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Measuring innovation in education with a special focus on the impact of organisational characteristics[1]

(DRAFT)

Introduction

Innovations created by teachers, teacher communities and schools in their daily practice play a crucial role in improving the quality and effectiveness of education. The invention of new, original solutions – simpler or more complex – are necessary to respond the many of the challenges teachers encounter in their everyday work. Protocols, central regulations, ready-made teaching materials do not provide solutions to all the problems that emerge in daily practice. Similarly to other knowledge intensive professions creativity and innovativeness are necessary skills for teachers and teacher communities to work effectively. And similarly to other knowledge intensive organisations, schools have to support innovative work behaviour and they have to manage change and innovation processes.

Recent research on innovation and innovation processes is devoting growing attention to what is called *employee-driven*, *practice-based* or *workplace* innovation. "Achieving innovations

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was earlier seen mostly as linear processes leading from scientific work to practical innovative applications. Nowadays, innovation is most often considered to be a result of co-operation in normal social and economic activities" – as written by two innovation researchers in their book on practice-based Innovation (Melkas– Harmaakorpi, 2012; 2). Two other innovation researchers have defined this form of innovation as "employees' or management's renewal of their own operations in some respect, for example, by developing and implementing new working methods, routines, products or services, where this renewal is based on informal learning through work processes within the operations concerned" (Nilsen – Ellström, 2012; 156). Employee-driven, practice-based or workplace innovation has also been described as "current, emergent, spontaneous, informal and unplanned" which „may not be part of the explicit agenda of the organization" but might lead to the „'remaking everyday work practice" (Høyrup, 2012). This kind of innovation is also called "hidden-innovation" (NESTA, 2007) because of the difficulty to grasp and measure it and because, in spite of its importance, it is typically neglected in national or sectoral innovations surveys.

Employee-driven, practice-based or workplace innovation in the education sector is often described as *teacher-led* innovation. An Australian report, analysing relevant policies and practices in four systems (Canada, England, Scotland and Germany) has provided a good summary of evidences on how advanced education systems move toward improvement models based on teacher-led innovation. As the author noted: "the challenge is to engage teachers in solving the problems faced by schools, learn from the new practice and innovations developed and then share the professional knowledge laterally so that all can benefit" (Fraser, 2005). Encouraging teachers and teacher communities to invent new, original solutions in their daily practice has become one of the core elements of the education policies of the high performing South-East Asian systems: one typical solution has been the adaptation of the Japanese model of lesson study (see, for example, Cheng, - Lo, 2013; Goodwin, 2014). This is a well-established form of using the creativity and initiatives of employees to improve continuously organisational performance, which is a typical practice in Japanese companies

The growing importance of the innovation behaviour and innovation activity of employees in improving the quality and effectiveness of systems and organisation is generating a need to measure this behaviour and activity. Measuring innovation and innovation processes in the education sector has become an important priority in several systems and this has been increasingly promoted also by major international agencies (OECD, 2014, 2017; Dunne et al., 2014). A proposal to launch of a new education sector innovation survey in the member states has recently been proposed by the OECD, and this idea has received strong support from the European Commission.[2]

In this paper we present some of the outcomes of an education sector innovation survey conducted in Hungary. The first outcomes, based on a first data collection round at education unit level, were presented internationally at the 2017 ECER conference in Copenhagen (see Halasz, 2018a). This paper is based on the results of a second data collection round at both educational unit and individual level.

Measuring educational innovation in Hungary

Similarly to many countries supporting innovation processes in the education sector has been a policy priority in Hungary for many years. Since the accession of the country to the European

[2] Direct information acquired by the author as them member of the OECD CERI governing board.

Union and the opening of structural funds for educational development in 2004 this support has been substantially strengthened. Thousands of educational unites and teachers have been involved in development interventions often explicitly requesting them to generate school or classroom level innovations (Fazekas, 2018; Halász, 2018b). The support for educational innovation has been oriented, among others, by education sector innovation strategy documents (NIERD, 2011; Balázs et al.., 2015).[3] An important element proposed by these strategies has been the development of instruments to measure innovation processes in the education sector. One of the aims of the Innova research project, launched in 2016, has been to create such instruments and, using data collected with these instruments, to analyse the dynamics of education innovation processes.

The theoretical framework of the Innova research project

The key elements of the theoretical framework of the Innova project has been presented elsewhere (see, for example, Halasz, 2018a). To summarize: innovations or innovation processes have been approached in the Innova research project simultaneously from four different perspectives: (1) innovation seen as a product; (2) the emergence of innovations; (3) the agents involved in creating/adopting innovations; and (4) the dissemination or diffusion of innovations. These four perspectives have been complemented by the temporal and spatial dimensions.

The Innova research project is focussing on innovations invented and applied by schools, teachers or teacher teams, that is, on bottom-up innovations. It uses a simple and pragmatic definition of innovation conceiving it as deviating from routine practice to produce better results. A key notion is what we call the "innovation triangle", inspired by Engeström's activity theory (Engeström, 1999a; 1999b). The innovation triangle has three components: (1) the specificities of the problems or the problem situation emerging in daily professional practice, (2) the cognitive processes used in the problem-solving process, and (3) the interactions of those involved in the problem-solving process.

A basic assumption of the Innova research project is that innovation is a natural part of the work of everyone who is facing challenging and complex tasks, and teachers certainly do so. This is why research on employee-driven, practice-based or workplace innovation seems to be particularly relevant in this context. Another basic assumption is that the innovation behaviour and innovation activity of people is strongly conditioned by the organisation in which they work. In fact, the aim of this paper is to explore, on the basis of Innova data, the complex relationship between the innovation behaviour and activity of individuals, on the one hand, and the organisational characteristics of their workplace, on the other.

The Innova education sector innovation survey

A major challenge encountered by those designing the Innova survey instruments has been their intention to create one single instrument for the whole education sector, that is, questionnaires that can be used at all level from kindergartens, through primary and secondary schools to university departments and doctoral schools, including also private training providers in the vocationally oriented adult education sector. Two types of questionnaires have been developed: one for the leaders of education units (organisational questionnaire) and one for the teachers employed by these units (individual questionnaire).

[3] For a concise presentation of the Hungarian National Education Sector Innovation Strategy see OECD (2016).

A first data collection has been conducted with the first version of the organisational questionnaire in the autumn of 2016, and a second round with the second version of the organisational and the individual (employee) questionnaire in the spring of 2018. In both cases emails were sent to the heads of all educational units in Hungary. The heads were invited to answer the organisational questionnaires and to forward the invitation to answer the individual questionnaire to the members of their staff. The data collections resulted in three separate databases. These have been merged in two complex datasets presented in *Table 1*.

Table 1
The Innova datasets

Organisational dataset				Individual dataset		
2016 data	2018 data	Individual data (aggregated for each organisation)		Individual data	2016 organisation data (linked to each individual)	2018 organisation data (linked to each individual)

These complex databases allow various analyses, including those focusing simultaneously on two levels (hierarchical analyses). In this paper we use only the individual database, focusing on the innovation activity of individual teachers. Organisational data – provided by the heads of the organisations where the individuals work – are used here as context variables linked to individual data, in addition to the context variables data provided by the individual respondents. Using these data describing the workplace context in which teachers innovate allows the examination of the possible impact of workplace characteristics on the innovation behaviour and activity of teachers.

Our teacher respondents have been invited to respond two groups of questions related with their innovation practice. The questions belonging to the first group are general: they are not connected with any concrete, specific piece of innovation (e.g. "I participated in a programme in which I had to create new curricula, teaching tools and pedagogical methods myself"). The questions belonging to the second group relate to one specific, concrete innovation created by the respondent and chosen by him/her for more detailed exploration. In this paper we analyse the relationship between the innovation behaviour/activity of individuals and the organisational context in which they work using only the data of those respondents who were willing to choose and to present one of their specific, concrete innovations.

