Chapter 4

The Role of Higher Education Institutions in Developing Innovation Skills Among University Students

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Abstract: Higher education institutions (HEIs) play an important role in the advancement of knowledge, social and economic progress. Through a literature review a list of 18 competences which are a good compromise between the requirements for standardization and the multifariousness of innovation competences was developed. Innovation depends on people who are able to generate and apply knowledge and ideas in the workplace and in society at large. Fostering critical thinking, creativity, and behavioural and social skills should be viewed as central elements of schools, colleges and universities. Developing creativity and resilience has been difficult due to pressure from the government for schools and students to report good tests results. The chapter is rounded up with some practical recommendations for HEIs regarding the development of innovation skills.

Keywords: Higher-Education Institutions, Universities, Higher Education, 21st Century Skills, Innovation Management

Introduction

Higher education institutions (HEIs) play an important role as contributors to the overall science and technology performance. Scientific publications and patents are, however, only intermediate outputs of research. Their general purpose is the achievement

of broader goals in the advancement of knowledge and achievement of social and economic progress. A well-educated cohort of university graduates equipped with innovation skills will have a much stronger impact on the overall performance of an economy than an elite of innovators without followers. Thus, the development of innovation skills should play an equally important role as one of the key outputs of HEIs. Science and technology (S&T) are recognised as producing tangible (e.g. new technological artefacts) and intangible (knowledge, skills, education etc.), codified (publications, patents, technical blueprints etc.) and tacit outputs (skills, cultural predisposition towards innovation, ways of approaching problems etc) (Sullivan, Sullivan Sr, 2000; Barré et al., 2002). Innovation skills are considered as *tacit outputs* here. The main purpose of this chapter is to highlight the role of HEIs in shaping the future innovation performance of economies through the delivery of educated R&D personnel working not only in the S&T sectors but also in other types of organisations. It is argued that HEIs underutilize their potential in the development of innovation skills among students by focusing on the development of knowledge rather than innovation skills and competences. It is argued that the development of innovation skills by HEIs should gain in importance. HEIs should re-design their curriculums and syllabuses to meet the demands of the 21 century labour market and Industry 4.0. Through a literature review a list of competences which are a good compromise between the requirements for standardization and the multifariousness of innovation competences was developed.

The case for innovation skill development in HEIs

A popular distinction used in measurement models in the social sciences is the division between input indicators and output indicators. Input indicators should, in principle, measure the resources mobilized with an expectation to achieve certain results. Output indicators measure the quantity of goods and services produced and the efficiency of their production. However, the quality of these goods and services is often subjective and depends on the priorities and the context. Human Capital development is one of the major functions of universities. High added-value in Human Capital formation does not always correspond, however with the development of innovation skills.

Part of the reason that the well described and defined innovation skills will pave the way to school reforms focused on the 21st century are the requirements of the job market. Therefore university teachers need to develop their teaching skills around our list of innovation skills. On the other hand, HEIs lack clear definitions and guidelines on what innovation skills are.

Many countries around the world, especially in Asia and Africa started developing their higher education systems only recently. Such situations offers an opportunity to structure the higher education systems in a manner different to those in Europe where innovation skill development is not an important output (with the exception of Germany). For countries such as Kazakhstan or Malaysia, the creation of a competitive higher education system is a fairly new experience. Even within the Western world, the context for higher education may vary depending on the tradition (Leitner, 2005; Leitner, 2007,

pp. 97–105) Koch points to three traditions of university development, each of which comprise a different context for the measurement of HEIs' results and outputs (Koch et al., 2000):

- The German Humboldtian tradition, in which education is referred to as “scientific” (unity of teaching and research),
- The French tradition, in which education is regarded as “professional”,
- And the Anglo-Saxon tradition, which stresses the “liberal” nature of education.

Naturally the German and French traditions of university, which, incidentally is dominant in the Polish system of education, should be the most resistant any changes regarding the innovation skills agenda.

In the case of a university, as in the case of many other outputs of HEIs, there exists a substantial time lag between the moment of graduation and the observable impact on the innovation performance of their employers. Innovation skills developed in the HEIs go beyond the situation of an individual university and individual employer who has hired a university's graduate. It is often difficult, however, to distinguish between inputs and outputs. As in the Marx's example, “the pickpocket becomes a productive worker too, since he indirectly produces books on criminal law” (Marginson, 1998).

Innovation depends on people who are able to generate and apply knowledge and ideas in the workplace and in society at large. OECD countries have long recognised the need to develop skilled people through education and training. Skills for innovation can be grouped into three broad categories (OECD 2016):

- Subject-based skills, which represent knowledge in a particular field.
- Thinking and creativity, including both higher-order skills and creative cognitive habits. These competencies include critical faculties, imagination and curiosity.
- Behavioural and social skills, including skills such as self-confidence, leadership and management, collaboration and persuasion.

