Innovation in vocational education – ways of reaching the tip of the iceberg

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Abstract: As innovation is a cornerstone for achieving the most dynamic knowledge-driven economy, we are facing a growing ‘innovation’ gap between EU and USA/Japan. One of the crucial parts of the Lisbon strategy is a Copenhagen process connected to Vocational Education and Training (VET). The article analyses the challenge posed to the students’ innovation. It shows the roots of the problem and the reasons for low performance. Based on the research, the article shows the influential key success factors, where the role of the teacher remains essential. It also indicates the importance of the systemic approach and the important role of the economy and supporting environment. The results are useful for policy makers, school principals and teachers alike.

Keywords: analysis; benchmarking; innovation; training; model; supporting environment; school; student; teacher.


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1 Introduction

The gap between knowledge holders and economy and consequently the abilities of the transfer of invention and research results to the economy represent a problem in the EU. The said problem is particularly evident in the countries in transition – such as Slovenia, as was evidently stated in the research carried out by the World Economic Forum (WEF, 2001). In spite of frequently excellent academic research, transfer to the economy is invariably difficult. For innovation success (according to the definition in the section ‘The methods’), more important than R&D expenditure are different factors, such as people, information and communication technology, knowledge management processes, culture, organisation structure, management systems, process of assets allocation...
Effective and successful management of innovation and pioneering R&D activities (as one of important concepts aimed at improving the innovation performance) is undoubtedly one of the greatest development challenges facing Slovenia today – in economy as well as in the educational system (Likar, 2002; Celan et al., 2002). The EU is well aware of the aforementioned problems, and is thus striving to improve the existing situation through various programmes also in countries in transition. One of the most important programmes/concepts is the Copenhagen process as an integrated part of the Lisbon strategy, in which vocational education and training (preparing learners for careers or professions that are traditionally non-academic and directly related to a trade, occupation or ‘vocation’ in which the learner participates: hereinafter: VET) must be developed to play their active and key role in advancing lifelong learning policies and supplying the highly skilled workforce necessary to make Europe one of the most competitive and dynamic knowledge-based economies and societies in the world. Our research principally tackles part of the Copenhagen declaration, especially the priority: Recognition of competences and qualifications and Quality assurance (EU Commission, 2002).

Part of the programmes should most definitely be focused on youth. Psychological studies, namely, suggest that 90% of all five-year-olds are creative, and that this figure drops to only 10% amongst those aged 17, and decreases even further to a level which indicates that a mere 5% of the adult population is creative. Problems perpetually arise as regards the processes surrounding implementation: indeed, the entire invention-innovation yield chain (hereinafter: I-I) needs to be mastered and accomplished in order to consider the realisation of an idea as successful. It is a process which is closely connected to the influential innovation and entrepreneurial supporting environment.

In Slovenia the assistance offered to youth is still fundamentally focused on R&D activities (research projects take place within the context of secondary schools and university faculties, programmes of the Association for Technical Culture of Slovenia, as well as research programmes organised at the municipality level). The innovatively oriented projects are only encouraged (not supported) to a relatively low degree. In spite of the fact that many of the assignments are markedly applicable and would thus deserve full support in their realisation, the projects usually end with the final stage of the research and eventual publishing of the results. The role of the teacher, and also other support, such as the support of the Chamber of Commerce and Industry of the Republic of Slovenia and the Institute for Innovation and Technology, are essential in encouraging innovativeness (Likar, 2005).

The programme/concept of Action Research represents an important part of innovation activities at school (Elliot, 1991), which is applied in many countries. In Slovenia, the National Education Institute supports the activities at different levels: at the level of teachers, organisations’ project groups (kindergarten, school, home), pedagogical consultant as well as the project teams of the National Education Institute of Slovenia (Komljanc, 2005). That is to say, the teachers are supposed to be able to transfer the research results to daily practice. Yet the experience from other countries’ educational systems shows that this is not so easy (examples of R&D and innovation activities of youth are very similar). When discussing the extremely important role of a teacher as well as the education system, the experience of developed countries should be taken into account. The international research PISA – the Programme for International Student Assessment (PISA, 2003) – shows the important role of the educational system.
In countries which ranked the highest (regarding economy performance). In the case of Finland (the winner) and other countries, the authors realised it is the teacher who represents the most important 'asset'. The quality of the educational system is evidently strongly related to the innovation performance in economy. Therefore, one of most important concepts aimed at improving the innovation performance is to train the trainers first. This concept is supported by many EU programmes (e.g., Phare, Leonardo da Vinci, Socrates).

