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EDITORIAL

With this issue you are holding in your hands, Journal on Efficiency and Responsibility in Education and Science (ERIES Journal) has completed the first decade of its history. ERIES Journal has gone an interesting journey since its inception, through an initial growth, followed by an expansion among scientist, until it has reached the current image. Increasing interest of authors and readers, together with indexation in various databases, proves that the path we decided to follow is the right one. Many more opportunities for its growth are ahead in the following decade.

We are glad to announce that ERIES Journal is now indexed in Emerging Source Citation Index (ESCI) by Clarivate Analytics. All issues published in volume 10 has been backwardly included in the ESCI – the part of Web of Science Core Collection. Moreover, ERIES Journal has been successfully re-accepted to Directory of Open Access Journals (DOAJ). We hope that these new indexations are the first step towards broad indexation in international databases. We expect to announce new indexations in the following issues.

In this last issue of the year 2017 (vol. 10, no. 4) we have variety of articles from University of South Bohemia, Institute of Mathematics of the Czech Academy of Sciences, La Salle University México, University of Economics and Management Prague, Czech University of Life Sciences Prague and University of Economics, Prague. We are glad that ERIES Journal constantly attracts researchers, academics and authors from diverse higher education and research institutions, as well as countries.

First article from authors Libuše Samková and Marie Tichá presents a study related to a usage of an educational tool called Concept Cartoons in future primary school teachers' education. This tool is considered as an instrument for observing how future primary school teachers reason about fractions. The authors used two sample groups: long-term participants and additional participation group, both composed by future primary school teachers. The tool of Concept Cartoons was used in problem solving, as well as in in problem posting activities. The results showed how these Concept Cartoons may be employed as a valuable universal tool in future teachers' education: as an environment for problem posing activities, as well as an instrument for qualitative assessment of subject matter knowledge and pedagogical content knowledge.

Second article presented by Carlos Alberto Jiménez Bandala and Luis Antonio Andrade aims to identify the level of incidence of social and economic variables on education considering the existence of a cumulative circular causation. Further, the authors point out public policy recommendations to improve people's well-being, in order to increase Indicators of development, especially in educational matters. The econometric analysis integrates information from 128 countries between a period 2010 and 2015. The results show different effects on the level of incidence of social and economic variables between rich and poor countries. In general, low economic growth leads to high rates of illiteracy, higher illiteracy means higher rates of poverty, an environment of poverty leads to other problems such as increased violence and corruption, high rates of violence and corruption increase educational lags and decrease possibilities of schooling, and, thus, a high illiteracy rate.

Third article from Lucie Vnoučková, Hana Urbancová and Helena Smolová deals with an analysis of students' perceptions towards a measurement of education quality standards. The authors try to identify significant groups of students according to their preferences in education quality. The data were collected using questionnaires and focus groups among 2,265 students and 168 academic staff. Two dimensional and multi-dimensional statistical methods were used to evaluate the results. The results identify five students' groups based on their education quality perception: Quality receptionists, Business oriented, Expert innovators, Distance learners and Arrangement oriented. Examination of students' interest in specific areas, subjects and courses leads to an identification of factors, which affect their preferences in education.

Last article from Kristýna Vltavská and Jakub Fischer deals with the application of the regional input-output tables to the analysis of the higher education institutions closedown. Regional input-output tables represent tool, which can be used for the assessment of the regional economic impact of the higher education institution closedown. The authors aim to demonstrate what happen to economy of individual Czech region when the Ministry decides to close down one higher education institution (HEI). Comparing the results for all 14 Czech regions, the authors conclude that the most significant impact of HEI's operation is for the South Moravia Region in terms of absolute changes of the total output and total gross value added of the region.

We hope that all our readers will find this last issue of the year 2017 interesting. We also hope that ERIES Journal will contribute to the field of efficiency and responsibility in education as it has contributed so far. With the end of the year 2017 we would like to thank to all the authors, reviewers and Editorial board members who contributed in increasing the ERIES Journal quality.

We wish you merry Christmas and all the best in 2018.

Martin Flégl

Executive Editor

ERIES Journal

ON THE WAY TO OBSERVE HOW FUTURE PRIMARY SCHOOL TEACHERS REASON ABOUT FRACTIONS

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Highlights
- *Concept Cartoons – a tool for observing future primary school teachers' reasoning*
- *Proper grasping of the concept of a fraction – a matter of a great importance*

Abstract
In our contribution we focus on the possibility to use an educational tool called Concept Cartoons in future primary school teachers' education, as an instrument for observing how future primary school teachers reason about fractions. In the introduction section we present Concept Cartoons, and also the primary school level of the fractions topic. In the first part of the research we analyse data obtained when future primary school teachers were solving a problem in the Concept Cartoon form. The task which we adapted to this form belongs to primary school mathematics, it focuses on the concept of a fraction per se (on the parts-and-whole decision and on comparison of two pre-partitioned models with diverse wholes). Using Concept Cartoons, we can observe which statements about the issue our respondents consider as correct, and which kinds of reasoning they use in their justifications. In the second part of the research we analyse problems that the respondents themselves posed in the Concept Cartoon form, with particular focus on tasks devoted to fractions.

Keywords
Concept Cartoons; fractions; future primary school teachers; problem solving; problem posing; reasoning

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Introduction

The study reported here is a part of a three-year qualitative educational research conducted under Czech Science Foundation project. The goal of the project is to implement inquiry-based education into university courses on mathematics and didactics of mathematics for future primary school teachers, and observe how active participation in these courses can influence professional competences of project participants, i.e. their knowledge, beliefs, and practice. In this particular study we focus on potentiality of an educational tool called Concept Cartoons, a tool which we use as diagnostic in the project.

In our last year's ERIE contribution (Samková and Tichá, 2016a) we focused on the possibility to develop project participants' open approach to mathematics during the course on mathematics, and introduced Concept Cartoons as a diagnostic instrument in the referred study. In particular, we used Concept Cartoons during problem solving activities to observe whether the participants of the study searched for different solutions of a given problem, and whether they accepted different forms of notations of a given solution. Lately, in the extended version of the contribution that was published in the ERIES Journal (Samková and Tichá, 2016c), we also used Concept Cartoons as a diagnostic instrument during problem posing activities in order to observe whether the participants of the study were able to pose Concept Cartoons that could allow their pupils to experience open approach to mathematics.

Now we investigate other opportunities related to using Concept Cartoons in future primary school teachers' education, and introduce Concept Cartoons as an instrument for observing future primary school teachers' reasoning. As a mathematical topic in the centre of the study we choose fractions, a topic that is just on the boundary between primary and lower-secondary school curricula in the Czech Republic, since the concept of a fraction per se belongs to the primary school curriculum (curriculum for pupils' age 6 to 11), and issues related to operations on fractions belong to the lower-secondary school curriculum (pupils' age 11 to 15). Again, we focus on problem solving and problem posing activities.

Our research questions are "What kinds of reasoning about fractions can be observed in future primary school teachers when using Concept Cartoons as a diagnostic instrument during problem solving?" and "What kinds of reasoning about fractions can be observed in future primary school teachers when using Concept Cartoons as a diagnostic instrument during problem posing?"

For the purpose of the research on the first research question we shall take a task on fractions belonging to primary school level, and adapt it to the Concept Cartoon form. We shall assign the adapted task to future primary school teachers, and observe how they reason when solving the task. For the purpose of the research on the second research question we shall ask future primary school teachers to pose tasks in the form of Concept Cartoons, and observe how they reason when posing the task.

The topic of fractions belongs to the most difficult ones, both in primary and secondary school context; many empirical researchers point out that (future) teachers tend to have only limited knowledge about this topic (Cramer and Lesh, 1988; Ma, 1999; Tirosh, 2000; Depaepe et al., 2015; Singer, Ellerton and Cai, 2015). The limitations refer to content knowledge as well as pedagogical content knowledge, so that our contribution addresses both these aspects.

From the perspective of ERIE conferences and ERIES Journal, the topic of our contribution is in relation to educational issues

such as students' ability to solve mathematical problems (Novotná et al., 2014; Novotná, 2016), pupils' academic efficacy in the course of transition between primary and secondary school levels (Hoskovcová and Krejčová, 2015), or assessment in inquiry based primary mathematics (Hošpesová and Žlábková, 2016). Moreover, the study deals with problem posing which is in relation to teachers' ability to pose mathematical problems (Patáková, 2013).

The paper has been developed as an extension of the contribution (Samková and Tichá, 2017b). At the beginning it presents background to the topic of fractions in the primary school classroom, and introduces participants of the study and employed tools (Concept Cartoons, problem posing). Then follows the description of the course of the research, and its results.

Fractions in the primary school classroom

As mentioned above, the part of the fractions topic belonging to the primary school mathematics in the Czech Republic consists of the concept of a fraction per se. The fundamental interpretation of fractions is the *part-whole interpretation* which is based on partitioning either a continuous quantity or a set of discrete objects into equal-sized subparts or sets (Behr et al., 1983), the continuous quantity might also be indicatively pre-partitioned (Lamon, 2006).