The innovation skills are defined very broadly depending on the research agenda and focus. Such a situation is not helpful for implementing school reforms aimed at making systems of education more adaptive to the requirements of the changing economy. According to many predictions (see for example: Beblavý 7 Veselková, 2014) the demand for high-skilled workers performing creative tasks will increase in the 21st century. We argue that the role of primary and secondary education in the development of innovation competences is somewhat overshadowed by the vastly overestimated role of higher education in the development of those skills. Many countries promote creativity and innovation in universities but the actual competences are developed at earlier stages of the education process. Therefore, it is necessary to create frameworks and agendas for innovation competency development in tertiary education.

Developing excellent subject-based knowledge is undoubtedly important for an innovative society, but it is not enough on its own. HEIs are at the front of knowledge-creation. We must not, however, lose sight of the innovation skills development as providing students with state-of-the-art knowledge does not equate with preparing them

for functioning in innovative environments, especially given the fact that we are facing a transition from the linear growth of human knowledge to exponential growth. In addition to raising academic achievement across all levels of education, HEIs need to pay more attention to which skills young people acquire. Looking at the economics and business education, possession of subject knowledge (e.g. accounting, marketing principles, coding and programming, foreign languages) is important but does not ensure that university graduates will be able to deliver added-value to innovative companies where thinking outside the box, critical thinking, ability to change mental models and re-frame thinking patterns are of paramount importance. Fostering critical thinking, creativity, and behavioural and social skills should be viewed as a central element of the remit of schools, colleges and universities (OECD 2016). Creativity and innovation are key to EU education policy (Ferrari et.al, 2009; European Union, 2010; Coate, Boulos 2012; Griffiths 2014). The words 'creativity' and 'innovation' both cover a range of meanings in English, though they tend to appear as a couple in EU policies. Moreover, the connections between the different meanings are not clear or agreed. So the terms are extremely ambiguous especially in how they relate to the purposes of education (Griffiths, 2014). Fostering creativity in education is intended to address many concerns including those in the economy. The role of creativity in the economy is being seen as crucial (Burnard, 2006) to assist nations for attaining higher rates of growth (including the catching-up processes with the most developed economies of the world), higher values and to cope with increased competition (Shaheen, 2010). Creativity is being made the focus of "curriculum and pedagogy" (Wilson, 2005) and an "official agenda" for improving schools (Burnard, 2006). Creativity is at the focus of many education reforms including Hong-Kong, China and Scotland (Shaheen, 2010). For example, in the Cultural Policy Statement by the Scottish Executive the Minister for Tourism, Culture and Sport it says that "The creativity of Scots – from the classroom to the board-room – is the edge we need in a competitive world."

Defining Innovation skills

The need to develop students' creative abilities is fundamentally important, because it is this quality that ensures skills demanded by contemporary employers (Ramankulov et al., 2016). Education policies to foster innovation have traditionally focused on increasing participation in science, technology, engineering, and mathematics (STEM) disciplines. Recently, however, a more comprehensive view of innovation has emerged which recognises the contribution of a wider set of skills and disciplines (OECD, 2016). Our understanding of creativity in the last 25 years has evolved from a belief in domain generality to one of domain specificity. In other words creative performance of an individual will vary depending on the domain. Baer (1994a, 1994b, 1994c) proved that creativity is not only content specific but is also task specific within content areas. The Consensual Assessment Technique (CAT), originally developed by Teresa Amabile (1983, 1997) and further developed by others is one method of creativity assessment, well-suited to test the domain specificity question. In order to define innovation skills a thorough literature review was conducted (Gordon, O'Toole, 2015; Alshannag, Ham-

da, 2015; Amabile, 1983; Amabile, 1997; Banaji et al. 2013; Berger, 2014; Brookhart, 2013; Cropley, 2015; Csapó, Funke (Eds.). 2017; Dror, Gershon, 2012; Erol et al. 2012; Fuller, Clarke, 1994; Hallam, Ireson, 1999; Hebert, Link. 2006; Heilmann, Korte, 2010; Herbig, Day, 1993; Kabukcu, 2015; Markides, 2013; OECD, 2011, OECD, 2015; OECD, 2016; McCrory, 2010; Muijs, Reynolds, 2011; OECD, 2014, Scott et al. 2010; Scott, Bruce, 1994; Sternberg, Williams, 1996; Ulijn, Brown, 2004; Williams, 1999; Trehan, 2017, Ray, 2019).