When examining knowledge, experience and motivation, the importance of the thinking and culture of the teacher as well as the school should be taken into consideration. According to Silver (1999), the complexity of the problem is directly concerned with innovation in teaching and learning, which is a study of interactions, attitudes, institutional policies and practices, national context, and the consensual and confrontational characteristics of all of them. Owing to the complexity of the innovation process, adequate teams represent a necessity (Lee-Kelley and Blackman, 2005).

The aforementioned research clearly indicates the importance of a motivated teacher who can educate creatively and motivate a student towards connecting different fragments of knowledge. The last issue is evidently an important step towards creativity. By broadening the term 'creativity' to 'innovation', it may be concluded that a successful innovation performance strongly correlates with the quality of the teacher, schools and educational system. These are also extremely important concepts aimed at improving innovation performance. Focusing on innovation, it is essential to consider all the phases of the I-I process, as follows: invention creation, research-development phase, design of prototype, practical testing, protection of intellectual property (patent, model, etc.), market research, creation of business plan, raising venture capital, presentation to potential market, production using own resources, marketing using own resources, and relationship with commercial sector.

The first phases - creating inventions and R&D phase (as one of important phases in achieving innovation excellence) - mainly depend on the teacher and/or school. In stages when the invention is being developed towards innovation, the role of the supporting environment becomes crucial (also one of the major concepts in achieving innovation excellence). In Slovenia, there are numerous supporting centres and programmes offering various forms of assistance (information, professional support on a certain scientific discipline, financial support in R&D, expert and financial support during entrepreneurial activities, etc.). However, the fact remains that the supporting environment in this country still fails to offer sufficient sustenance owing to the repeated disharmony of measures, inefficiencies, and lack of orientation towards young people (Izhodška, 2002; Likar, 1999). One crucial reason why the aforementioned endeavours and activities have yielded only a fraction of the desired results pertains to the development of a supporting environment (Bučar and Stare, 2002). Only recently has the orientation of such support begun to be devolved away from a central source towards both regional and local levels. This is of crucial importance when youth decide upon realising the invention using their own resources (self-employment). The next important concept, which is well-known in many developed countries as well, appears to be cooperation with commercial enterprises in which ideas derive from actual practical and theoretical problems of the organisation.

It is a fact that the transfer of invention and research results to the economy represents a problem in the EU and especially in countries in transition, and also in Slovenia. The invention and consequently the innovation/business success in economy in most cases
represent a logical result of the quality of the educational process. Therefore, the understanding of the invention-innovation chain in the educational system is crucial for the competitive economy as well.

According to the aforementioned facts, it may be concluded that mastering the invention-innovation chain is one of the most complex processes in the economy. As a result, the following findings concerning the innovation process are evident:

- The first phases of the I-I process (especially R&D) in the Slovene educational system are much stronger than the latter phases (e.g., business part) of the I-I chain.
- A direct role/support of the educational system/school/teacher is essential, especially in the first phases of the I-I chain (creating inventions and R&D), yet the impact remains insufficient.
- Teachers are inappropriately trained and motivated to support students' activities in the whole I-I chain.
- During the stages when the invention is being developed towards innovation, the role of the national supporting environment becomes crucial.
- National and local programmes aimed at increasing the innovative performance in the educational system are essential, yet the impact remains insufficient.
- Cooperation between the educational system and commercial enterprises is important but inappropriately developed.

The stated facts are the basis for the research, aimed at indicating the roots of the problem and the reasons for poor performance. Based on the research, the most important problems and influential key success factors will be shown. Therefore, the article presents important guidelines for policy makers, school principals and teachers alike. Even though the research was focused on the Slovenian school system, the presented results and guidelines for improvement may also prove valuable in other less- and medium-developed European countries.

2 The methods

The analysis focused on the role of the teacher, schools and educational system in encouraging creativity and supporting idea realisation and the connected supporting environment as well as the economy.