The indicators of individual innovation activity and behaviour

In this study we use two individual innovation indexes calculated from the individual questionnaire of the Innova survey. One refers to what we call *innovation behaviour*, the other to what we call *innovation activity*. We make a distinction between these categories. Innovation behaviour is a set of attitudes, predispositions and related forms of actions. Innovation activity designates the intensity or frequency of people creating innovative solutions in their work. The indicators of innovation behaviour allow the establishment of typologies classifying individuals according to their attitudes, predispositions related with innovation. People belonging to these categories might show various levels of actual innovation activity.

The innovation behaviour index

For the measurement of innovation behaviour we have been using a simplified version of an instrument originally developed by de Jong and Den Hartog (2008), and later adapted to educational institutions by Messmann - Mulder, 2012). This simplified instrument, originally called Innovation Work Behaviour (IWB) scale, consists of 12 statements on various activities related with innovation. Respondents were invited to indicate the frequency of these activities in their professional practice on a 1-7 Likert scale. Our exploratory factor analyses revealed two independent IWB factors: one related with creativity and idea generation, and the other related with the implementation or realisation of ideas. For this study a principal component analysis was used with the specification of 2 factors. These two (independent) factors explain 67% of variation. Table 2 shows the correlation of the two factors with the test items.

Table 2
The innovative work behaviour of respondents (factor correlation matrix)

	Factor 1	Factor 2
Obtaining approval to realise new ideas	,833	,201
Searching for supporters to realize new ideas	,808	,217
Encouraging staff members who are important in the institution to adopt new ideas	,787	,219
Taking risks to make promising solutions	,734	,334
Systematically introducing new solutions at work	,718	,420
Converting new ideas into a practical solution	,703	,445
Evaluating the usefulness of emerging new ideas	,664	,452
Following up on developments in institutions like us	,635	,373
Finding new working methods, techniques, tools	,260	,832
Finding new ideas in difficult areas	,293	,790
Creating original solutions for specific problem situations	,348	,755
Follow up on new developments in my field	,235	,684

We call Factor 1 "*Implementation behaviour*" and Factor 2. "*Creative behaviour*". Factor scores have been converted into a 1-100 scale for easier comparability. Both new variables present a normal distribution.

The innovation activity index

The individual Innova questionnaire has contained a number of questions aimed at exploring the intensity of the *innovation activity* of respondents. The latter have been asked to indicate the frequency of certain forms of actions in their own practice of the last ten years. The frequency has been used as a scale where the answer "this hasn't ever happened" got the value of 1 and the answer "this happened many times" got the value of 4. The answers to these questions have been used to calculate a composite innovation activity indicator (CII). In this case we have developed the indicator on the bases of theoretical considerations. Only a few questionnaire items were used to calculate the value of the composite index and the value of the index was based on simple average calculations and some theory based weighting.

The primary value of the indicator has been calculated as the simple average value of the following four items:

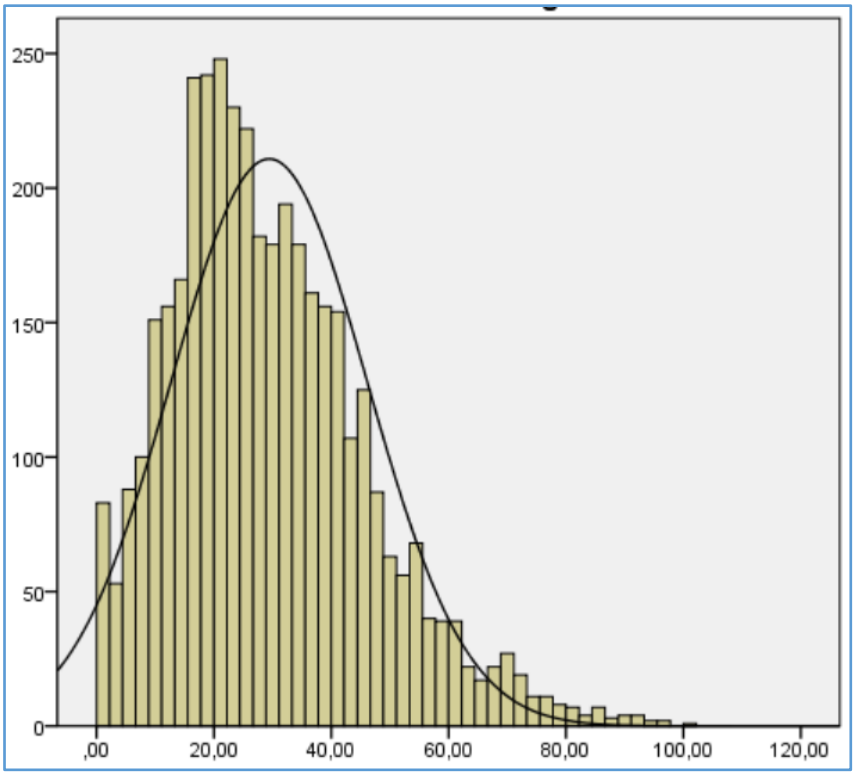
- "I discovered and started to use solutions that were significantly different from my previous practice"
- "I started to use solutions that were significantly differed from my previous practice, which I learnt from others"
- "Some of the new solutions I invented significantly improved the efficiency of my work"
- "I experimented with new solutions and methods that helped my own work"

The primary value of the CII has been increased (weighted) in function of the occurrence of the following specific features.

1. A particularly high level frequency of the third item above considered as the most important from the perspective of what we consider innovation activity
2. High level frequency of innovations in a number of specific domains, listed below:
    - Methods and tools for planning and implementing lessons
    - The evaluation or measurement of students' achievements
    - Activities outside the classroom or lessons
    - Technical and IT solutions in in teaching
    - The internal organisation of the workplace
    - Technical and IT solutions affecting the leadership and the management or the organisation
    - External relations with partners/users
    - The development of competences and abilities of students
    - New solutions for nurturing talent
    - The education disadvantaged students and/or students with special education needs
3. High level frequency of certain innovation transmission activities, such as the replication of solutions created by the respondent by colleagues within her/his institution or from other institutions
4. The detailed presentation of one specific concrete innovation (which was optional in the questionnaire)

Although the Innova research project did not aim at evaluating the general level of innovation activity of Hungarian teachers (our sample does not represent the totality of the national teacher labour force), the relatively high number of responses from the various subsectors of the education system allows the formation an approximate picture about the intensity of individual level innovation activity in the Hungarian education system. As *Figure 1* shows the distribution of individuals with lower and higher level innovation activity – as measured by our CII index – is close to normal (similarly to what we see in the case of the two innovation behaviour variables.