So that the primary school teachers and pupils meet usually tasks requiring

- to match fractions with various continuous models (e.g. to colour a fractional part of a shape, to ascertain which part of a shape is coloured, to ascertain a whole for a given fractional part of a shape, to find a fractional part by paper-folding, etc.); for samples see Figure 1 (pre-partitioned model) and Figure 2;
- to match fractions with various discrete models (e.g. to colour a fractional part of a set of discrete objects, to ascertain which part of the set is coloured, to ascertain a whole for a given fractional part of the set, etc.), for a sample see Figure 3;
- to compare fractions using the models; for a sample see Figure 4.

The models used for this purpose may be linear, planar, and also spatial. Being on the primary school level, models that use manipulatives are the first in line – pupils may use scissors, do paper-folding, glue coloured papers together, manage mosaics, marbles or cubes, etc.

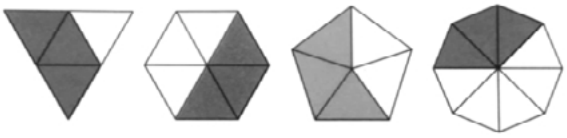

Figure 1: „Name by a fraction what part of the shape is coloured." (source: Divíšek, Hošpesová and Kuřina, 1999: 100; own translation)

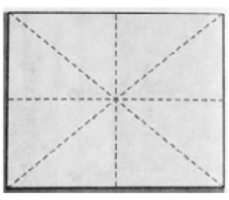

Figure 2: „Divide by folding a sheet of paper into eights." (source: Divíšek, Hošpesová and Kuřina, 1999: 93; own translation)

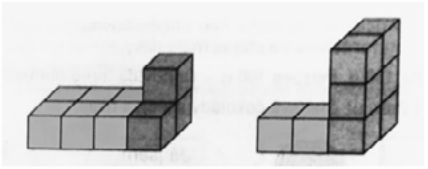

Figure 3: „a) Use yellow and blue cubes to build the building by the picture. b) Write by a fraction what part of the cubes in the building is blue. c) Add or remove some cubes, so that the blue cubes form 1/3 of all the cubes in the building." (source: Koman, Kuřina and Tichá, 1997: 8; own translation)

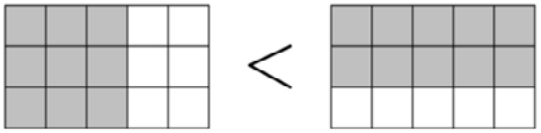

Figure 4: „What is more: 3/5 or 2/3?" – a graphical solution (source: own GeoGebra construction)

Primary school teachers and pupils can also meet more complex tasks that combine several different fractions (either with the same whole for all given fractions, or with different wholes for particular fractions), or tasks that are based on one or more fractional changes:

> There were 16 cakes on a plate. Petra ate a quarter of them, Michal ate a half, and Eva ate the rest. How many cakes ate Eva? (Divíšek, Hošpesová and Kuřina, 1999: 119; own translation)
>
> In the beginning of the season, the price of peppers was 72 crowns per kilogram. In the middle of the season, the price has fallen by half. In the end of the season, the price again grew, by half of the new price. What was the price in the middle and in the end of the season? (Koman, Kuřina and Tichá, 1997: 124; own translation)

Some rather difficult non-standard tasks based on the concept of a fraction can be found in entrance exams to lower-secondary selective schools, i.e. in exams that are taken by pupils in the last year of primary school level (pupils' age 10 to 11):

> A half of the ketchup in a bottle is already consumed, and the bottle with the ketchup weighs 690 g. After dinner, at which the family consumed a half of the remaining amount of the ketchup, the bottle with ketchup weighs only 430 g. What is the weight of the ketchup in a full bottle? What is the weight of an empty bottle? (Brlicová, Vémolová and Zelený, 2016: 23; own translation)
>
> Lumberjacks cut up the trunk of a spruce. A half of the logs were one-meter-long, a quarter of the logs were 75-cm-long, and the remaining 2 meters were cut to logs half-a-meter long. How long was the trunk of the spruce? (ibid: 69; own translation).

Some non-standard tasks based just on the concept of a fraction can be occasionally found also in newspapers, in a recreational mathematics column:

> There are 700 adults in a village where 1/3 of women is married to 1/4 of men. How many women and how many men live in the village? [1]

To solve such tasks, the pupil (as well as the teacher) has to be well oriented in the described situation, and has to decide properly what are the parts and the wholes of the situation.

Generally said, the decision about what is the whole in a task is the crucial one, and we shall focus on this issue from the

1 Very similar but much more difficult task that no longer belongs to primary school mathematics is presented by Lamon (2006: 12): "What is the ratio of men to women in the town where 2/3 of the men are married to 3/4 of the women?"

perspective of future primary school teachers. An inability to identify the whole causes many misconceptions and wrong solutions, not only within the topic of fractions but also in many others. This is because the reasoning employed when working with fractions serves as an important base for reasoning in other mathematical topics, namely percentages – a topic that is widely applicable in our everyday life, with high impact on personal financial issues:

> Is it better to have 30 % coffee extra free or a 25 % discount on the price of a jar? (Littler and Tylor-Basil, 1999: 76)

The inability to identify the whole often causes misconceptions also during problem posing; typical examples of such misconceptions were presented e.g. by Hošpesová and Tichá (2015) who asked in-service and pre-service teachers to pose several word problems including fractions 1/2 and 3/4, and, among others, received the following responses:

> Dad decorated 1/2 of the guest-room. Granddad decorated 3/4 of the living room. Who decorated more and how much more? (ibid: 440)
>
> There were 20 passengers on a plane. 3/4 of the passengers left the plane during the stopover, 1/2 boarded the plane. How many passengers continued the journey? (ibid: 440)

Materials and Methods

Participants

The referred study relates mainly to a group of respondents we have been observing systematically on a long-term basis. We will call them *long-term participants*. These respondents are 31 future primary school teachers, completely all students of the third year of five-year master degree program at the Faculty of Education, University of South Bohemia in České Budějovice.[2] During the academic year that preceded the referred study, the long-term participants had successfully completed their mathematics content course, and in the time of the referred study they were attending a subsequent course on didactics of mathematics.

Each of the long-term participants had been randomly assigned a unique code number. The code numbers had been chosen from the range between 1 and 39, to provide anonymity not only for the initial group of long-term participants but also for potential newcomers. In such a setting, not all of the numbers from 1 to 39 had been used, so that a newcomer did not obtain automatically the biggest number but one of the smaller ones that had not been assigned yet.

Some of the tasks discussed in this paper were also occasionally assigned to other groups of participants: future primary school teachers from the same university and the same study year but another academic year, or future lower-secondary school teachers from other universities (Faculty of Education, Charles University in Prague, and Institute of Mathematics, Pedagogical University of Cracow, Poland). We will call them *additional participants*. Results related to additional participants will be also discussed in the study, to obtain a more complex overview of the reported issue. Data collected from 78 future lower-secondary school teachers will provide an illustration to the first part of the study, and data collected from 36 additional future primary school teachers will enrich the second part of the study.

Diagnostic instrument

As a diagnostic instrument in our study we use again the educational tool called *Concept Cartoons* (Keogh and Naylor, 1999). Each Concept Cartoon is a picture showing a group of several children in a bubble-dialog, where individual children present alternative viewpoints on the displayed situation, e.g. opinions, statements, proposals of ways of solving, possible results (see Figure 5). The alternatives may be correct as well as incorrect; their correctness may also be unclear or conditional. Concept Cartoons and their history were introduced in detail in our previous contributions (Samková and Tichá, 2016a, 2016c; Samková, 2016a), various samples of Concept Cartoons may be found there.

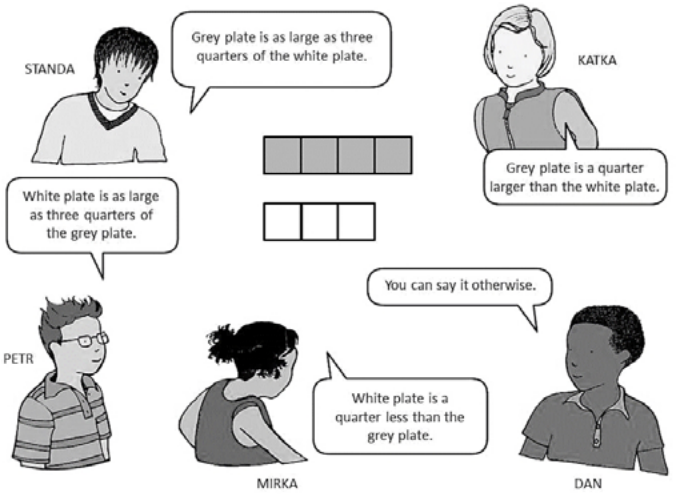

Figure 5: Concept Cartoon on fractions, own translation (source of the template of children with empty bubbles: Dabell, Keogh and Naylor, 2008: 5.9)

Our recent research showed that the tool may be widely employed in future primary school teachers' education: besides identifying the aspects related to open approach to mathematics (Samková and Tichá, 2016a, 2016c), we used it also for identifying various aspects of the process of grasping of a situation (Samková and Tichá, 2015), for distinguishing between procedural and conceptual knowledge (Samková and Hošpesová, 2015), as an instrument promoting the awareness of the need of proper argumentation and leading towards deductive argumentation (Samková and Tichá, 2016b), for investigating pedagogical content knowledge (Samková, 2016a, 2016b), or for observing reasoning on pattern generalization (Samková and Tichá, 2017a).