Through an analysis of the situation as regards youth and their mentors in Slovenia, it was considered necessary to establish exactly how they master the invention-innovation chain. The study encompassed 159 teachers/mentors, mainly from vocational secondary schools, as follows: 21 employed in grammar schools, 92 in vocational technical secondary schools, 123 in vocational secondary schools and seven in other institutions (some of the teachers were employed at two institutions). The average age of the respondents was approximately 35 years, which is considered quite a young generation. It is important to stress that the respondents were teachers engaged in the educational programmes which are based on subjects such as innovation, R&D and entrepreneurship. The research was part of the Phare programme (Phare, 2001) – Innovative training programme, from idea to business training of teachers in secondary and higher education.
Innovation in vocational education

(Likar, 2005). Owing to the aforementioned fact, the respondents had more knowledge on topics of innovation and R&D than their colleagues: the latter should be carefully taken into account during data interpretation. Furthermore, the respondents were the mentors involved in R&D and innovation projects also prior to the training course. The analysis covered Savinja, Pomurje, Podravje and the Zasavje region – the NE part of Slovenia. Among the teachers, 56% were mentors.

Many different definitions of the term 'innovation' are being applied in praxis. For example, Rogers (1995) defined it in terms of how it is perceived by individuals or workgroups in an organisation: "An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption... If the idea seems new to the individual, it is an innovation." Therefore, the most important terms – for invention and innovation – used in the questionnaire based on OECD definitions were clearly defined (Frascati Manual, 1994).

Before the respondents answered the questions, the following definitions were introduced to them:

- **The invention** is a new and promising idea.
- **The innovation** originates from the invention when being completely developed to the applicable phase and the customer/client usage or purchase. The innovation means a process of transferring the idea into a new market product, new service, training or educational device, improved working process, etc.
- **Organisations which form part of the support environment**: ministries, Slovenian Intellectual Property Office, Small Business Development Centre, Chamber of Commerce and Industry of the Republic of Slovenia, technology parks, regional and local development centres, business incubators and others.

3 Results and discussion

3.1 Question No. 1

The following question was raised:

*How many inventions per year does each of your students have on average that he/she would like to realise?*

Table 1 Percentage of youth and number of their inventions per year and the average age are shown

<table>
<thead>
<tr>
<th>Number of inventions/year</th>
<th>Percentage of students (%)</th>
<th>Average age</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>65.0</td>
<td>16.9</td>
</tr>
<tr>
<td>1</td>
<td>15.5</td>
<td>17.0</td>
</tr>
<tr>
<td>2</td>
<td>9.5</td>
<td>16.9</td>
</tr>
<tr>
<td>3</td>
<td>6.6</td>
<td>17.1</td>
</tr>
<tr>
<td>4</td>
<td>3.4</td>
<td>16.8</td>
</tr>
</tbody>
</table>
The results show that more than half (65.0%) of the students have no ideas, 15.5% of them have one, less than 10% have two or three ideas and only 3.4% of all the students have four or more ideas that they would like to realise per year.

In spite of the fact that the respondents were informed on the definition of innovation, the experience shows that the terms 'invention' and 'idea' are still being confused – which is the praxis in Slovenian society as well. That is to say, each idea is not yet an invention.

3.2 Question No. 2

The following question was raised:

*To what extent are the particular phases of I-I applicable for students?*

The respondents could opt between the following answers: 1 – independently, 2 – supported by mentor, 3 – supported by organisations of the Slovenian supporting environment, 4 – supported by enterprises.

According to Figure 1, the youngsters could have a fairly substantial number of ideas, but they would require support in the R&D phase, in the creation of a business plan, in raising venture capital and in cooperating with commercial enterprises. On the basis of Figure 1, the scale of a particular type of support was also calculated, taking into the consideration all the phases of the I-I chain (i.e., proportion of the area sum which relates to particular type of support – explained in legend of Figure 1 – indicated in all columns). According to the respondents' opinions, the mentor's support is of key importance (40%), followed by the importance of the organisations within the Slovenian supporting environment.
environment (37%) and the economy (23%). An evident conclusion is that according to the teachers’ opinions, the phases of the I-I chain for the young unsupported people are feasible only up to 10%.