Figure 1.
The individual composite innovation activity index



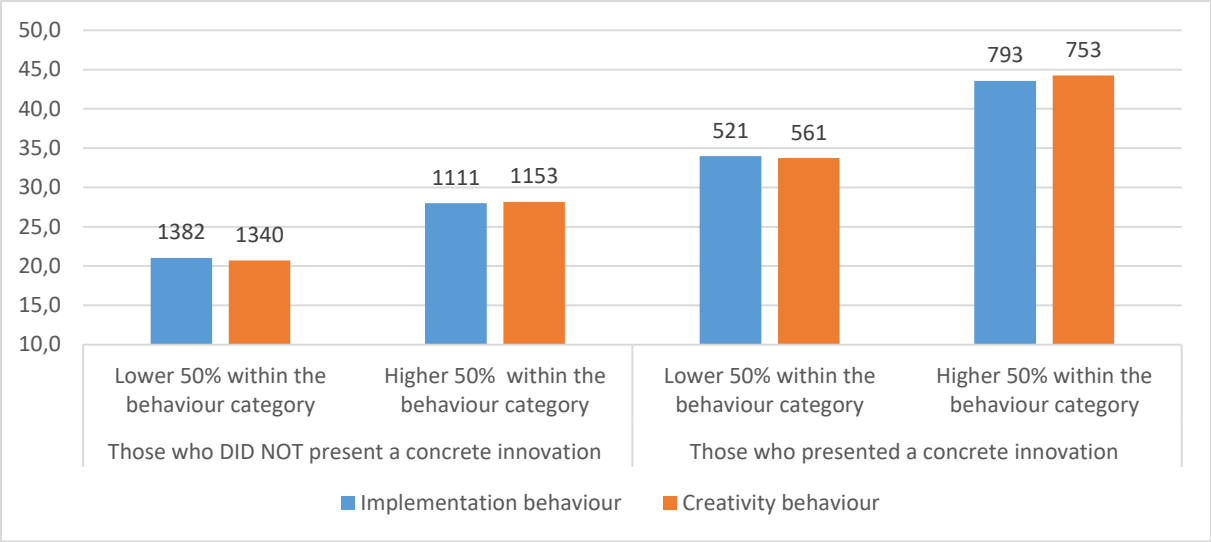
Note: The values if the CII innovation activity index is between 0 and 100 (Mean = 29,1; SD=16,7)

As mentioned, respondents in the Innova survey have been invited to choose one concrete, specific innovation they created and answer a number of specific questions related with this concrete innovation. From the more than 4000 respondents more than 1300 have accepted to present one concrete innovations created by them (34%). Unsurprisingly, the CII of these respondents is significantly higher that the index of those who could not or did not want to present a concrete innovation of their own. As mentioned earlier, in this study we shall analyse the relationship between contextual factors and individual innovation practice on this limited sample. Before doing this, it is interesting to make a short detour to see the relationship between Innovation behaviour and innovation activity. In the following short section we still use the whole individual database, including those who did not present a concrete innovation.

Innovation behaviour and innovation activity

It is not surprising that innovation activity and innovation behaviour are not independent from each other. Those who show higher level value in the two IWB indicators also show higher CII scores, identically in both IWB (implementation and creativity) domains, and this is similar among those who presented and those who did not present concrete innovations. In *Figure 2* we compare the CII scores of people belonging the lower and the higher 50% in both IWB categories (the difference between them is always statistically significant). The figure also shows that the relationship between innovation activity and innovation behaviour is similar in the implementation and the creativity groups in spite of the fact that there is zero correlation between the two IWB indicators.

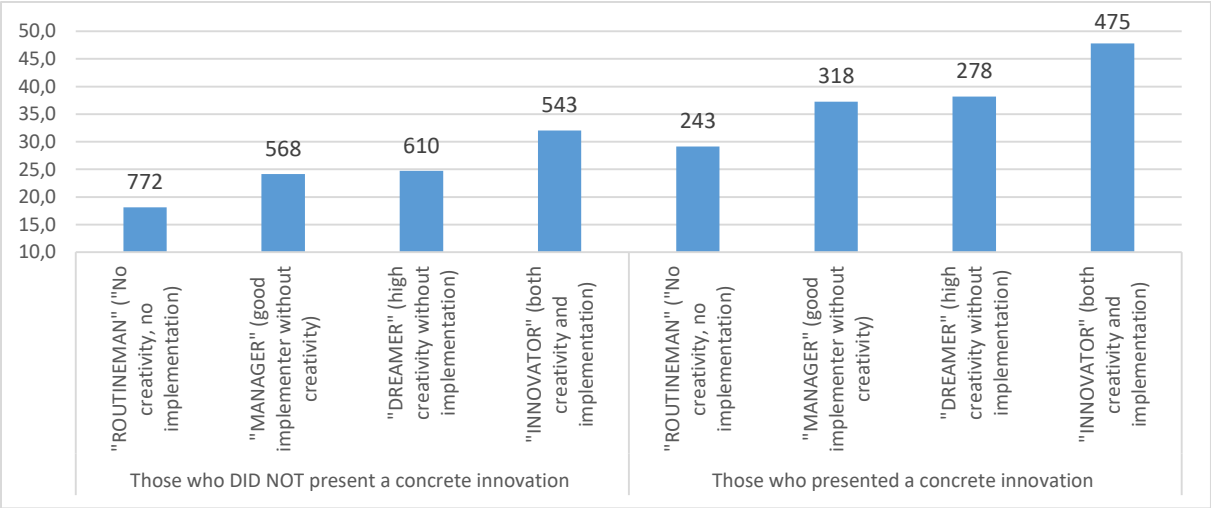
Figure 2.
The innovation activity (CII score) of individuals belonging to the lower and the higher 50% of the innovation behaviour groups among those who presented and those who did not present concrete innovations



Notes: Data from the Innova2 individual database. The scale indicates the value of individual CII (1-100 scale). The numbers above the bars show the number of cases. All differences between the pairs of bars are statistically significant.

The existence of two IWB indicators allows the establishment of typologies. We call "Routineman" those who do not show either creativity or implementation behaviour. Those who show both are called here "Innovators". Those who show creativity without implementation behaviour are the "Dreamers" and those who show the opposite combination are called here the "Managers". *Figure 3* shows the CII score of people belonging to these four types, separately for those who presented and those who did not present a concrete innovation of their own. The differences of the CII score of "Dreamers" and "Managers" are statistically not significant but all the other differences are.

Figure 3.
The innovation activity (CII score) of individuals belonging to the four IWB types among those who presented and those who did not present concrete innovations



Notes: Data from the Innova2 individual database. The scale indicates the value of individual CII (1-100 scale). The numbers above the bars show the number of cases. All differences, except for the two bars in the middle are statistically significant.

Figure 2 and *Figure 3* also show the difference of CII scores between those who presented and those who did not present concrete innovations. In the following we proceed our analyses only within the former group, that is, those who were willing to select one of their own innovations and were willing to provide data on this specific innovation. The number of cases in this group is 1353: 79% of them are from the K-12 sector, 16% form higher education and 4,3% from other sectors.

Individual behaviour and organisational characteristics

In this section we analyse the relationship between the two categories of individual innovation indicators (CII and the two IWBs) and some organisational characteristics. The questionnaires of the Innova surveys contain several sets of questions related with organisational characteristics. This study does not allow the exploration of relationships through all relevant sets of questions. We have selected thee areas for analysis: (1) the innovation activity of the organisation (the generation of organisational level innovations); (2) the dynamic capacities of organisations (workplaces operating as learning organisations); and (3) the general organisational profile of organisations.

In the first area we use questions developed within the Innova research projects, in the two other areas we use the adapted and simplified version well-known organisational research instruments. I all cases we use data provided by the heads of those education units (pre-schools, schools, university departments) where the examined individuals (teacher, trainers) work.