Surprisingly, there is no one popular definition of innovation skills. According to the “genus by difference” definition¹, innovation skills should be defined as skills which are used by organizations to make them more innovative, the skills which help the employer to achieve innovation results”. Thus, innovation skills should be defined as “skills which are used for innovation”. “Extensional” definitions simply list all the things that could be considered as an example of this. This approach is the most dominant in the literature as most of the authors of research publications and reports simply provide lists of specific skills which are labeled “innovation skills” (e.g.: Levy, Cannon, 2016; World Economic Forum, 2018). Despite the plethora of publications on innovation skills, there are surprisingly few studies covering the issue of identification of those skills. For the purpose of this discussion innovation skills will be defined according to the “Extensional” definitions, and produced below are a list of innovation skills based on an extensive literature review.

1. **Curiosity and exploring possibilities** – teaching to be curious and looking beyond the horizon; rewarding students for asking questions; teaching how not to be satisfied with the first option, encouraging curiosity about finding out what other options could be; teaching how to experiment and be open to empirical verification of one’s assumptions.
2. **Idea formation** – teaching how to develop own ideas and other people’s ideas.
3. **Problem solving** – teaching how to solve problems and overcome obstacles.
4. **Independent thinking** – breaking up mental models, teaching that ‘not all the glitter is gold’ even if this sometimes may go against popular opinion. Identifying useful sources of information and gathering and utilizing only that information which is essential.
5. **Divergent thinking** – teaching on how to change the perspective and see the problem from another angle; thinking outside-the-box.
6. **Framing problems** – teaching how to put an abstract and vague concept into measurable frames which can be described and elaborated.
7. **Multiple idea facilitation** – teaching how to work on parallel ideas without prematurely selecting the ‘correct one’.
8. **Ability to learn** – active approach to one’s learning; appreciating the need to learn and the ability to reflect upon one’s performance; receiving and asking for feedback and accepting criticism from others.

¹ Definition by genus and difference relies directly on the intension of the terms defined, and it does so in the most helpful way. Definitions by genus and difference are also called analytical definitions, or by their Latin name, definitions per genus et differentia

9. **Courage and risk-taking** – teaching to be brave and facing the challenges; rewarding ‘those who dare’; teaching that disagreement is a positive attitude in certain situations; importance of taking risk in lives and accepting failures, coping with failures.
10. **Problem visualization and developing imagination through useful metaphors** – teaching how to explain and make sense of the world through indirect communication, including metaphors; utilizing art, poetry, theatre etc. to develop imagination; teaching how to put abstract concepts, problems, projects into pictures and graphs visualizing workflow, responsibilities of team members etc.
11. **Decision making** – meeting deadlines, taking responsibility and risk management, taking leadership roles,
12. **Leading people** – teaching how to be leaders, teaching about the importance of good leadership for the success of plans, taking initiative.
13. **Delayed gratification, or deferred gratification** - the ability to resist the temptation for an immediate reward and wait for a later reward.
14. **Change management and improvisation** – teaching how to improvise, work without or outside of agenda, trying to achieve the result without previous preparation, ad hoc mobilising of resources, teaching how to cope with uncertainty and changes, preparing students for situations in which several interpretations are plausible; assessing situational forces that are promoting and inhibiting an idea for change.
15. **Perseverance** – importance of not giving up; trying harder, testing all options, not being discouraged to easily, working-hard.
16. **Developing hobbies and teaching that having a hobby is an asset** – rewarding students for nourishing their extracurricular interests; encouraging students to engage in extracurricular activities, including voluntary work, student entrepreneurship etc.
17. **Collaborating** – teaching how to achieve synergies, use the resources and skills of other people on a win-win basis; teaching to listen to suggestions from others and to trying new ideas.
18. **Developing future orientation** – teaching about the benefits of looking to future opportunities; evaluating future directions and risks based on current and future strengths, weaknesses, opportunities and threats.
19. **Empathy** – although empathy can be thought of as a skill which is loosely related to innovation many research studies on creativity point to the importance of empathy. Innovations are developed by people characterised by compassion and their ability to understand and share the feelings of others.

The challenge for HEIs

As it was previously established that development of innovation skills should be one of key outputs of HEIs, the overarching challenge is how to implement the generally accepted postulate that HEIs should put more emphasis on development of innovation skills. Below is a list of possible specific challenges which HEIs may face while introducing the innovation skills development agenda:

- How to convince more conservative academics that making higher education more responsive to the needs of the job market does not jeopardize their academic mission and centuries long tradition;
- How to restructure academic culture which traditionally was aimed to develop academic competences? – academic teaching is currently strongly aligned with the requirements of academic careers, i.e. the best university graduates are predestined to become university professors;
- How to train academic teachers to develop innovation skills? – academic teachers do not have a business background which is very useful in teaching innovation skills;
- How to evaluate innovation skills learning outcomes? – currently the baseline for evaluating learning outcomes such as student projects, essays, tests is often in the discipline pursued by the academic teacher;
- How to account for long-term benefits of innovation skills development? – many HEIs use a short-term to medium-term proxies of salaries earned by university graduates. In the case of innovation skills the long term outcomes would be innovation performance of the organizations employing university graduates.