Another instrument used in this study is *problem posing*. We have been using it in future teachers' education for more than 10 years, as an educational, motivational and diagnostic tool (Tichá and Hošpesová, 2013; Hošpesová and Tichá, 2015), and we are convinced that it can lead future teachers to deeper understanding of mathematical topics as well as to enhancement of their pedagogical content knowledge.

Recently, we have often combined *Concept Cartoons* and *problem posing* together, to get another perspective on future teachers' reasoning and pedagogical content knowledge: by combining the two instruments we already observed future teachers' open approach to mathematics (Samková and Tichá, 2016c), and reasoning during pattern generalization (Samková and Tichá, 2017a).

First part of the research: Concept Cartoons and problem solving

The first part of the research relates to problem solving. It aspires to look for answers to the research question "What kinds of reasoning about fractions can be observed in future primary school teachers when using Concept Cartoons as a diagnostic instrument during problem solving?"

2 In the Czech Republic, future primary school teachers are not math specialists; after graduation they are expected to teach all primary school subjects. They are supposed to study a four or five-year master degree program designed especially for future primary school teachers.

In this part of the research, data collection took part in several independent stages during the academic year. Each time we assigned the respondents (long-term participants) a worksheet with a Concept Cartoon focusing on the topic of fractions, and asked them to decide which children in the picture are right and which are wrong, and to justify the decision. For the purpose of data collection, the participants worked on the worksheets individually, during the lesson.

For the study referred here we choose the Concept Cartoon shown in Figure 5. The task behind this picture concentrates on the parts-and-whole decision from various perspectives, since it is based on comparing two pre-partitioned models with diverse wholes. This Concept Cartoon has two correct bubbles (Petr, Mirka), two incorrect bubbles (Standa, Katka), and one open bubble indirectly inviting respondents to present their own opinions on the pictured situation (Dan). We assigned the Concept Cartoon to long-term participants in the time before the topic of fractions was discussed at the didactical course. The Concept Cartoon was also independently assigned to 78 additional participants – future lower-secondary school teachers from Prague and Cracow.

During data analysis we registered combinations of bubbles that were chosen by individual respondents as right, and combinations of bubbles that were chosen as wrong. Afterwards we also analysed which kinds of reasoning appeared in justifications presented in the worksheets.

Second part of the research: Concept Cartoons and problem posing

The second part of the research relates to problem posing. It extends the first part of the research, and aspires to look for answers to the research question "What kinds of reasoning about fractions can be observed in future primary school teachers when using Concept Cartoons as a diagnostic instrument during problem posing?"

In this part of the research, data collection took place in one stage. For the long-term participants it was several months after the first part of the research, in the time after the topic of fractions was discussed at the didactical course. The group of additional participants for this part of the research consisted of future primary school teachers from the same university and the same study year but different academic year; those did not attend the first part of the research.

We asked the participants to create their own Concept Cartoon that could be assigned to primary school pupils during a lesson on mathematics. The fractions topic was neither required, nor mentioned in the assignment; the long-term participants did not know about the relation between the first and the second parts of the research.

Both long-term and additional participants worked on the task individually, in the form of a written homework; the homework was treated by 26 long-term participants, and by 36 additional participants.

During data analysis we focused again on reasoning about fractions, but this time from the perspective of problem posing. We concentrated on the nature of the alternatives offered in bubbles, and on kinds of reasoning that appeared in explanations provided by individual respondents in descriptive texts that accompanied the posed Concept Cartoons.

Results

Problem solving and choice of alternatives to agree

Initially, we observed responses from the perspective of individual alternatives given in bubbles, and without further analysis of the reasoning behind the answers. We monitored which alternatives were chosen by the respondents as the ones to agree.

From this perspective, the responses of long-term participants seemed to be rather comforting: all of the respondents correctly agreed with Petr and disagreed with Standa, majority of the respondents correctly agreed with Mirka. Just responses to Katka's bubble pointed out that the respondents might have faced some difficulties: minority of the respondents correctly disagreed with Katka. For proportional details see Figure 6.

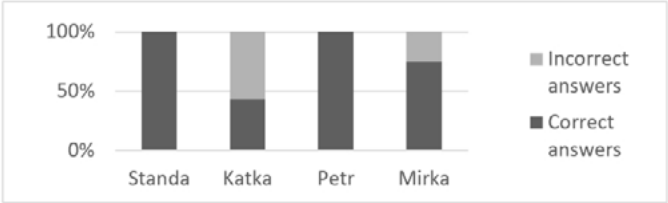

Figure 6: Answers to bubbles given by long-term participants, n = 28, 2016 (source: own calculation)

Next, we focused in detail on responses related to Mirka and Katka, and observed which combinations of agreement and disagreement appeared in worksheets. This method revealed us that the range of the difficulties might be wide: only minority of the respondents who correctly agreed with Mirka displayed also disagreement with Katka. For proportional details see Figure 7.

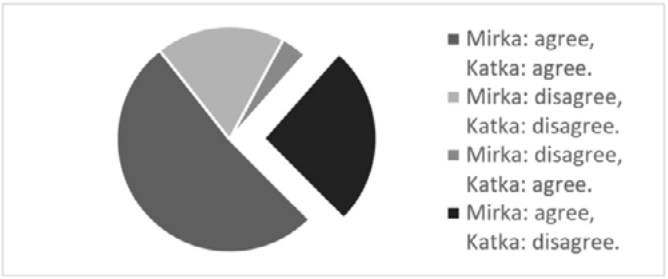

Figure 7: Combinations of answers to Mirka's and Katka's bubbles given by long-term participants; the only correct combination „Mirka: agree, Katka: disagree" is separated, n = 28, 2016 (source: own calculation)

Also the results related to data from additional participants (future lower-secondary teachers) showed similar trends – particular proportions differed for different groups of respondents but the only correct combination always belonged to minority of respondents. See Figure 8 and Figure 9.

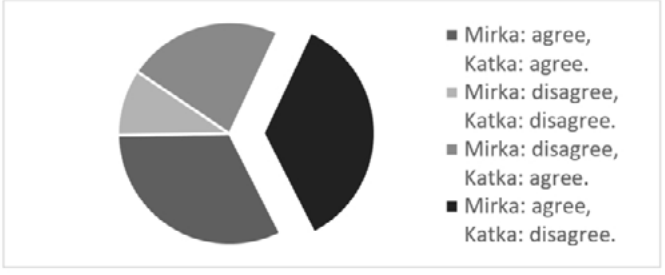

Figure 8: Combinations of answers to Mirka's and Katka's bubbles given by the additional participants from Cracow, n = 62, 2016 (source: own calculation)

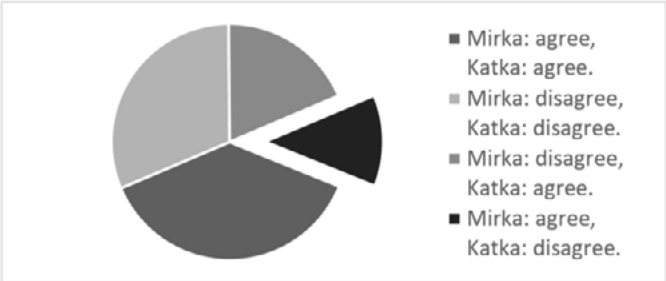

Figure 9: Combinations of answers to Mirka's and Katka's bubbles given by the additional participants from Prague, n = 16, 2016 (source: own calculation)

Problem solving and kinds of reasoning

Alarmed by the previous results, we observed more thoroughly the reasoning that led the respondents to their decisions, especially to the incorrect combinations of responses related to Mirka and Katka. The following overview and illustrative data excerpts belong to long-term participants.

Most of the incorrect responses were caused by handling fractions as an additive structure:

S16: Mirka and Katka – the same solution, just one of them used the word "less" while the other used "larger", and they swapped the plates.

by not realizing that the whole in Mirka's interpretation is not the same as the whole in Katka's interpretation:

S25: True: Katka, Mirka, Petr. They took the whole as 4/4, and then matched and compared. They were thinking in fractions, and properly.

S30: Katka is true, the grey plate is a quarter of the grey plate larger. She would not be true, if she thought of it as of a quarter of the white plate.

or by handling 1/4 as a new reference unit, as a "named number" (Hruša and Vyšín, 1964):

S32: Katka – correct. … grey = 4/4 white = 3/4
grey is 1/4 bigger than white

Among the long-term participants there were several who saw the sources of errors in linguistics, and proposed their own corrections of texts in bubbles. Some of them considered both Katka and Mirka as incorrect:

S19: Katka – the grey plate is by its own 1/4 larger than the white plate
– just more precise formulation is needed
Mirka – the white plate is smaller by 1/4 of the grey plate

some considered Katka as correct and Mirka as incorrect:

S13: Katka – yes. But I would rather write "by its own quarter".
Mirka – no. It is not clear by which quarter.
I would rather write "by a quarter of the grey plate".