Individual and organisational innovation activity

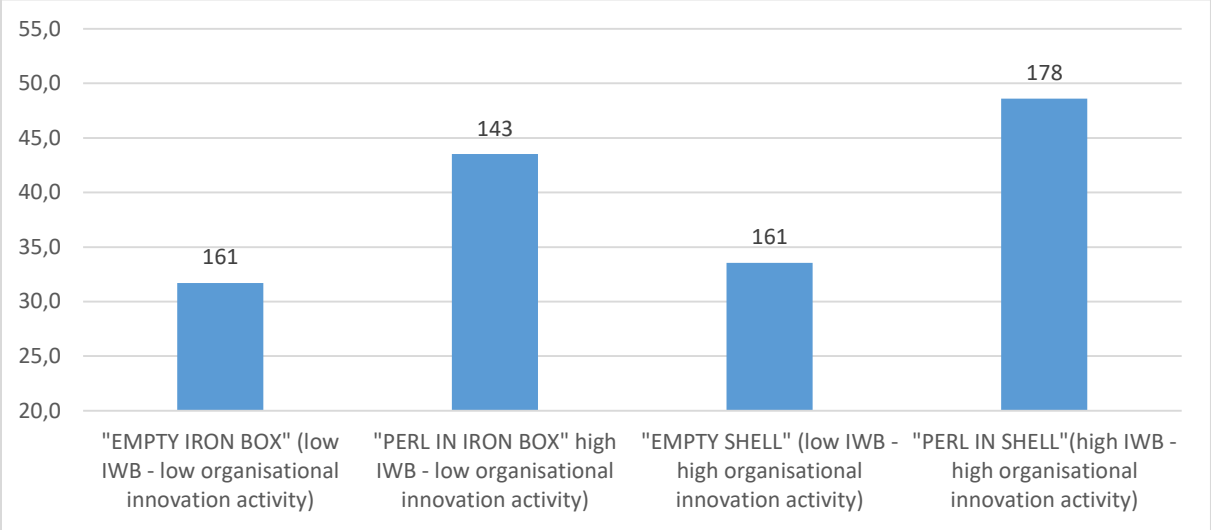
The Innova database contains data not only about the innovation activity of individuals but also about that of their workplaces. The organisational innovation activity score (characterizing the workplace) has been calculated similarly to the way individual CIIs have been calculated. This is based on similar questions but in this case the questions are related not with the individual but with the organisation and the answers came from the heads of these organisations. Those teachers who work in an organisation of higher level innovation activity show significantly higher level CII scores. While the average CII of those teachers who work in organisations belonging to the lowest one third of organisational innovation activity is 36,1 (N=199) those working in the highest one third have a score of 41,9 (N=235).

The level of organisational innovation activity might have an impact not only on the innovation activity of individual teachers but also on their innovation behaviour (IWB), although this influence seems to be lower. In fact we did not find statistically significant difference between the IWB score of teachers working in organisation showing lower and higher innovation activity.

Data on the innovative work behaviour of individuals and the level of organisational innovation activity allows again the creation of four specific groups which reflect four particular workplace constellations. The first is described with the metaphor of "*Empty iron box*": this is the case when an individual of low level average innovation behaviour score finds himself/herself in an institution showing low level innovation activity. We call "*Perl in iron box*" the case when the individual has high average IWB scores but works in an organisation with low level innovation activity. When an individual with low average IWB score works in an organisation of high level innovation activity we use the metaphor "*Empty shell*". And when both the individual's average IWB score and the innovation activity level of her/his workplace are high this constellation is

called "*Perl in shell*". *Figure 4* shows the CII scores of individuals belonging to these four groups.

Figure 4.
The innovation activity (CII score) of individuals belonging to the four combinations of IWB and organisational innovation activity



Notes: Data from the Innova2 individual and organisational database. The scale indicates the value of individual CII (1-100 scale). The numbers above the bars show the number of cases. All differences, except for the difference between the "Empty iron box" and the "Empty shell" people are statistically significant. Unsurprisingly the "Perl in shell" situation seems to be the most favourable for the emergence of high level individual innovation activity.

It is important to stress that in this analysis organisational data are used to characterize individuals, assuming that the workplace environment in which individuals work can be interpreted as one of their personal attributes. The unit of analysis is the individual, but the data describing the individual characteristics has been provided by the head of the workplace of the individual and comes from an organisational database.

Individual innovation behaviour/activity and the dynamic capacities of organisations

We use the term "dynamic capacities" to describe the capacity of organisations to behave as intelligent learning organisations. The dynamic capacities of organisations have been measured in our 2016 data collection round with a test adopted from the simplified version of the "Dimensions of Learning Organization Questionnaire" (DLOQ) originally developed by Watkins and Marsick (Marsick – Watkins, 2003; Yang et al., 2004; Bess et al., 2010; Song et al., 2013; Horváth, 2017; Horváth – Halász, 2017). Respondents (leaders of educational units) were requested to express their agreement with 14 statements about their organisation.

A principal component factor analysis (with varimax rotation) executed on the organisational database[4] resulted in 3 factors with eigenvalues higher than 1, explaining 60% of variation (see *Table 3*). Factor 1 has been interpreted as people "working in organisations of high internal coherence being open to their external environment" (labelled "*Coherence/openness*"); factor 2 has been interpreted as people "working in organisations providing support for the learning and the work of their employees" (labelled "*Support for learning and work*"); and factor 3 as

[4] For this analysis only the organisations of those individuals were included who presented one of their specific concrete innovations. The number of organisations included in the factor analysis was 436.

people "working in organisations with a culture favourable for learning" (labelled "*Learning culture*").

Table 3
The dynamic capacities of respondents' organisations (factor correlation matrix)

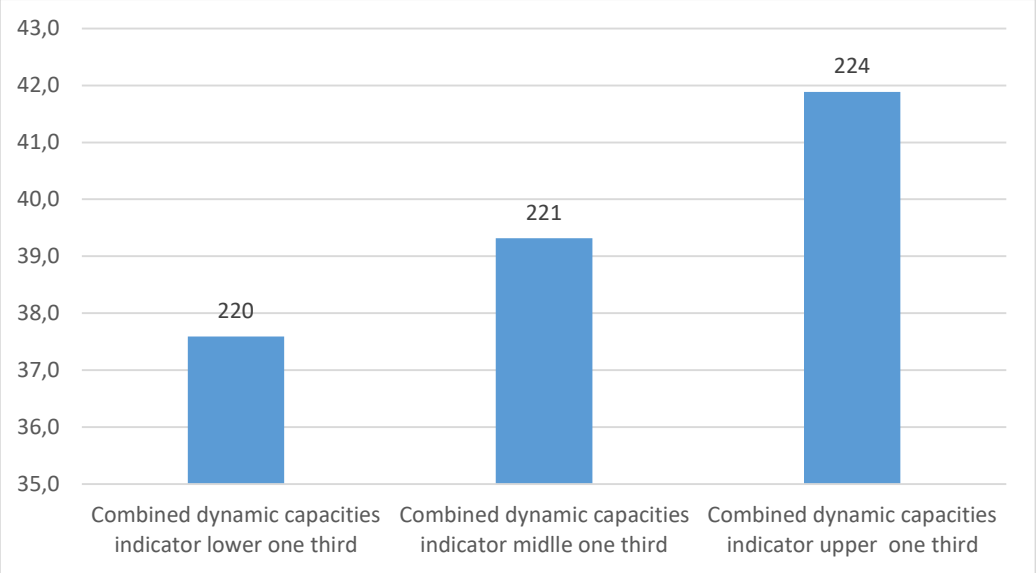
	Factor 1 ("Coherence/ openness")	Factor 2 ("Support for learning and work")	Factor 3 ("Learning Culture")
The organisation/institution encourages employees to seek solutions to problems even beyond the institution	,741		,112
In our organisation/institution there is a great consideration of how decisions impact the employees' morale	,729	,108	,168
In this organisation/institution there is an aspiration of unifying ideas regarding the organisation's vision for the future	,653	,335	,261
The organisation/institution supports that employees think in a community perspective	,619	,320	,313
The organisation/institution recognises staff initiatives	,546	,531	,190
The organisation/institution works with external partners to achieve common goals	,507	,386	,180
The organisation/institution provides adequate resources to the employees in order to successfully complete their tasks		,795	,126
The organisation/institution generally supports the need for learning and training opportunities	,147	,791	
In the organisation/institution, the number of those that learn new skills is growing	,173	,645	,300
The organisation/institution provides a quick and easy access to necessary information to the employees	,443	,573	,130
The organisation/institution recognises the learning activities of employees	,461	,528	,347
The employees are open to provide and receive honest feedback from and to each other	,167	,163	,905
The employees openly discuss mistakes in order to learn from them	,222	,109	,871
The employees approach problems in their work as opportunities to learn and develop	,294	,239	,744