The said statistical value may be misleading at first sight. The question arises whether young people are able to carry out only 10% of the necessary activities independently. We strongly believe that the aforementioned figure relates only to those activities which young people can carry out completely independently. Yet most of the activities require some sort of support, or more precisely, a ‘supporting impulse’ which would enable young people to overcome the impediments when performing most of the work by themselves. The aforementioned is essential for a clear understanding of the teacher’s role and also time management of the mentor’s work.

In our opinion the extended significance of the teacher in performing market analysis and the creation of a business plan (Figure 1) is a reflection of the fact that the research encompassed a significant number of teachers from economy and business schools.

The young people are able to perform most of the activities from the I-I chain by themselves, while a mentor is essential for the so-called ‘supporting impulse’. The mentor helps directly or directs student to an apt expert within the Slovenian supporting environment or an enterprise, yet the expert needs to be qualified adequately. Teachers do not possess such knowledge, nor is this knowledge presented to them systematically.

3.3 Question 2a

The following question was introduced:

State the proportion of students who have successfully finished any of the phases in the I-I chain.

The question is similar to Question No. 2, yet the answers in this case are connected to the final result – i.e., the phase which was completed with some kind of support.

Figure 2 The proportion of students who successfully finished any of the phases in the I-I chain

![The share of students that have successfully finished any of the phases in the invention-innovation chain.](image)
Answers clearly indicate that 17% of the students reach the invention phase, and 10% complete the research-development phase, while the share of those who reach further phases plummets dramatically.

Young people were asked a comparable question within the research (Likar, 2003) which shows their views on the same issue. Although the methodology applied was somewhat different, it may be established that the data shown above correlate well with the results of the said research.

The teachers stated the following concrete projects: mobile lathe, device for minimizing the volume of empty plastic bottles with steam, new type of glue smelt in the sellotape, remote management of household appliances with GSM, temperature regulation in greenhouses, packaging for different kinds of dried fruit, automatic welding machine, a device for cleaning the car windscreen using the water from the condenser in the air-conditioning, depth drilling on the classical lathe, multilayer glove for washing the body, pet cemetery. The category of business innovations, which is related mainly to the work at school, includes the following: upgrading of module teaching aids for the subject of mechanics, optimisation of school experiment on water electrolysis, teaching aids for drawing and mechanics, and preparation of the programme on organising sports competitions. Part of the cases belongs to the area of tourism: organising Greek and Hungarian evenings, a business plan for reviving farmhouse tourism, tourist guide on Dobin and surroundings.

These are mostly the projects which originated from a close cooperation with the mentor.

3.4 Question 3

Respondents were faced with the following question:

Where do you see the hampering factors for intensive innovative and entrepreneurial activities of the students?

The respondents could choose among the following answers: 1 – unimportant, 2 – less important, 3 – important, 4 – extremely important.

The mean value was calculated, which represents 'the extent of influence per obstacle' and which encompasses the values from 1 to 4 (1 – unimportant to 4 – extremely important).

As important factors the respondents stated lack of ideas, knowledge and material and financial assets as well as 'others'. The respondents stated the following factors: (dis)interest of management, unmotivated teachers and students, time management, overly occupied students and teachers, disinterest of school for inventions, bureaucracy, tight timetable, bad students and similar factors.

Surprisingly, high risks and lack of entrepreneurial spirit are stated as less important factors. On one hand, the said finding was interpreted as higher self-assurance of young people if compared to youth before the beginning of the democratic processes. These observations were confirmed by many teachers. This is definitely positive since it represents one of the most important factors of success. It is similar for the entrepreneurial spirit – easily read as motivation, which together with expert knowledge and necessary support represents the required prerequisite for success.
Figure 3. The obstacles for intensively more innovative and entrepreneurial activities of the students are presented, as well as the mean value which indicates the extent of influence of a particular obstacle (1 – unimportant to 4 – extremely important).

Obstacles that prevent a more intensive work of students in the area of innovations and entrepreneurship.

3.5 Question 4

The following question was introduced:

Who helped the students, and to what extent, in the invention-innovation processes?

For certain categories (who) the respondents selected a degree of support (to what extent) among the following possibilities: 1 – no assistance, 2 – minimal assistance, 3 – moderate assistance, 4 – tremendous assistance. The mean value representing the degree of assistance was calculated (1 – no assistance, 4 – tremendous assistance).