On the other hand, majority of the respondents who correctly identified Mirka as being true and Katka as being wrong, also proposed proper reasoning in their worksheets. For instance, the respondent S33 who suggested to show that 1/4 of the grey plate does not equal 1/4 of the white plate (and accompanied the suggestion by an illustrative picture), or S2 who deemed it necessary to emphasize that even though the grey plate is compared to the white plate by 1/3 larger, the white plate is compared to the grey plate by 1/4 less.

Problem posing, choice of alternatives to pose, and kinds of reasoning

Among Concept Cartoons posed by the participants (both long-term and additional), we found only several that included the topic of fraction; none of them appeared in the group of long-term participants.

On the other hand, these several Concept Cartoons devoted to fractions were of decent quality, with probable and plausible pupils' misconceptions offered in bubbles, and decent explanations in the descriptive text. For illustration, we shall introduce in detail one of them – the one shown in Figure 10. This Concept Cartoon is based on a task that requires to ascertain a fractional part of a set of discrete objects (3/5 of 30), and its complement.

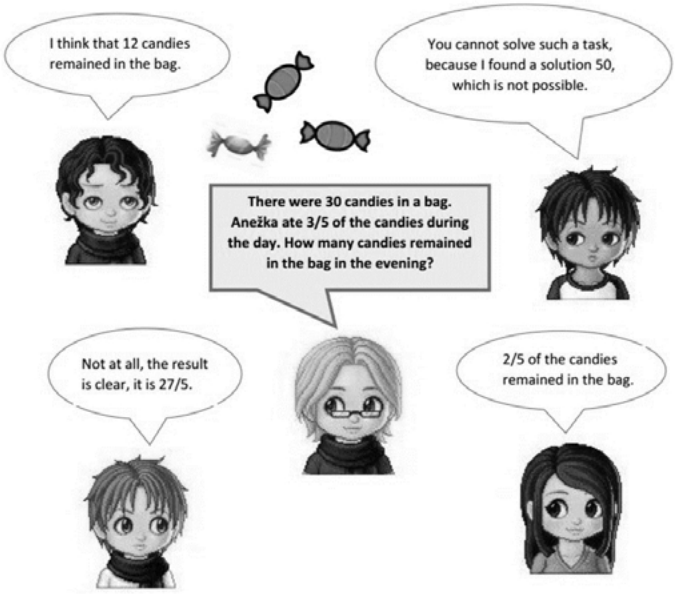

Figure 10: Concept Cartoon posed by one of the future primary school teachers; own translation (source: student work)

The top left bubble offers the correct result (12), and the descriptive text accompanying the picture explains how the child could get to the result: by determining the 3/5 of 30 (by calculations 30:5=6, 3·6=18) and subtracting it from the whole (30-18=12).

The bottom right bubble offers the result 2/5, which is related to an alternative way of solving: it determines the complement first, in the term of fractions (5/5-3/5=2/5). The respondent provides an additive commentary to this bubble: "This way of solving is also correct, but we do not know the precise number of candies. However, it is not exactly written in the assignment how the result should be presented." [3]

The top right bubble offers a child's commentary which is based on the most frequent misconception related to the tasks requiring to ascertain a fractional part of a set of discrete objects. This misconception consists in reversing the order of numerator and denominator in the above mentioned calculations related to determining the fractional part. In case of determining 3/5 of 30 the misconception leads to calculations 30:3=10, 5·10=50.

3 In Czech language, which is the language of our participants, we may use the same wording for the translation of "how many candies" and "how much of the candies". So that the Czech version of the question in the angular bubble really does not determine whether the result should express the number of candies or the fractional part.

From our experience, the misconception often appears as the consequence of learning without understanding, when the pupil learns the procedure but not the concept, and so that they may make a mistake in the order of the steps of the procedure. The occurrence of this misconception increases rapidly after the lesson where the pupils learn how to ascertain a whole for a given fractional part of a set of discrete objects (e.g. if 3/5 of a whole is 30, what is the whole?), because the reversed order belongs to this type of tasks.

The bottom left bubble offers a misconception which is not so frequent, and results in subtracting 3/5 from 30/5. The respondent provides an explanatory commentary to this bubble: "The pupil subtracted the removed part of candies from the total amount of 30 candies, which he wrote as 30/5, and did not realized that this is the whole, and thus equals 5/5."

The author of the Concept Cartoon also provides a list of educational goals related to the problem she posed:

- to understand the relations between the parts and the whole;
- to learn and remember that if we have a fraction *from* something, we have to divide by the denominator, and multiply by the numerator, not vice versa;
- to realize that the fraction stands for some amount (3/5 of 30 = 18), and do not combine these notations (30 – 3/5);
- to realize that the remainder cannot be bigger than the original amount;
- to consider that more different notations of results might exist here.

Summarized, the Concept Cartoon posed by the participant supplied us with a lot of information about her reasoning and pedagogical content knowledge. We can see that she knows various ways of solving the task, and also the most frequent pupils' misconception.

She reasons properly, also in accordance with open approach to mathematics (she realizes that there might be more ways of solving or more notations of the result). The only serious objection goes to her second educational goal: the effort to lead the pupils "to learn and remember that if we have a fraction *from* something, we have to divide by the denominator, and multiply by the numerator, not vice versa" would rather strengthen the just-procedural and non-conceptual view of the task, and could increase the occurrence of the reverse-order misconception.

Discussion

We can say that our results are in accordance with the results of the research that preceded our study. Looking at the results from the perspective of Concept Cartoons, we can see the importance of not considering respondents' answers apart from reasoning behind the answers, and the importance of observing the answers in complexity – the data excerpts in the 'Results' section together with Figure 6 and Figure 7 clearly illustrate this issue. Since Concept Cartoons offer several alternative viewpoints to comment on, they make the respondents to reason not only in the context of their "favourite" interpretation of the topic behind the picture, but also in the context of other interpretations – an activity which is a very important part of teachers' education, especially in case of primary school teachers and fractions (Behr et al., 1993; Lamon, 2006). On the other hand, Concept Cartoons can offer alternatives of different difficulty (of different levels of mathematical knowledge), which makes them *polyvalent math tasks*, a special class of open problems that proved their positive impact in (future) teachers' education (Hellmig, 2010; Nohda, 2000; Samková and Tichá, 2016c).

Generally said, in this contribution we offered an illustration of how Concept Cartoons could help in future primary school teachers' education: by perceiving Concept Cartoons as a representation of practice (Samková, 2017), the educators can study future teachers' responses to fictitious pupils' ideas or observe how future teachers create their own Concept Cartoons, and thus obtain information on various dimensions of teachers' knowledge (e.g. to what extent they have ideas on sources of misconceptions and errors).

Looking at the results from the perspective of the fractions topic, we can see the importance of focusing on proper grasping of the concept of the fraction, namely on the whole-and-parts relations. In accordance with previous research on primary school teachers' knowledge of fractions (e.g. Cramer and Lesh, 1988; Ma, 1999; Tichá and Hošpesová, 2013), analysis of the data collected during our study revealed various serious misconceptions that future primary school teachers employed in their reasoning, mainly handling fractions as an additive structure, identifying improperly the whole in a task, and handling fractions as named numbers.

Our data also revealed several respondents that saw the sources of errors just in linguistics but not in mathematics, a phenomenon which we know from our previous experience with future primary school teachers responding to Concept Cartoons (see Samková and Hošpesová, 2015). Nevertheless, the linguistics is an integral part of mathematics and cannot be treated separately, mathematics cannot be separated from its own language. Each mathematical topic has its own terminology and the way how it should be employed, the terminology is tied to the context of the topic in which it originated, and very often undergoes some changes when used in another context. For instance, the statement "Peter has 5 more books than Paul" originates in the context of natural numbers and refers to an additive structure, while the statement "Peter has 1/5 more books than Paul" originates in the context of fractions and refers to a combination of multiplicative and additive structures. Both the statements have the same wording (only numbers differ), and one has to be able to distinguish the diverse contexts given by the numbers, to understand that the fraction 1/5 refers to the whole that is stated in the statement after the conjunction "than". The responses given by the respondents S13 and S19 clearly show that these respondents are not aware of the reference to the whole that is given in the text which they comment on. In Czech language (which is the language of our long-term respondents) the syntax of the above mentioned statements differs only a little from the English syntax, the core of the problem stays the same. More details on the Czech case can be found in (Tichá and Macháčková, 2006), details on the English case e.g. in (Lamon, 2006). Talking of linguistics and mathematics, we must not forget to mention that the mathematical language often differs from the informal everyday language, and that this fact may become another source of mathematical misconceptions that look like linguistic ones (for illustrative examples see Kuřina, 1986).