The factor scores (converted into a 1-100 scale for easier comparability) have been used as new variables interpreted as learning organisation dimensions. These variables are used here as indicators of the environment in which our respondents do their daily work. This makes it possible to compare individuals operating in different working environments which might have an influence on their innovation activity and behaviour. This is again a case of using

organisational data to characterize individuals, assuming that the workplace environment in which individuals work can be interpreted as one of their attributes.

Data show that those individuals who work in organisations with higher level dynamic capacities (their workplace is closer to what we call a learning organisation) show slightly higher level innovation activity. Those who are working in organisations belonging to the upper one third of the combined index (mean of the three factor scores mentioned in the previous paragraph) are significantly more active in creating innovations in their daily work than those who work in organisations belonging to the lower one third (see *Figure 5*).

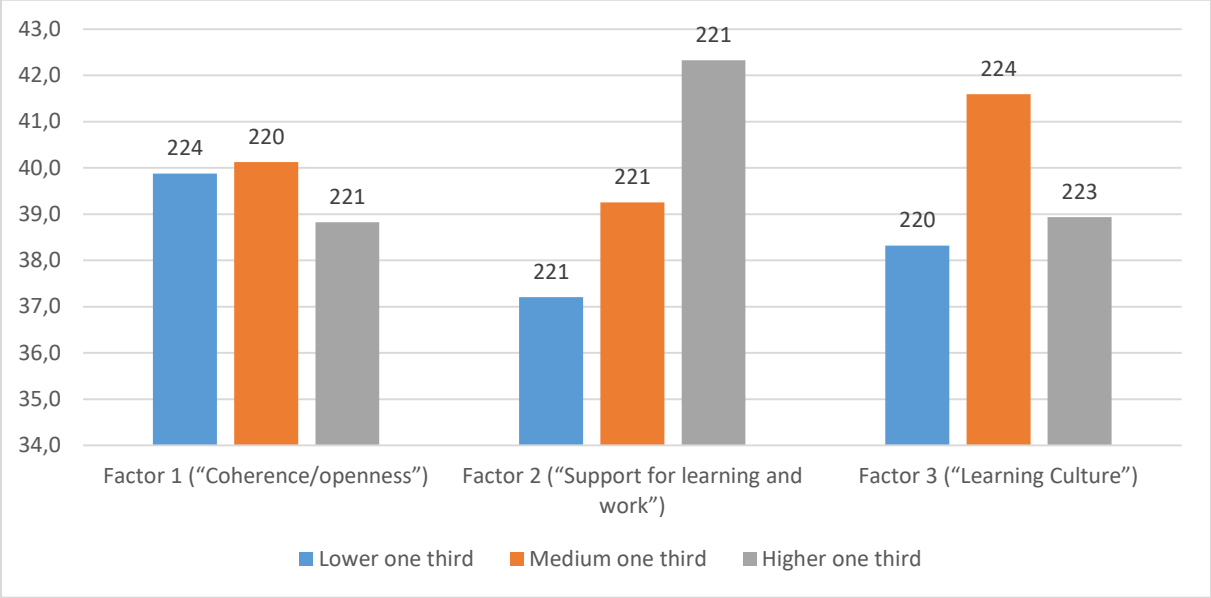
Figure 5.
The level of innovation activity of individuals working in different organisational environments



Notes: Data from the Innova2 individual and from the Innova1 organisational database. The scale indicates the value of individual CII (1-100 scale). The numbers above the bars show the number of cases. The differences between the lower and the upper one is statistically significant.

However, when decomposing the combined indicators into its specific components we see a more differentiated picture. It seems, there is only one dimension of learning organisation which has a clearly positive linear relationship with the level of innovation activity of individuals: those who are working in organisations which – according to their leaders – show higher level support for the learning and the work of their employees are significantly more active in creating innovations than those who work in organisations where leaders think this kind of support is low. Interestingly, there is a slight (statistically not significant) negative correlation between the innovation activity of individuals and the factor interpreted as internal coherence combined with openness to the outside world. Individuals working in organisations described by their leaders as showing high level internal coherence accompanied with high level outward openness seem to be less active in creating innovations than those who work in other, less coherent and more inward looking organisations. A similar pattern can be seen in connection with what we described as learning culture. Those who work in organisations which, according to their leaders, show particularly high level of culture seen typically as favourable for learning seem to be less active in creating innovations than those who are working in an organisation with a medium level of such learning culture (see *Figure 6*).

Figure 6.
The level of innovation activity of individuals (CII scores) working in different organisational environments

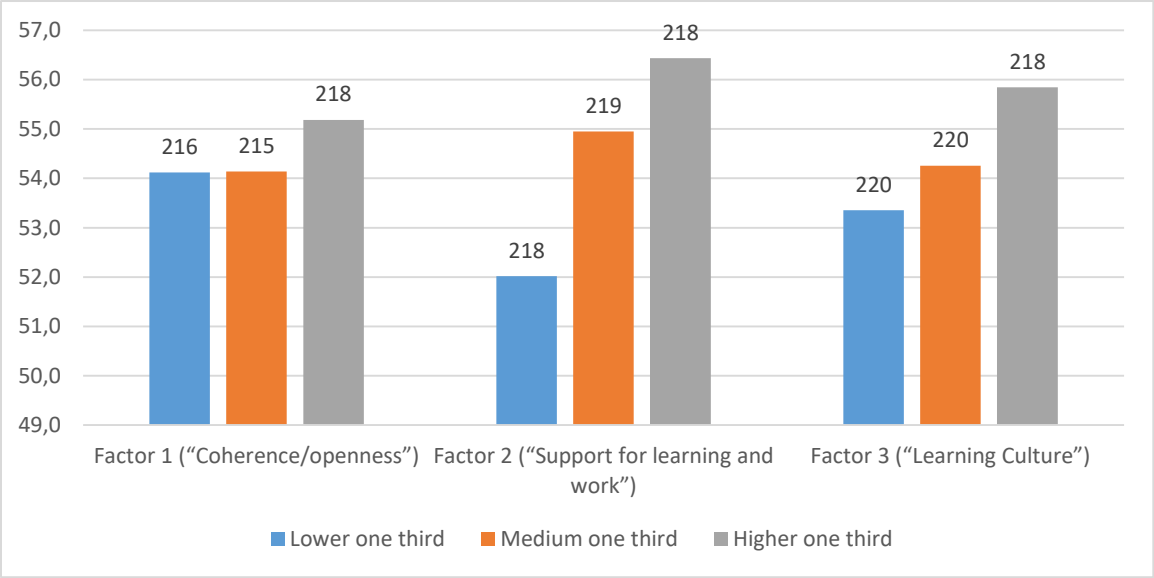


Notes: Data from the Innova2 individual and from the Innova1 organisational database. The scale indicates the value of individual CII (1-100 scale). The numbers above the bars show the number of cases. Differences in function of "Coherence/openness" are statistically not significant. Differences between the lover and higher one thirds in "Support for learning and work" are statistically significant as well as the differences between the lover and medium high one thirds of "Learning culture".