As clearly indicated in Figure 4, the assistance of teachers is of tremendous importance, as well as the help of the school (as a whole). Besides, the role of peers and parents is also important. The roles of the educational system and commercial sector seem to be less important. It is surprising, since 89% of respondents originated from vocational and technical schools. Since the research is related to schools educating students for professions, the connection with praxis and business sector is indispensable – but regrettably too small.

The experience concerning the cooperation of business sector and youth show a low degree of cooperation and preparedness of the business sector. As long as the cooperation between the youth and the economy is only based on principle, the companies are more than interested. But when it comes to concrete arrangements and agreements, the companies are unprepared to invest in the projects which would eventually bring them welcome results (solutions, cooperation, personnel, etc.).
The comparison of the aforementioned results with the research findings (Likar, 2003), which emphasise that young people fail to see equal support in teachers, proves to be especially remarkable. As the most important source of assistance, they stated cooperation with peers, followed by the support of teacher and school, cooperation with business and parents and, far from the last, the role of the supporting environment (obviously the youth are aware of its existence, yet they exploit its services even less than the teachers). Our experience in the work with young people shows that the majority of the most innovative ones require support which cannot be offered to them by their teachers. Thus, they seek other forms of cooperation, such as cooperation with peers of similar interests, especially in smaller groups. Only a small proportion of the most creative young people succeed in finding appropriate expert and business connections.

3.6 Question 4a

In the second part of the question, teachers who in the first part of Question 4 stated that certain categories (parents, teachers, school, etc.) ‘do not help’ or ‘offer negligible assistance’ assessed reasons for the said phenomenon. They opted from the following categories: lack of time, lack of knowledge, lack of determination, shortage of material assets, shortage of financial assets, too great of a risk.

Results clearly indicate that teachers notice the principal problem in the shortage of parents’ assistance (75% of all the answers), especially owing to lack of time and knowledge. This is followed by the problem of the cooperation with the companies and tradesmen (71% of answers), mainly due to insignificant determination and too great of a risk. Next is the educational system (67% of answers), which according to the teachers fails to show enough determination towards the improvement of the existing situation.
The said problem is closely related not only to the question of financial and material support, but also to the Slovenian supporting environment, which appears in 57% of all the answers. The peers and chiefly their lack of determination appear in the same amount of answers. The school (40%) and teacher (19%) represent the minutest problem with lack of time and low degree of financial resources.

This part of the answer indicates that majority of the answers related to the lack of assistance point at the parents (75%). It is our strong belief that the problem of parents’ knowledge probably represents the most important impediment – even greater than, for example, the hindrances related to the educational system, organisation within the supporting environment and others. Not only the educational system but also the supporting environment is part of the organised system, which is strategically developed and directed by the state and competent organisations. This is indeed their task and mission and the state budget is used for this purpose. Deficiencies, which prevent young people from achieving innovativeness and entrepreneurial spirit, are probably easier to compensate in this case. In any case the lack of determination in the aforementioned organisations causes great concern since it is far more difficult to obtain determination than, for example, to overcome the lack of knowledge. Nevertheless, the role of parents may be concluded as of great importance, yet it may not be regarded as a systemic factor.

3.7 Question 5

This question was related to the familiarity with the Slovenian supporting environment. Focus was made on the most important organisations and programmes pertaining to invention-innovation and entrepreneurial activities. The respondent could select from five possible answers (1 – unfamiliar, 2 – I have heard of it, 3 – I am thinking of using its services, 4 – I have already used their services once or cooperated, 5 – I regularly use its services or cooperate). The mean value was calculated, which occupies values from 1 to 5 (as do the answers).

The answers reveal that the interviewees are, for the most part, familiar with their immediate educational environment. From the regional aspect, they primarily acknowledge the programmes in particular and the organisations in their vicinity (municipalities – the programmes on research, occasional cooperation with the industry). It is a matter of organisations which above all encourage and support pedagogical activities and research work. Beside the said organisations, the teachers emphasised the significance of school, management, training, colleagues and internet as major support to their work.