In the referred study we also used Concept Cartoons in problem posing activities, we asked future primary school teachers to pose a problem that could be assigned to primary school pupils during a lesson on mathematics. Our illustrative example shows in detail what kinds of information such a task can provide, and how can it inform us about respondent's reasoning and pedagogical content knowledge. The results again confirmed the importance of problem posing in future teachers' education (Hošpesová and Tichá, 2015).

We are aware that the weak point of our study consists in size of the sample, and that the results cannot be generalized. But we

hope that our study can become a source of an inspiration for other educators of teachers.

Conclusion

In this contribution we focused on the possibility to use an educational tool called Concept Cartoons as an instrument for observing how future primary school teachers reason about fractions. We used them in problem solving as well as in problem posing activities. From mathematics content perspective we concentrated on the concept of a fraction per se, which belongs to the primary school curriculum. As a part of the contribution we provided an extensive overview of how the concept emerges in the primary school classroom.

The main group of respondents consisted of future primary school teachers that had already completed the mathematics content course covering the topic of fractions.

Data collected during problem solving activities confirmed how the topic of fractions is difficult for future primary school teachers, and highlighted the significant difference between subject matter knowledge and pedagogical content knowledge that dominates this topic. Although the respondents had already studied the topics in detail within the content course, they were not able to respond properly to fictitious primary school pupils' ideas about fractions that were assigned to them on a worksheet with a Concept Cartoon – only minority of respondents mastered to respond properly to all presented statements on the parts-and-whole decision. Similar trends appeared even in an additional group of respondents, future lower-secondary school teachers from two other universities.

Contrarily, the illustrative example collected as a product of problem posing activities of one of the future primary school teachers showed how Concept Cartoons may help to elaborate a wide range of pedagogical content knowledge: the author of the cartoon posed an appropriate mathematical problem, presented several ways of its solving together with several frequent possible pupils' misconceptions, and justified all of them properly.

The results confirmed that Concept Cartoons may be employed as a valuable universal tool in future teachers' education: as an environment for problem posing activities as well as an instrument for qualitative assessment of subject matter knowledge and pedagogical content knowledge.

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EDUCATION, POVERTY AND THE TRAP OF POOR COUNTRIES IN THE FACE OF DEVELOPMENT

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Highlights

- *There are others factors -not necessary economics-, such as poverty and corruption, that affect the level of education*
- *Developed countries should to to attack poverty problems to advance the educational level*
- *Developing countries must address problems of corruption*
- *In developing countries, the economic growth is significant (90%), but they have fallen in a poverty trap*

Abstract

This article aims to identify the level of incidence of social and economic variables on education, considering the existence of a cumulative circular causation, in order to point out public policy recommendations to improve people's well-being and thus increase Indicators of development, especially in educational matters. An econometric analysis integrates available information from 128 countries between the period 2010-2015. The results show different effects on the level of incidence of social and economic variables between rich and poor countries.

Keywords

Cumulative Circular Causation, development, econometrics, literacy, poverty trap

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Introduction

The World Bank was founded in 1944 with one principal goal: reducing poverty. The World Bank adopted two specific objectives in 2015: 1) to end extreme poverty and 2) to promote shared prosperity. The World Bank hopes to reduce a share of people living in extreme poverty to 3% by 2030. Moreover, another goal is to increase an income of the poorest by 40% (World Bank, 2016). The strategies for achieving these two goals are to promote growth that is sustainable and inclusive, to create more and better jobs, to invest in people's health, education, nutrition, and sanitation (World Bank, 2017a). Therefore, education is seen as a powerful tool to end poverty.

According to data from the World Bank (2016), in the last 50 years, poverty has declined significantly. However, there are still two notable problems: a) poverty reduction has been uneven on the planet. Eastern European countries have reduced poverty more rapidly, whereas other countries in Africa and Latin America have had many difficulties to fight the poverty. b) Higher poverty is harder to eradicate. People living with USD 3.10 per day decreased from 2.59 billion in 1981 to 2.2 billion in 2011 (barely 390 million people less, which is approximately 15% less over a period of 30 years). This stagnation shows the vulnerability of people to an eventual return of poverty. Therefore, the progress could be temporary and in the face of any contingency such as "economic shocks, food insecurity and climate change threaten to rob them of their hard-won gains and force them back into poverty" (World Bank, 2017b: 2).

On the other hand, education has been seen as a powerful tool to eradicate poverty. If we consider illiteracy figures, we can observe that adults who do not know how to read or write decreased from 871 million in 1980 to 758 million in 2014 (UNESCO, 1995; UNESCO, 2014). A reduction of just over 100 million, which equals to a reduction ofless than 13% in 34 years. As in poverty reduction, we seem to be stuck. If the behaviors were linear it would take about 200 years to eradicate poverty and 250 years to eradicate illiteracy. However, the world economic arose by 114% in the same period (IMF, 2017). It seems that economic growth has no relation to the reduction of both poverty and illiteracy, at least its effects have been small. Our research problem then arises. Why is poverty persistent? Why is illiteracy persistent too? Is it possible that poverty may be eradicated through education? Or indeed, illiteracy will be eradicated when poverty ends? In this paper, we investigate the relationship between poverty and education.In this sense, the article aims to identify the level of incidence of social and economic variables on education. We consider that many countries are in a trap, as they cannot get out of either a poverty or illiteracy. There is a small effect of economy on education. Therefore, we argue that the social conditions are the major factors for improving education.

The literature over the relation of education with other economic and social factors, with an econometric analysis, is wide. For example, Bonilla (2013) uses average years of schooling as a proxy for human capital. Arellano and Bond´s (1991) methodology shows that the total of average years of schooling, as well as the level of structural development and investment effort of a country, are significant in order to explain the rate of an economic growth. Others authors (Barro, 1991; Romer, 1986) show that the human capital in education is significant for the economic growth.

The article is organized as follows: In the first section, we continue with an extension of the introduction in a relation how to understand the the education, as well aswith an explication of

Cumulative Circular Causation and poverty trap. In the second section, we introduce the methodology of our research, as well as the dataset. In section three, we present the obtained results with an emphasis to a decomposition between rich and poor, followed by their respective econometric analysis. Finally, in section 4 we focus on some concluding remarks and discussion.

Education, independent or dependent variable?

Education is an exclusively human characteristic that separates us from the rest of the hominids, and allows to transmit knowledge, skills and abilities. However, at the same time, the education frames cultural patterns, axiological norms, rules and practices of life in society (Bruner, 1997). Thus, education is the instrument by which productive forces and means of production are produced through the scientific and technological development. This promotes both qualitative and quantitative advances of the mode of production. What is more, education is an instrument by which a society is reproduced socially through their ideals, values and habits too.

Education is a seed of transformative and, therefore, liberating thought (Freire, 1970), as it contributes to the fact that, at a certain level of development, means of production and productive forces to be contradicted each other and overcoming becomes revolutions through which humanity advances. Here arises the importance of the role of education in social development.

According to UNESCO (1958), an individual is illiterate if: "cannot with understanding both read and write a short simple statement on his [or her] everyday life" (UNESCO, 1958: 3). Reading and writing were defined as the minimum capacities that a human being should have. It is about the most basic educational conditions and from which we follow in this study. The lag in literacy leads a country to continuous lags in subsequent levels of education (Sauvageot, 1978; UNESCO, 2006). Thus, it is essential to take care of illiteracy as a priority for nations.

In the 1950s, in the context of a growing debate over developmental theories, education, particularly measured by illiteracy rates, became an indicator of the degree of a country development (Cipolla, 1969; UNESCO, 1957). This means that education is the result of economic growth, because "growth" and "development" were seen as a binomial. On the other hand, some more authors began considering education as the indispensable prerequisite of a country for economic take-off (Rostow, 1960). This other view recognizes education as the cause. The question here is about the role of the relationship education and economic growth, whether education is the independent or dependent variable?

International policies that have been developed after the 1980s and 1990s overlapped idea that education is an independent variable. Therefore, national governments and international agencies should focus their efforts on increasing literacy to boost economic growth and development. Even boosting education is one of the strategies the World Bank has set to achieve its goal of eradicating extreme poverty by 2030 (World Bank, 2016).

In 1995 UNESCO presented that the developed countries increased their literacy rate more rapidly than the least developed countries. In fact, during the period from 1980 to 1995, the illiterate population decreased by 16 million in developed countries, whereas in developing countries the illiteracy increased by 24 million people (UNESCO, 1995). It seems that there is a logical relationship between poverty and education, which could explain that the persistence of poverty in developing countries lies in the persistence of illiteracy. Hence, despite the public policies implemented throughout the 1980s, why was illiteracy persistent in 1995? What is more, This persistency is currently in force.