It is important to stress that *Figure 6* shows the innovation activity of individuals. If we look at the innovation activity of organisations (education units) we see a different picture. The innovation activity of organisations shows a positive correlation with all the three indicators of organisational dynamism. The question of why people working in organisations showing the highest value in "Learning culture" show lower level innovation activity than those working in organisations belonging to the medium one third (see the right part of *Figure 6*) is not easy to answer. As *Table 3* shows these are people whose leaders think their employees are particularly "open to provide and receive honest feedback from and to each other", they are particularly ready to "openly discuss mistakes in order to learn from them" and "approaching problems in their work as opportunities to learn and develop".

As for the relationship between the innovative work behaviour (IWB) of individuals and the dynamic organisational capacities of their workplace we see stronger connections, although these are slightly different in the case of the two IWB types. As *Figure 7* shows individuals demonstrate higher level "creative behaviour" in those organisations which have higher level dynamic capacities. Similarly to what we have seen in the case of CII the connection with the factor internal coherence and outward openness is week (statistically not significant) and the connection is the stronger with the factor of supporting the initiatives and the learning of employees.

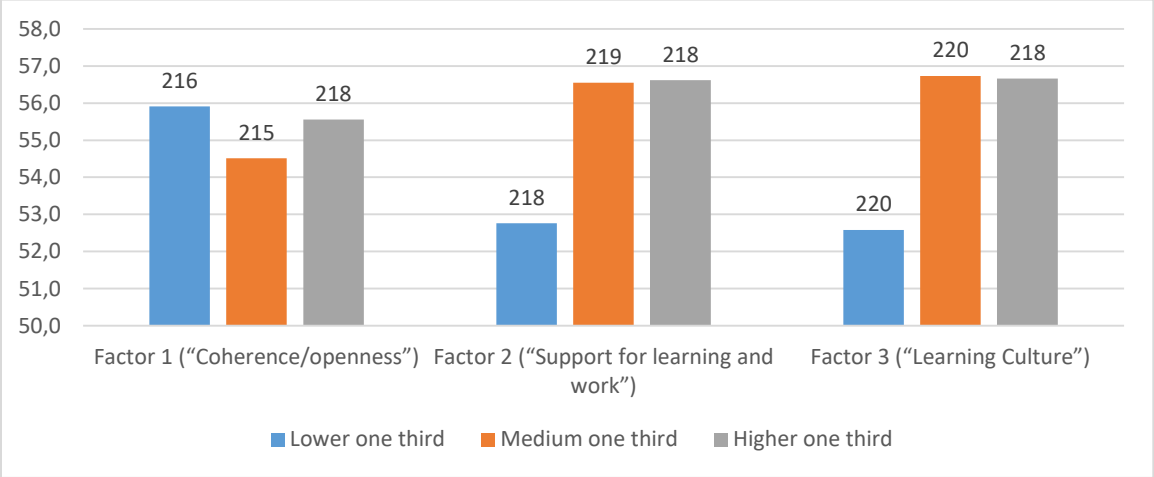
Figure 7.
The creative behaviour scores of individuals working in different organisational environments



Notes: Data from the Innova2 individual and from the Innova1 organisational database. The scale indicates the value of the creative behaviour scores of individual (1-100 scale). The numbers above the bars show the number of cases. Differences between the lover and medium one thirds in "Support for learning and work" and differences between the lover and higher one thirds in "Learning culture" are statistically significant.

As for “implementation behaviour”, this also has higher values in case of individuals working in organisations with higher dynamic capacities. Interestingly, the level of this kind of innovation behaviour is at the same in the case of people working in organisations belonging to the medium and high one third of the value of the factors “support for learning and work” and “learning culture” (see *Figure 8*).

Figure 8.
The implementation behaviour scores of individuals working in different organisational environments



Notes: Data from the Innova2 individual and from the Innova1 organisational database. The scale indicates the value of the implementation behaviour scores of individual (1-100 scale). The numbers above the bars show the number of cases. Differences between the lover and medium one thirds in "Support for learning and work" and "Learning culture" are statistically significant.

To summarize: the innovation behaviour and activity of individuals (teachers, trainers) is not independent of the dynamic capacities of their workplaces (schools, university departments), but the connections are not very strong. From the three dynamic capacity factors of workplaces only two (support for work/learning and level of learning culture) show significant correlation

with the innovative behavioural characteristics of individuals. One factor (internal coherence and outward openness) seems not to have significant correlation with individual innovative behavioural characteristics. Organisations (workplaces) demonstrating higher value in this factor combine the stress of common internal values (coherence) positive attitudes towards cooperating with their environment (openness). While they show higher level organisational level innovation activity they seem not to give particular support for their employees to innovate as individuals.

Individual innovation behaviour/activity and the general profile of the organisation

The general organisational profile of the educational units examined has been determined using a simplified and adapted version of the Organizational Culture Assessment Instrument (OCAI) developed Cameron and Quinn (Cameron - Quinn, 2006). Our instrument contains only 16 items. A principal component factor analysis (warimax rotation) executed on the organisational database[5] resulted in 2 factors with eigenvalues higher than 1, explaining 61% of variation (see *Table 4*). Factor 1 has been interpreted as people "working in effective, democratic and stable organisations" (labelled "*Effectiveness*"); factor 2 has been interpreted as people "working in dynamic, innovative, performance oriented organisations" (labelled "*Dynamism*").

Table 4
The organisational profile (OP) of education units (factor correlation matrix)

	Effectiveness	*Dynamism*
The members of the organisation are involved in the decision-making process in a wide and proper manner	,756	,208
The goals of the organisation are clear and understandable for most employees	,750	,224
Work is supported by the organisation's rules and the formal methods and procedures applied	,719	,203
Decisions in the organisation typically come about by common agreement	,708	,194
Workflows in the organisation are planned and controlled	,658	,230
The organisation usually works intensely	,555	,419
Working conditions are stable, predictable and well-designed	,509	,247
The relationship between the workplace and the staff is positive	,458	,416
The organisation is seen by external viewers as a dynamically developing system	,191	,783
Outside viewers see the organisation as a dynamic, full of potential	,197	,751
The organisation encourages creative insights and innovative ideas	,282	,650
The organisation places great emphasis on innovation, trying out new things and discovering new opportunities	,160	,629
In the organisation, there is a constant pursuit of achieving better and greater performance	,310	,623
In the organisation, individual goals are guided by organizational goals	,371	,605
Employees of the organisation feel that they are important to the organisation	,478	,569