There are still valuable possibilities for cooperation in connection with the organisations which have oriented their activities towards supporting young people in recent years and which still remain relatively unknown. The latter provide support especially in the phase of the I-I chain from the R&D phase onwards – where the drop in activities is recorded according to the above-mentioned results (Figure 1). Additional endeavours for the establishment of this support (the existing one is definitely unadjusted to the needs of youth) and appropriate promotion would undoubtedly increase the efficiency of the supporting environment and consequently denote higher level of innovation in schools.
Table 2  Mean values reflect the stated level of familiarity or cooperation with the particular organisation (1 – unfamiliar, 5 – I regularly use its services or cooperate)

\begin{tabular}{|l|c|}
\hline
Organisations of Slovenian supporting environment – programmes related to youth & Mean value \\
\hline
Cooperation within the context of the school environment in assignments which are not an integral part of the curriculum. & 3.9 \\
National Education Institute & 3.2 \\
Ministry of Education, Science and Sport & 3.2 \\
Local municipalities – meetings of young researchers and their mentors & 3.2 \\
Cooperation with enterprises in the commercial sector & 3.0 \\
Cooperation with faculties of education and institutions & 2.8 \\
Chamber of Commerce and Industry of the Republic of Slovenia & 2.6 \\
Ministry of the Economy & 2.4 \\
Small Business Development Centre & 2.2 \\
Slovenian Intellectual Property Office & 2.0 \\
Institute for Innovation and Technology & 1.9 \\
Technology parks & 1.7 \\
Innovation Relay Centre & 1.6 \\
Venture Capital Funds & 1.5 \\
\hline
\end{tabular}

3.8 Question 6

The question raised was:

*How do you as a teacher expect the school/principal to facilitate the work of a mentor in creative and innovation projects?*

Each of the possible answers offered the following possibilities: (1 – no expectation, 2 – partial expectation, 3 – great expectation, 4 – enormous expectation). A mean value was defined which indicates the level of expectation and occupies values from 1 to 4.

The results indicate that teachers expect the greatest assistance in material and/or financial as well as moral support for their work. Moreover, the appraisal of their work and thus related promotion are also important. Considerably lower support is expected in the promotion of the results of their work and in the cooperation with the entrepreneurial supporting environment and the economy.

Considering the proportion of students who concluded the particular phase of the I-I chain and which amounts to one percentage point (Question 3a), familiarity with the supporting environment, which is poor (Question 5), as well as the fact that the cooperation with the economy is extremely slow (experience shows that too small of an emphasis on mutual cooperation is given by teachers and the economy alike), it may be concluded that the teachers fail to see any need to guide young people towards reaching innovativeness. The latter is confirmed by numerous teachers’ statements, which claim that the project has been concluded by reaching R&D phase and nothing more can be done. This also remains a standard praxis of many teachers in the case of reaching practical results of directed R&D projects in schools. However, the aforementioned already relates to the change in the mode of thinking and values of teachers, and not to the necessary knowledge for obtaining higher practicability or innovativeness.
4 Summary of key findings

Hereinafter, the summary of key findings is described on the basis of key parts of the I-I chain, which is followed by the recommendations for improvement.

4.1 Acknowledging the problem and creative phase

This is the first and very important phase in the invention-innovation chain. Two factors are of great significance:

1. The first one is related to the acknowledgement of problems or new opportunities which represent the basis for creative work. On one hand the potential solutions unquestionably offer answers to the already known problems. The concrete problems deriving from the economy are only a few, just as teachers rarely define clear problems and solutions which would possibly lead to innovation. On the other hand the entrepreneurial praxis indicates that essentially new market products are normally created by finding a solution to the problem: the solution which has previously been overlooked by others. Among the ideas (see Question 2a) there are many such kinds – for example a device for cleaning the windscreen using the water from the condenser in the air-conditioning. Also, the number of these types of innovations remains low and is frequently a result of a student’s own activities.
The next phase is creative and therefore the one where ideas for the solutions are created. As established in Question 1 almost half of the students have ideas – they are therefore creative. Of course, a distinction needs to be made between the idea and the invention – the number of inventions remains considerably lower than the number of ideas.

We believe that the teachers with appropriate pedagogical approaches should encourage creativity more intensively, and what is also imperative, the students should be guided towards the acknowledgement of problems which usually bring new solutions implicitly.