Cumulative Circular Causation and poverty trap

Myrdal (1957) argues that particularly countries and poor regions face a problem of "Cumulative Circular Causation" in which the effects of a cause of underdevelopment trigger other causes that accumulate cyclically, widening the gaps of poverty. As a result, development is not in a balanced way. From this perspective, the effects at one point become causes at another time. That is, independent variables become dependent and vice versa:

> "When the system starts rolling it is 'true that the changes in the forces' —though not all the forces themselves - work in one direction; but it is because the variable are assumed to be interlocked in such a causal mechanism that a change of any one causes the others to change in the same direction. With a secondary effect upon the first variable." (Myrdal, 1944: 1067)

For example, a country with a high poverty level (independent variable) will not be able to spend substantial expenditure on education as opposed to rich countries. So, its result will indicate a low educational level (dependent variable). However, at a later stage, the low level of education (independent variable) will consequently be the cause of a low level of scientific and technological development, and poor level of formation of fixed capital and industrial activities, and will be less attractive for foreign investment. As a result, this country will have a low growth of the Gross Domestic Product and, consequently, will continue with high level of poverty (dependent variable).

What we rescue from this approach is not only the ability to analyze the problem by investing the explained and explanatory variables, but also: a) to break with the cause-effect dichotomy and consider a factorial plurality that allows to include variables formerly considered exogenous or even externalities; b) moving from static schemes such as "vicious circles" (Nurkse, 1953) to speak of cycles with a cumulative tendency; c) amplify the action lines of public policy to address different problems, allowing to direct efforts to economic and social areas simultaneously or identifying the greatest effect in solving a problem.

Following Myrdal (1944), we consider that poverty and illiteracy are part of a cycle of cumulative causation that has not been addressed in an integral way. Because of expecting effects in one variable (poverty), all efforts have been focused on another variable (education). However, given a plurality of factors, other variables that were originally triggered have been neglected affecting the stagnation, for example corruption. Therefore, the poorest countries fall into a poverty trap that they cannot get out of, even by allocating more resources to what they consider as an independent variable, since, in the words of Myrdal (1944: 77), "a rational policy is unlikely to operate to achieve the change of a single factor".

Materials and Methods

According to the previous part, our variables for constructing the econometric model are as following:

- Y – Education;
- X_1 – Economic growth;
- X_2 – Corruption level;
- X_3 – Homicides rate;
- X_4 – Unemployment rate;
- X_5 – Poverty rate.

In case of education, we consider the percentage of illiterate people, as reported by the World Bank statistics, which comes mainly from the census data of each country. Although there

is an evidence that such indirect evaluation could overestimate literacy (UNESCO, 2006), we stay with it as it is the only comparable basis between countries.

Economic growth is based on the average real growth rate of the Gross Domestic Product of each country for the period 2010-2015 (IMF, 2017). The level of corruption is in relation to the Corruption Perception Index (CPI) developed by Transparency International (Transparency International, 2016). The values of CPI range from 0 to 100, where 100 means the lowest possible level of corruption, and vice versa. The level of corruption is related to the year 2015 (Transparency International, 2016). For the homicide rate, we consider the proportion of homicides per 10,000 inhabitants, by the year 2015 (World Bank, 2017a). For the unemployment rate, data of an average of this rate is used for the period 2010-2015 (IMF, 2017). Last but not least. for the poverty rate, we take the percentage of people living on less than USD 1.9 a day (extreme poverty line) by 2015 (World Bank, 2017a). The sample size contains of 128 countries worldwide, which is the number of countries that reported complete information for all variables required during the period of study, as this was our criterion of selection.

Once all the variables were defined, we need to construct a functional form that would reflect the effect of the economic levels represented by the variable of economic growth. Economic growth would first softly impacted the level of education for low growth levels and, depending if the level of growth was increasing, so did the level of education (Figure 1)

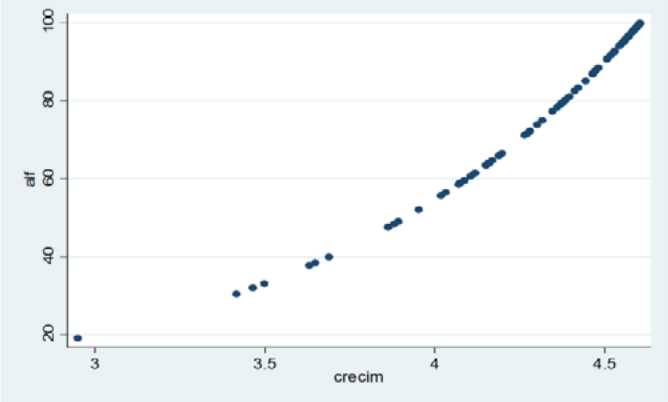

Figure 1: Relationship with decreasing returns between growth (axis X) and education (axis Y) (source: own elaboration).

That is, we argue that the economic level would gradually affect the level of education. Thus, we proposed functional forms such as,

1) $Y_i = \beta_0 + \beta_1 lnX_{1i} + \text{Some} + u_i$,

$$Y_i = \beta_0 + \beta_1 \sqrt{X_{1i}} + \text{Some} + u_i$$

$$Y_i = \beta_0 + \beta_1 e^{X_{1i}} + \text{Some} + u_i$$

$$Y_i = \beta_0 + \beta_1 {X_{1i}}^2 + \text{Some} + u_i$$

In principle, proposals 1) and 2) are not feasible, since there are countries whose levels of growth are negative and, therefore, the expressions are not defined. Then, we work with the expressions (3) and (4), where the term relative to "Some" refers to the plurality proposed by Myrdal (1944). We consider factors such as corruption (X_2), violence (X_3), unemployment (X_4) and poverty (X_5). All as part of a cumulative circular causation process.

Results

In this section, we present our results regarding the aim of the article to identify the level of incidence of social and economic variables on education. First, we did the estimation with all the variables, because the majority of variables are of social character. Thus, our general model is as follows

$$Y_i = \beta_0 + \beta_1 e^{X_{1i}} + \beta_2 X_{2i} + \beta_3 X_{3i} + \\ + \beta_4 X_{4i} + \beta_5 X_{5i} + u_i \quad (1)$$

We get the following result

$$\widehat{Y}_i = 79.46592 + 2.49\text{x}10^{-12} e^{X_{1i}} + .2064117 X_{2i} + \\ + .1299047 X_{3i} + .2569594 X_{4i} - 1.015 X_{5i}$$

$$t = \quad (0.04) \quad (4.28) \quad (0.117) \quad (1.22) \quad (-6.64),$$

$$R^2 = 0.4567$$

The first estimation shows that corruption (X_2) and poverty (X_5) were the only significant variables. The growth factor, (taken as $e^{X_{1i}}$), was not significant.

Subsequently, we made the following estimation,

$$Y_i = \beta_0 + \beta_1 {X_{1i}}^2 + \beta_2 X_{2i} + \beta_3 X_{3i} + \\ + \beta_4 X_{4i} + \beta_5 X_{5i} + u_i \quad (2)$$

With this second estimation, we get the following result,

$$\widehat{Y}_i = 79.46592 - 0.01588 {X_{1i}}^2 + .20571 X_{2i} + \\ + .122818 X_{3i} + .2449 X_{4i} - 1.0103 X_{5i}$$

$$t = \quad (-0.90) \quad (4.31) \quad (1.05) \quad (1.17) \quad (-6.62),$$

$$R^2 = 0.4603$$

Similarly, as in estimation (1), corruption and poverty remain significant, whereas the other variables, including economic growth, remain non-significant. However, regarding Myrdal (1957), we wanted to keep the impact of the growth together with the only significant variables, corruption and poverty. So, we proposed the following two models, in which we treat the economic growth similarly as in (1) and (2):

$$Y_i = \beta_0 + \beta_1 e^{X_{1i}} + \beta_2 X_{2i} + \beta_5 X_{5i} + u_i \quad (3)$$

and

$$Y_i = \beta_0 + \beta_1 {X_{1i}}^2 + \beta_2 X_{2i} + \beta_5 X_{5i} + u_i \quad (4)$$

The respective estimations for (3) and (4) are

$$\widehat{Y}_i = 86.647 - 0.0000000083 e^{X_{1i}} + \\ + 0.1857 X_{2i} - 1.033 X_{5i}$$

$$t = \quad (-0.03) \quad (4.01) \quad (-6.76),$$

$$R^2 = 0.4448$$

and,

$$\widehat{Y}_i = 84.0841 - 0.0183X_{1i}{}^2 + 0.1857X_{2i} - 1.02X_{5i}$$
$$= \quad (-1.04) \quad (4.06) \quad (-6.74),$$
$$R^2 = 0.4497$$

Despite that the economic growth (X_1) remains non-significant, an improvement is observed both statistically and intuitively in (4). It is important to note that the effects of the corruption and the poverty are almost the same in (3) and (4), i.e. they remain unchanged. To make the statement clearer, we did the following estimation,

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_5 X_{5i} + u_i \qquad (5)$$

Whose result was,

$$\widehat{Y}_i = 83.8572 - 0.073X_{1i} + 0.1859X_{2i} - 1.033X_{5i}$$
$$t = \quad (-0.24) \quad (4.05) \quad (-6.76),$$
$$R^2 = 0.4451$$

Similarly, as in the previous estimations, the economic growth remains unaffected. However, the socials variables, corruption and poverty, remain almost unchanged statistically and intuitively. The result are the following:

Theorem: In reference to Myrdal (1957) in the Cumulative Circular Causation process, the growth effect is no longer significant for the education, whereas exogenous variables previously considered as corruption and poverty become more important. Concluding that, even by modifying the size of the impact of growth, the effects of social variables on education are invariant under any permitted functional and logical form of economic growth.