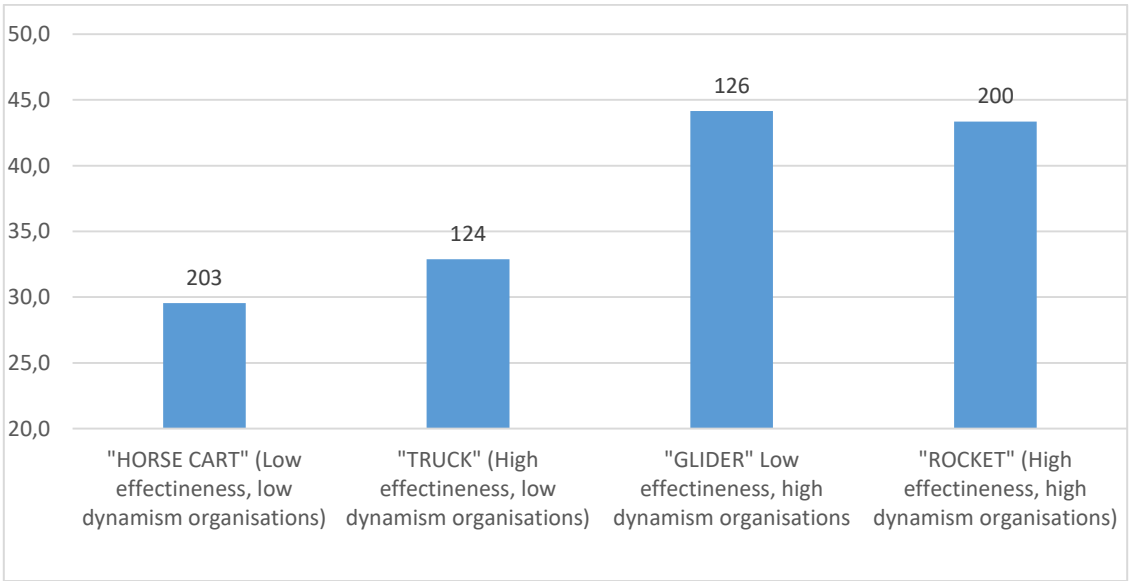
[5] For this analysis only the organisations of those individuals were included who presented one of their specific concrete innovations. The number of organisations included in the factor analysis was 389.

Quantification and measurement are a key feature of the work culture	,138	,479

The factor scores – similarly to the dynamic capacity variables – have been converted into a 1-100 scale for easier comparability and they have been used as indicators of the profile of the organisational environment in which our individual respondents work. Here again we have been using organisational data to characterize individuals.

The two independent organisational profile (OP) variables allow the identification of four different types of workplaces that can be described again with four different metaphors (see *Figure 9*). Interestingly, the innovation activity of people working in "*Rocket*" organisations (characterized by both high level effectiveness and high level dynamism, including innovativeness) demonstrate slightly lower level innovation activity (statistically the difference is not significant) than those who work in "*Glider*" organisations (characterized by high dynamism and innovativeness but lower level of effectiveness and stability).

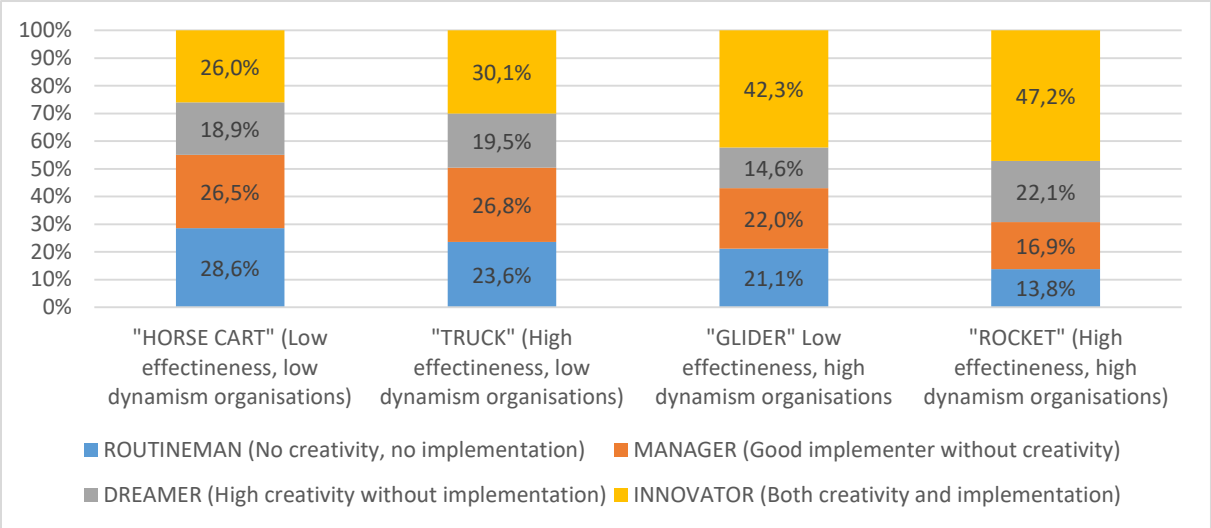
Figure 9.
The level of innovation activity of individuals (CII scores) working in different organisational environments



Notes: Data from the Innova2 individual and organisational databases. The scale indicates the value of the CII score (1-100 scale). The numbers above the bars show the number of cases. Differences between, except between two highest values are statistically significant.

People with different innovation work behaviour (IWB) patterns are represented differently in the four groups of organisations with different organisational profiles (OP). In the less effective and less dynamic organisations ("*Horse carts*") there is a much higher proportion of people without both creativity and implementation capacity ("*Routine men*") than in the three other kinds of organisation (especially in "Rockets"). And inversely: the proportion of "Innovators" is much higher in organisations labelled "Rockets" and "Gliders" than in those labelled "Horse carts" or in "Trucks" (see *Figure 10*).

Figure 10.
The distribution of individuals belonging to different IWB categories within the four groups of organisations with different organisational profiles (OP)



Notes: Data from the Innova2 individual and organisational databases.

We assume that the positive relationship between the innovative work behaviour (IWB) and the organisational profile (OP) patterns reflect the outcome complex evolution processes. "Horse cart" type of institutions provide less favourable environment to "Innovators" than "Rocket" organisations: "Innovators" probably try to leave these organisations and try to find a workplace which is closer to the "Rocket" pattern. And, inversely, if "Innovators" leave the "Horse cart" organisations the chances of the latter to develop into something that is closer to the other extremity diminishes. This might generate self-amplification processes making the low lower and the high higher. Let us illustrate this just by one figure: while more than 70% of individuals working in "Rocket" type organisations chose the answer "frequently" or "very frequently" when asked about how often they participated in the past ten years in further training where they "learnt new ways to improve their performance" this proportion was less than 58% among those who work in "Horse cart" type or organisations.

Multivariable analysis

In the previous sections we have demonstrated positive relationships between the innovation activity and behaviour of teachers and trainers, on the one hand, and the characteristics of their workplaces (pre-schools, schools, university departments), on the other. In most of the figures presented so far we combined two or three variables and we compared specific groups. In this section we present the outcomes of a multivariable analysis including all organisational variables and all individual innovation behaviour/activity variables used in the sections above. Since one of the goals of the Innova research project – as we could already see – is to identify specific types of educational organisations in function of their possible impact on the innovation behaviour/activity of teachers we use cluster analysis as a relatively simple statistical procedure supporting classification.