4.2 Development-entrepreneurial phase

Here we wish to highlight the steps from the ‘R&D’ to the ‘presentation at the fair or exhibition’ phase according to Figure 2. The number of those who successfully concluded the said phases dramatically decreases. In my opinion, this is related to the otherwise strongly developed R&D activities in the educational system, yet insufficient support for further phases of the I-I chain. The fact is also confirmed by the belief of those interviewed who seem to believe that the R&D phase may be accomplished only with the support of their teacher (Question 2) and by the R&D phase being systemically encouraged (see Introduction). The teachers are well aware of the fact that the role of organisations of the supporting environment is also imperative for a successful implementation of the remaining steps. The answers (Question 5) point out that the teachers have little knowledge of these forms, especially those necessary for implementing the phases from R&D onwards. Moreover, there is also low material and moral support offered by the educational system, and also from the school management, which consequently means lower outcome of inventions developed by the young people.

The question also arises as to why in these phases the teachers expect more support from the organisations of the supporting environment than the economy (Question 2). The reasons may well be two. The teachers still look at the inventions from the school’s or R&D point of view rather than as an entrepreneurial opportunity for youth. Their purpose fails to be oriented towards the achievement of useful novelty (which does not necessarily equal the entrepreneurial opportunity). However, the other reason remains poor connection with the economy.

4.3 Entrepreneurial phase

Phases evolve which are according to the interviewees closely related to the economy. Reaching entrepreneurial results is of course not of paramount importance in the orientation of the secondary school. Nevertheless, owing to a high percentage of respondents coming from the vocational schools, a greater number of activities which could already during their studies represent the basis for their future (self-)employment would most definitely be expected. Unfortunately, successful projects carried out by young people still remain a consequence of mentor’s personal determination or student’s initiative. The forms of assistance from the Slovenian innovation-entrepreneurial supporting environment are poorly known, especially nationally, and they also fail to be adjusted to the needs of young people. The local support is poor as well. The obvious consequence is a low number of innovations. The results clearly show that there is only 1% of innovations, yet we believe that even a lower number than that corresponds to the correct definition of the term ‘innovation’.
5 Recommendations

On the basis of presented facts and other experiences from the work with young people, education and economy we advocate the following measures:

5.1 On the state level

- Strategic support to innovation processes concerning economy and academia/educational system (Anders, 2006).

- Establishing programmes for cooperation among educational system/VET, economy and business supporting system, which is at the moment poor. Once the cooperation is established, the synergetic effect is a logical continuation also when students become employees. In this way programmes of business supporting organisations will also become more custom oriented and consequently more frequently exploited. Former students with concrete innovation and business experience from school will become the best ambassadors of innovation activities in organisations as well.

- Not only should the Slovenian supporting environment be adjusted to the needs of youth in all phases of the I-I chain, but it should also be appropriately presented. Not only are the potential users unfamiliar with the supporting environment, but the said supporting environment also fails to provide comprehensive assistance (‘one-stop-shop’ in the correct meaning of the word), which young people would require even more than experienced entrepreneurs.

- Strengthening local forms of support (for example, the voucher system of consultancy).

- More intensive support and financing offered to the organisations which have in recent years oriented their activities towards offering assistance to youth and which substantially contribute to the strengthening of innovation processes in schools.

- To improve the model of action research (primarily oriented towards improving educational work of teachers), it should be upgraded in order to support also the innovation projects of young people.

- More intensive continuation of national youth competitions for Slovenia’s most inventive business-oriented projects (inventions, R&D projects, business plans, etc.).

- Availability of venture capital funding (provided by the state or region) for the needs of young people – support for individual projects.

5.2 On the educational system level

- Adjusting curricula – professionally, materially and morally support creative and innovatively oriented work at schools as a joint cooperation among management, teacher and students.

- Motivating and informing young people to start thinking creatively.

- Encouraging creativity in resolving concrete problems (personal initiative, mentor’s suggestions, ideas deriving from the economy).
The training of young people.

Train all teachers on invention-innovation chain knowledge so that they understand the meaning of innovativeness and are able to offer students basic knowledge and skills and also appropriately award them.

Provision of essential information to educators as to innovative teaching methods and the encouragement of innovation.

Each school should have at least one mentor with substantial experience. The said person would act as a generalist (necessary knowledge on innovation or entrepreneurial processes, knowledge on supporting environment, cooperation with the economy).

Research processes should be intensively oriented towards reaching viable novelties.

Integrating experienced managers (senior managers) in project teams within the school.