Despite the non-significance of the growth over education. It is worth rescuing expression (4), that shows a negative quadratic effect of growth on education. Then, addition to the significant improvement, such an inverse U-shaped effect (Figure 2), is interesting to analyze.

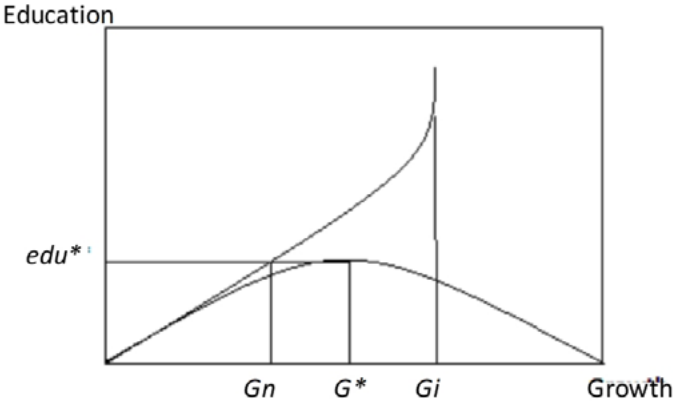

Figure 2: Real and expected effect of growth on the level of education (source: own elaboration)

Figure *2* shows a slightly positive economic growth effect at the onset, which led to slight decrease in illiteracy levels. However, without reaching the expected levels of literacy (see curve increasing in Figure *2*). Therefore, it is advisable to consider other factors that take a significant impact on education (see theorem). In this case, the poverty index and the level of corruption, which caused education to return to its low initial levels (see part 2 of the Figure *2* and equation 4).

In addition, in Figure *2*, with a *G** value, the maximum education value (*edu**) can be reached, a value that could be reached with a smaller Gn value. Thus, economically, there is a social loss with value, *G** - *Gn*. In addition to this, if *Gi* is considered as the maximum possible investment with which an optimal level of education is obtained, our model shows that this *Gi* value is inefficient, since education begins falling much earlier. This justifies the fact that it is necessary to attack other social problems that could be significant for increasing the level of education.

The analysis and previous conclusions regarding the non-significance and negative effect of the economic growth (final part of Figure *2*), make us wonder, what would have these countries done to advance in education, if the economic growth is not a factor? Therefore, it would be interesting to do an economic decomposition to make the analysis more detailed. We analyze the economic decomposition in the next section.

Differences between rich and poor countries

In order to do the decomposition between countries, we must define a threshold that separates rich countries from the poor one. We observed that countries with a population at the poverty line greater than 3% had different effects than those with a lower percentage. This level is the goal of the World Bank (2016) to reduce the population living in extreme poverty by 2030. Thus, we can divide our database into two groups:

1. Rich countries: with a percentage of people living with USD 1.90 per day less than 3%,
2. Poor countries: with a percentage of people living with USD 1.90 per day greater than 3%.

For the group of rich countries, we have a total of 48 observations, whereas we have a total of 80 observations in case of poor countries. We use model (4) for the analysis of both groups. In case of the rich countries, we get the following result,

$$\widehat{Y}_i = 97.197 - 0.00089X_{1i}{}^2 + 0.027X_{2i} - 23.05X_{5i}$$
$$t = \quad (-0.19) \quad (1.59) \quad (-3.32),$$
$$R^2 = 0.3284$$

whereas, in case of the poor countries, we get the following result

$$\widehat{Y}_i = 80.233 - 0.0656X_{1i}{}^2 + 0.2431X_{2i} - 0.8264X_{5i}$$
$$t = \quad (-1.64) \quad (2.62) \quad (-4.16),$$
$$R^2 = 0.3391$$

We can see that the effect of the growth on inverse U-shaped recovers significance in poor countries and completely lost in rich countries. Likewise, corruption (X_2) loses significance in the group of rich countries, whereas and the significant effect is maintained in the group of poor countries. Finally, the effect of poverty is more marked in rich countries than in poor countries, and remains as the only factor affecting education. Accordingly, the results suggest that the rich countries first eradicated the poverty, which was the determining factor to raise the level of education. Then, before giving a conclusion for the poor countries, we must make additional analysis.

Econometric analysis in case of poor countries

First, let's estimate the impact on education only using social factors, poverty and corruption, which we will call reduced model.

$$Y_i = \beta_0 + \beta_2 X_{2i} + \beta_5 X_{5i} + u_i \qquad (6)$$

Whose estimation is as follows,

$$\widehat{Y}_i = 80.233 + 0.2431 X_{2i} - 0.8264 X_{5i}$$

$$t = \quad (2.74) \quad (-4.25),$$

$$R_R^2 = 0.3158$$

Where R_R^2 is the value R squared referred at the reduced model. We observed that the corruption and poverty remain significate, and with the correct sign.

Further, we aggregated to (6) the variable of the growth, under the transformation ${X_{1i}}^2$, to obtain our augmented model,

$$Y_i = \beta_0 + \beta_1 {X_{1i}}^2 + \beta_2 X_{2i} + \beta_5 X_{5i} + u_i \qquad (7)$$

And the estimation is the showed in (6), this is,

$$\widehat{Y}_i = 80.233 - 0.0656 {X_{1i}}^2 + 0.2431 X_{2i} - 0.8264 X_{5i}$$

$$t = \quad (-1.64) \quad (2.62) \quad (-4.16),$$

$$R_C^2 = 0.3391$$

Where R_C^2 is the value R squared referred at the augmented model,

Then, to justify if the aggregation of the growth is significant, we test the following hypothesis,

$$H_0 : \beta_1 = 0 \quad \text{vs} \quad H_a : \beta_1 \neq 0,$$

To reject H_0 it is necessary that squared sum of residuals of augmented model ($\mathrm{RSSA}_{(C)}$) is smaller than squared sum of residuals of the reduced model ($\mathrm{RSSA}_{(R)}$), whose statistic is,

$$F_{obs} = \frac{\mathrm{RSSA}_{(\mathrm{R})} - \mathrm{RSSA}_{(\mathrm{C})} / (k-g)}{\mathrm{RSSA}_{(\mathrm{C})} / (n-k-1)}$$

That follow a F-Distribution, this is F_{n-g-1}^{k-g}, where k is the number of variables explicative in the augmented model, and g is the number of variables explicative in the reduced model. Thus, $k-g$ is the number of variables aggregate (Gujarati, 2003). This, statistics can be expressed as

$$F_{obs} = \frac{R_C^2 - R_R^2 / (k-g)}{(1-R_C^2)/(n-g-1)} \sim F_{n-g-1}^{k-g}$$

So, if $F_{obs} > F_{n-g-1}^{k-g}$, then we reject H_0 and, thus, justify that the aggregation is statistically significant.

In our analysis with (6) and (7) we get,

$$F_{obs} = \frac{0.3391 - 0.3158 / (1)}{(1-0.3391)/(76)} = 2.67$$

And $F_{76,.05}^{1} = 3.96$. Then, the aggregation of the growth is not significant, even though that the aggregation is individually significant in 90% level (see 6).

As a result, statistically our best model is only (6) and, the economic effect is not relevant over the education in 95 %. However, with a base in the p-value this aggregation is nearly significate at 90%, this is,

$P\left(F_{76}^{1} > 2.67\right) = 0.8942$, that seems to be reasonable.

Therefore, we can consider two main results of the analysis:

Result 1. The quadratic effect of the growth on the educational level in rich countries loses significance reached in (4), as well as the level of corruption. The poverty rate remains significant and effective (-23.05). Then, it is advisable that the rich countries add all their efforts to combat poverty, which would be reflected in an immediate effect on educational rates. Combating poverty will have an effect of the 23.05 percent on the literacy rate for each index recovered in poverty reduction.

The R squared value of the models ranged from 0.33 to 0.45; although they are not high values, we can accept them as valid when considering the level of significance of the included variables and take into account that not all functions are linear.

Result 2. If we choose to accept the aggregation of growth as meaningful, then we have a more complete model for the group of the poor countries. This allows us to observe that in addition to the negative effect of the level of growth, there are other variables to consider, corruption and poverty.

In this result, it is worth mentioning that the quadratic and negative effect of growth on the level of education is very low (-0.0656) (see 5 or 7), then the relationship between education and growth follows a form in Figure 2.

Discussion

Previous research measuring the correlation between education and poverty can be found at three levels: a) micro level (individual), has carried out case studies, mainly showing the effects of poverty/corruption in the education results of persons or individual performance tests such as PISA or competency assessments (Aiyar, Kapur and Mukherjee, 2011; Hallak and Posisson, 2007); b) meso level (contexts), its object of study are families, communities or schools (Dreze and Sen, 2002; Koirala and Aryal, 2005); c) macro level (structural), reviews the effects of the poverty/corruption variables considering national or subnational statistics and trying to explain, in a structural way, the behavior of these from inequalities or imbalances (Mauro, 1995; Bardhan, 1997; Pritchett, 2001; Tanzi and Davoodi, 2001; Dridi, 2014). At this level we place the present study.