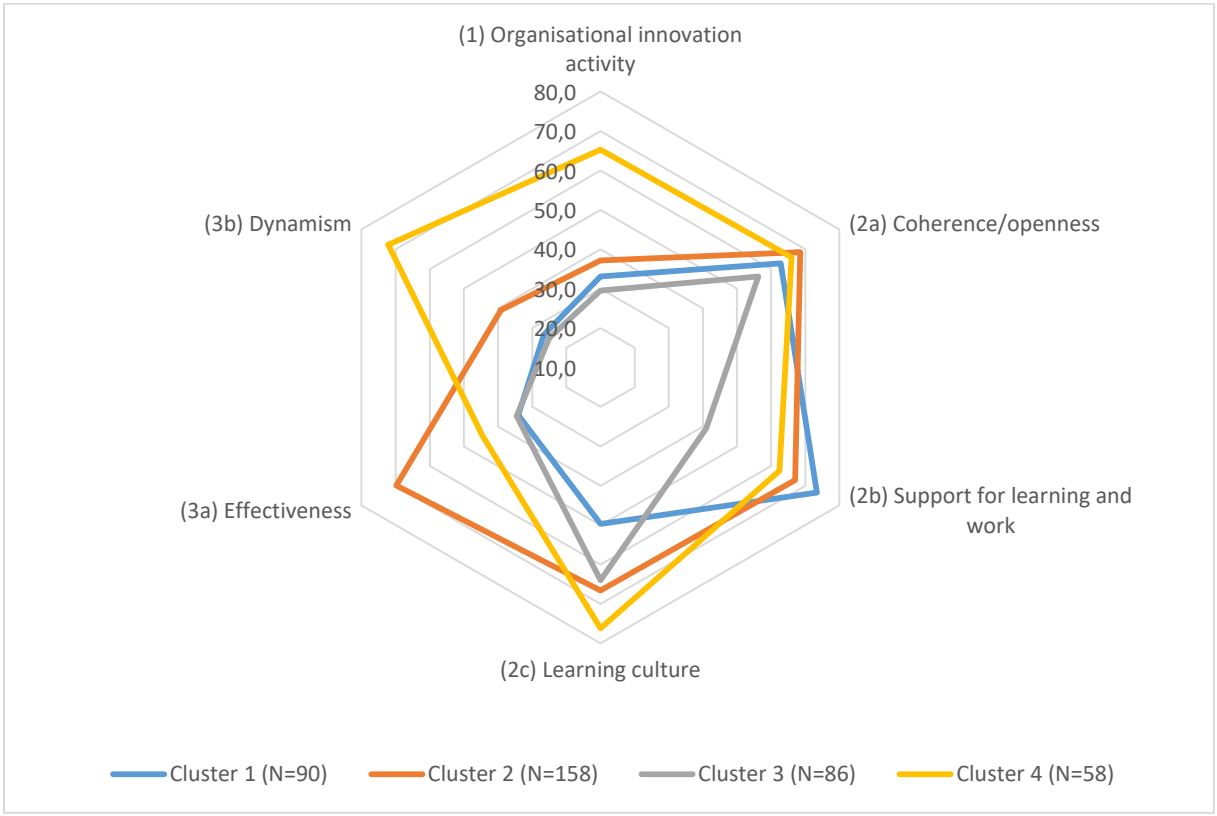
A two-step cluster analysis with a preliminary specification of the number of clusters (N=4) has been used in this analysis. The six organisational variables used as input variables in the cluster analysis are the same as those used in the sections above:

(1) Organisational level innovation activity
(2) Organisational dynamism (learning organisation)
    2a: Coherence/openness
    2b: Support for learning and work
    2c: Learning culture

(3) Organisational profile
    3a: Effectiveness
    3b: Dynamism

Figure 11 shows the average value of the six organisational variables of the educational units belonging to the four clusters. The highest number of units (N=158) belong to cluster 2. These units can be described as (1) having an average level of organisational innovation activity; (2) relatively high learning organisation values, particularly high in coherence/openness and lower in both learning culture and support for learning and work; and (3) an organisational profile with very high level effectiveness and much lower but still quite high level of dynamism. These are well organised, effective education units which do not show particularly high level dynamism and do not excel in innovation activity. They are *effective routine-led schools*.

Figure 11.
The organisational characteristic of four groups of institutions



Notes: Data from the Innova1 (2a, 2b, 2c) and from the Innova2 (1, 3a, 3b) organisational databases. Only cases with data from both Innova surveys are included.

The smallest number of units (N=58) belong to the cluster 4. Education units in this cluster show (1) very high level of organisational innovation activity; (2) high level learning organisation features, with very high level of learning culture but much lower level support for learning and work; and (3) an organisation profile of high level dynamism but much lower level effectiveness. Our data also show that these schools see themselves as particularly high performing: their self-reported performance indicators[6] are the highest. These are the *innovative, dynamic, self-contained schools*.

[6] Both leaders and employees were asked about how they see the performance of their organisation compared to similar organisations and how they see the temporal change of performance. The statements related with

The number of education units belonging to cluster 1 (N=90) and cluster 3 (N=86) is similar and these units are also similar in their innovation activity level and organisational profile. They show (1) low level organisational innovation activity; and (3) an organisational profile with low level of both effectiveness and dynamism. However, they show (2) very different learning organisation characteristics. Cluster 1 schools offer very high (the highest) level of support for learning and work for their employees but their learning culture values are the lowest. In contrast, cluster 3 schools provide very low support for the learning and work of their employees, but the level of their learning culture is relatively high. Our data related with self-reported performance show low level performance in both clusters but cluster 3 showing the lowest. Units in cluster 1 could perhaps be described as *effort-making laggards*, while units in cluster 3 as *self-contained laggards*.

Individual innovation behaviour and activity shows different patterns in the four groups. As *Figure 12* shows the innovative work behaviour (IWB) scores of individuals are the highest in the group we described as *effective routine-led schools* but the scores of individual innovation activity (CII) are the highest in the group described as *innovative, dynamic, self-contained schools.* All individual innovation activity/behaviour scores are the lowest in the group of organisations described as *self-contained laggards.*

Figure 12.
Average individual innovation behaviour and activity scores in four clusters of education units

Notes: Data from the Innova2 individual and the Innova1 and Innova2 organisational databases. The characteristics of the four clusters are presented in *Figure 11*. The differences between the IWB scores of cluster 1 and 2 are statistically significant but those between cluster 1 and 3 are not. In the case of CII only differences between cluster 3 and cluster 4 are statistically significant.

The identification of specific clusters might help the planning of improvement interventions, including the exploration of existing innovation capacities of both organisations and people working in these organisations. This might also support the self-evaluation of educational organisations, including the identification of their strength and weaknesses. Higher level organisational capacities in general predict higher level individual innovation capacities but, as

performance in the text are based on the analysis of composite performance indicators based on the questionnaire items mentioned.

confirmed by multivariable analyses, some organisational features might be more supportive than others.

Conclusion

Innovation generated by employees in their daily practice has an important role in improving the quality of services. Those who are continuously inventing new solutions when encountering challenges in daily work perform better than those who are led simply by routines and standard protocols. In this respect the education sector is certainly not different from other public sectors. Individual employees (teacher and trainers) differ in their capability and willingness to innovate. Some of them show significantly higher level innovation activity and show more traits of innovative work behaviour than others.

Similarly to other public service sectors innovation activity and behaviour can be measured in the education sector through innovation surveys. Innovation surveys, when collecting data at both individual and organisational level make it possible to explore how different workplace environments influence the innovation activity and behaviour of individual employees. The education sector innovation survey realised in the framework of the Hungarian Innova research project has generated both individual and organisational data. A key assumption of the Innova project has been that innovation activity and behaviour can be captured using the same instruments in all subsystems of the education system, from pre-school to post-graduate tertiary education. In this paper individual and organisational data have been used to explore the differences between the innovation activity and behaviour of teachers and trainers working in different workplace environments. The analysis in this paper has covered only those individuals who, when invited to answer the Innova questionnaire, accepted to present in detail one of their own specific innovations.

The analysis has demonstrated significant differences between the innovation activity and behaviour of teachers and trainers employed by educational institutions/organisations showing different organisational characteristics. Those working in institutions/organisations (1) showing higher level innovation activity, (2) being closer to what we call a learning organisation and (3) being more effective and dynamic tend to be more innovative. On the basis of these organisational features education it is possible to identify specific clusters of education units. People working in organisations belonging to these clusters show different levels of innovation activity and behaviour. Data presented in this paper can be used by the designers of education development interventions: these interventions can be made more effective if the specific innovation capacities of target units are taken into account.

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