Establishing connections with the commercial sector in the realisation of projects (especially those which derive from industry and business itself).

Providing support from expert fields and entrepreneurs (personal realisation of the innovation within a company, sale of intellectual property rights).

Establishment of self-managed project teams with open communication processes as suggested by Kenny (2002).

A huge part of the proposed activities could be implemented using instruments and programmes to implement the Copenhagen process, e.g., European Social Fund, EU structural funds and the European Regional Development Fund, Leonardo da Vinci and the future integrated action programmes in the field of lifelong learning, Socrates and others.

6 Conclusion

Results clearly indicate that the mentor's role is of key importance in the invention-innovation processes of young people – similarly to what was established by the PISA research carried out in Finland. Yet in the case of mentors the problem of professional qualification was soon encountered, as well as the motivation and support they receive either from the school management or educational system. An even greater problem represents the fact that a great proportion of teachers fail to perceive any need to direct young people towards reaching innovativeness. The ones who are aware of the said prerequisite believe that the Slovenian supporting environment and economy, as well as the educational system, could contribute significantly, yet their assistance remains negligible.

Our experiences show that the cooperation between the mentors and the economy presents an important factor of inventiveness and later on innovativeness of youth. It is a matter of focused creativity, where the contact with issues from the economy and their realisation mean the opportunity for knowledge application on concrete problems, which thus means a greater number of innovations. The problem is closely connected to the
relatively small absorption capacity of the commercial sector, which 'overlooks' a significant part of the applicable sector-pertinent inventions and the results of R&D; consequently, the potential commercial yields of these go unharvested (Kern, 2001). However, many successful Slovenian cases (for example, Istituti Callegari – the Italian designer school) show that an important part of inventions is also implemented. In relation to this, there is also a need for an efficient systemic and holistic approach (Mulej et al., 2003; Mulej and Ženko, 2003; Markič, 2005) as well as associated measures that would foster innovation processes within the education system (Pečjak, 2001; Trunk, 2000: Lesjak et al., 2003) as well as within the economy.

To start with, school politics and curricula should be upgraded, teachers should be trained and a closer connection should be established between the economy and the supporting environment, and the mode of philosophy should be changed as well – from routine to innovative (Bottino and Cutugno, 2001) and from classical to adaptive organisation (Llorens-Montes et al., 2004). Senior managers represent an unexploited yet extremely interesting possibility (experienced and retired companies’ managers) to be prepared to help teachers and youth. Acquired knowledge and skills shall help students to adjust to changes in the labour market more easily. Future job seekers shall develop additional skills and qualifications. During their studies they shall thus be prepared to adjust to fast changes in the economy and society, so as to make them more flexible and successful seekers of the job at the end of their studies. Consequently, positive effects as regards the Lisbon strategy may well be expected, i.e., reduced gap between education, research sphere and entrepreneurial sector, and thus the prosperity of the economy.

The process proves to be extremely tedious, and as stated by Mulej needs to be systematically planned (Mulej and Ženko, 2002; Llorens-Montes et al., 2004) and efficiently implemented. It is also essential to take into consideration a number of potential limitations to the fostering of creativity in education, i.e., difficulties in applying the terminology, conflicts between policy and practice, limitations in curriculum organisation, and limitations stemming from a centrally controlled pedagogy (Craft, 2003). Together with the abovementioned processes in EU, the requirements for efficient schools have also been amplified. As stated by Wrigley (2003) in the case of British schools, the risk of lowering democratic aspects of learning may emerge with the measures taken to reach the said objective. In our opinion, democratic aspects of learning remain a prerequisite for the greater innovativeness of youth.

As mentioned in the section Methodology, the research was conducted among the teachers who are more closely connected to the innovation processes than their peers. We thus believe the research among a random panel of teachers would demonstrate even poorer results in every aspect. Besides, an international research would represent a good base for benchmarking of the presented results. As the transfer of innovations is closely connected with cultural aspects and traditions in various countries (Koren, 2006), it would be especially useful to repeat this type of study in other countries, especially in those with a more developed entrepreneurial culture. As the cultures in countries are different, such aspects should also be taken into account when discussing the way leading to innovation excellence.

The challenges remain great; a systemic and holistic approach is necessary since the innovativeness of young people is only the tip of the iceberg.
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References


Innovation in vocational education


