funded study places would increase competition amongst students and consequently the quality of their education. In the health professions labour market demand leads to growing number of vacancies as the number of people joining the labour market after gaining qualifications is diminished by the brain-drain. This problem cannot be solved by education policy alone.

Conclusion

Education policies aimed to strengthen STEM in primary and secondary education in Latvia have not reached their goals as STEM competencies and research skills amongst students have not increased. Consequently, there are no changes in popularity of STEM related study areas in higher education and professional preferences of students. Medical professions have sustained their popularity, whereas engineering still remains unpopular, despite a sizable increase of state funded study places.

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