Teaching innovation skills

Developing creativity and resilience has been difficult due to pressure from the government for schools and students to report good test results. Systems of education in most countries in the world can be described as relics of the industrial age but some countries such as Japan are moving forward. Japan changed its rote based learning system by removing 30% of the content in its curriculum to encourage deeper learning and added a greater emphasis on creativity (Anderson, 2019).

As stated previously, teaching innovation skills should be the primary goal of 21st century HEIs. Teachers' beliefs, practices and attitudes are important for understanding and improving educational processes. They are closely linked to teachers' strategies for coping with challenges in their daily professional life and to their general well-being. They shape students' learning environment and influence student motivation and achievements (OECD, 2009). In the lecture hall, university teachers are likely to put greater emphasis on ensuring that learning is well structured than on student-oriented activities which give them more autonomy. Another concern of many academic teachers will be meeting the academic standards of students' learning outcomes which,

according to the teachers should be as close as possible to the requirements of scientific journals. The criteria for excellence in the business world, especially in the case of economics and business are different from those required by academia. Andreas Schleicher, the head of the education division at the Organisation for Economic Cooperation and Development (OECD) claims that although society is scared that human jobs will be replaced by robots, we are still teaching children to think like machines (OECD, 2009).² The countries that are succeeding in developing skills like empathy and communication—Singapore, Finland, certain Canadian states—have relatively small educational systems, but scale to create new challenges. In England, for example, the school inspection body (OFSTED) has acknowledged that developing creativity and resilience has been difficult due to pressure from the government for schools and students to report good tests results.³

Some practical recommendations for HEIs

Some research on implementing the innovation skills in HEIs has been conducted by OECD (Blašková et al., 2014; Hoidn, Kärkkäinen, 2014) but further endeavours in the field are still needed. The success in the implementation of innovation skills agenda in HEIs depends not so much on making the decision makers aware of the challenge as in implementing some hands-on, pragmatic improvements and sharing good practices in this area. Below is a list of some suggestions for HEIs regarding the implementation of the innovation skills agenda:

1. Redesign syllabi in such a way that each syllabus contains a specific section labeled “Innovation skills development”. Every teacher should demonstrate how (s)he wants to develop innovation skills within the core subject knowledge. This postulate is easy to implement for almost every university subject, including those which by definition do not focus on soft skills development. For example, accounting class may simply contain accounting in start-up companies, biology class may describe the application of newly developed substances in innovative products etc.
2. Implement interactive teaching methods which facilitate students’ own inquiry. Students learn best by finding solutions to problems on their own and should be allowed to think of solutions to practical problems themselves before the teacher shows them how they are solved. Thinking and reasoning processes are more important than specific curriculum content.
3. Provide more opportunities for university teachers to interact with business practitioners. Tacit knowledge transfer should be promoted.

² J. Anderson, The unlikely champion for testing kids around the world on empathy and creativity, <https://qz.com/1540222/how-changing-the-pisa-test-could-change-how-kids-learn/>.

³ The Future of Education and Skills 2030 project aims to help countries find answers to what knowledge, skills, attitudes and values are needed for today’s students to thrive and shape their world, as well as how instructional systems can effectively develop them. <http://www.oecd.org/education/2030/>.

4. Expose students to more challenging problems, including so called “ill-defined problems” (see for example: Davidson and Sternberg, 2003) and exposure to different cultural contexts.
5. Putting more emphasis on the process of solving a problem rather than on the final outcome. The way a student approaches the problem and works on the solution is usually neglected by university teachers who concentrate on the result.
6. Introducing a broadened selection of grades within the university evaluation schemes. Innovation skills could be subject to separate evaluation and their progress could be measured during the educational cycle at the university.

Conclusions

It is argued that innovation skills developed in tertiary education are an important innovation output for the economy. Innovation calls for a large number of – often highly educated – people equipped with diverse skills sets. It is increasingly acknowledged that future innovators and entrepreneurs will require a large range of skills to be able to meet the demands of the changing economy (OECD, 2010). Universities have traditionally positioned themselves as: (1) producers of knowledge in the form of scientific papers and patents; (2) educational institutions which provide skilled labour for the economy and for universities themselves. Today the demands and expectations should be raised as innovation skills should become an integral part of university education. In this chapter the rationale for such a statement was presented along with some practical suggestions on how the innovation skills agenda could be launched in HEIs.

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