The relationship between education and economic growth can be seen from different perspectives. In economics the dominant form is to take education as an independent variable from which influences growth, such as the Mankiw, Romer and Weil (1992) model, that is an adaptation of Solow's model (1956):

$$Y_{(t)} = K_{(t)}^{\alpha} H_{(t)}^{\beta} \left(A_{(t)} L_{(t)} \right)^{1-\alpha-\beta}$$

Where *H* (human capital) is determinant of *Y* (economic growth). Human capital is understood as the workforce formed and endowed with the skills and abilities to better perform a job, that is, education affects growth through the process of training human resources. In this regard, should be noted the results of Hanushek and Kimko (2000), who found a significant positive relationship between the level of science and mathematics of the labor force and the variations in economic growth between countries.

However, we find in the research that there is no significant correlation between both variables, it could even be seen that it becomes negative by showing an inverted U-shape (Figure 2). This micro-macro contradiction was also presented by Pritchett (2001) who compared the growth of educational

capital and Gross Domestic Product (GDP) growth per worker. The correlation resulted to be insignificant and negative. In attempting to explain the results, Prichett suggested that the low impact between the two variables is due to the fact that the educational capital that the workers have developed could be used in unproductive, but remunerative activities such as piracy and corruption.

Corruption, however, does not appear to be a problem for rich countries with the same intensity as it is for poor countries. Bardhan (1997) points out that corruption is "pervasive and endemic" in developing countries. In this regard, Mauro (1995) showed negative correlations between the Corruption Perception Index and the GDP investment rate. Easterly (2001) also found a negative correlation between corruption and growth, while showing that corruption tends to decrease as the level of development of a country increases. Laffont (2006) concludes with similar conclusions as he places an inverted U between GDP per capita and corruption. As a result, at a certain point of development corruption begins to decline.

Considering the above, we have taken education as a dependent variable in this article, from the possibility of reversing the roles under Myrdal's Cumulative Circular Causation theory (Myrdal, 1957). From this approach, our results coincide with those previously mentioned, economic growth and education have a negative and insignificant correlation. However, by including in the model variables previously considered exogenous, such as corruption and poverty, economic growth and education become significant.

This can be explained by the fact that according to Tanzi and Davoodi (1997) and Mauro (1995), corrupted countries tend to spend less on education. Corrupted countries allocate resources to other areas where it would be easier to get bribes. The results of Dridi (2014) suggest that corruption significantly reduces access to school, is a burden of poor countries that prevents them from accumulating human capital and condemns them to poverty.

We argue that corruption, as a result of the economic situation of low growth, poverty and low educational level, affects education in a Cumulative Circular Causation. Thus, that its effects become more powerful, even above economic variables. Since, even if the educational level were increased, the efforts could be dispersed towards less productive, but more profitable activities (Bardhan, 1997). For example, a student in a more corrupted country would be more attracted for choosing a law degree rather than an engineering degree because it could result in higher incomes (Tanzi and Davoodi, 2001).

These cumulative effects can also be explored with the poverty variable. UNESCO (2006) shows a significant negative correlation between poverty and education, finding that where poverty rates are high, literacy rates tend to be lower. In addition, they considered education as an independent variable. Similarly, if poverty is measured by the level of consumption, Dreze and Sen (2002) showed a significant positive correlation with education at the subnational level of India, where again education was the independent variable.

Studies that have seen education (measured as a percentage of illiteracy) as a dependent variable, have found strong correlations with variables gender, age, household size, residence status in urban areas, formal level of schooling, wealth of home (Carr-Hill, 2005). On the other hand, Koirala and Aryal (2005) found an illiteracy trap in which minority groups fall from discrimination. The authors' argument indicates that marginalized groups are ignored in official statistics. Therefore, they are not served, they receive few educational opportunities and being illiterate remain marginalized.

We generalize these types of traps as a structural problem of poor economies where the slope of the correlation curve between education and poverty is negative in rich countries, whereas in poor countries the slope of the curve makes it an almost horizontal line. Thus. any effect on the independent variable becomes imperceptible in the dependent (Figure 3). This change in slope is explained by the effects of Cumulative Circular Causation (Figure 4) that the developing countries have experienced and which makes it necessary to address social problems as a whole to obtain a greater impact than to exclusively focus on economic variables.

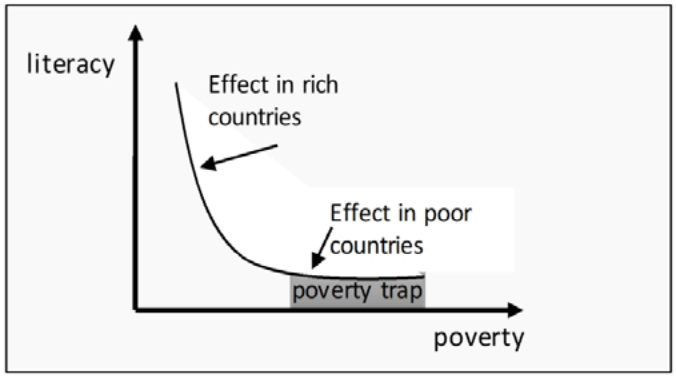

Figure 3: Poverty trap for the poor countries (source: own elaboration)

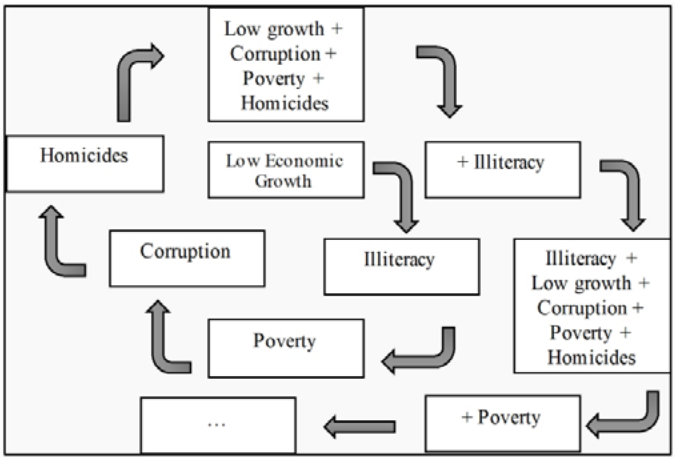

Figure 4: The problem of education under causation circular cumulative (source: own elaboration)

Conclusion

The relationship between poverty and economy is very complex and has been studied from different points of view. Most of the time the studies consider education as an independent variable. In this article, we proposed to break the dependent-independent dichotomy, to see education at the same time as cause and effect. Supported by Myrdal's theory (Myrdal, 1957), we proposed an econometric model that measured the correlation between economic growth and education. The results showed that we should include other variables into the model to gain significance of variables, we proposed corruption and poverty.

Furthermore, we separated the measurement of the effects between rich and poor countries to analyze differences between both groups. This separation enabled us to prove the effects of a Cumulative Circular Causation for poor countries. Therefore, low growth leads to high rates of illiteracy, higher illiteracy means higher rates of poverty, an environment of poverty leads to other problems such as increased violence and corruption,

high rates of violence and corruption increase educational lags and decrease possibilities of schooling, and, thus, a high illiteracy rate.

By cumulative effects, the first independent variable (economic growth) has decreased its incidence effects on the dependent variable that now affects the effects of the causal variables, before effect of the first one (Figure 4), which would mean a variation in the slope. The change of sign is explained by considering that at a given level of growth, economic growth not only fails to positively influence literacy, but also has a negative effect because of the greater effects that the rest of the variables have. Therefore, even if countries continue to grow, education stagnates or decreases, which ends up slowing down the growth. Therefore, neither an increasing rate of growth can lead to lower illiteracy, nor increasing literacy can increase a growth. As a result, countries fall into a poverty trap in which they reproduce intergenerationally poverty and illiteracy (Figure 3).

This type of studies allows visualizing the variables with greater effects on a given situation. So, we suggest that each country should consider its conditions in a structural way and not in isolation. We propose that state intervention in poor countries should address social variables, while in developed countries their weak point is to ensure that the percentage of their population in the poverty line does not increase beyond 3%, that we identified as the threshold of the poverty trap.

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FACTORS DESCRIBING STUDENTS´ PERCEPTION ON EDUCATION QUALITY STANDARDS

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Highlights

- *Identification of key evaluation factors for ensuring continuity of the assessment process*
- *Identified factors describe student behaviour when assessing each subject*
- *Evaluation of subjects, teachers, materials and teaching techniques and technologies is presented*

Abstract

Education quality assurance is the necessity for today's competitive environment in university education. Quality assurance standards and strategies are being used in most of universities and higher education institutions. But the perception of quality standards is being usually seen from the perspective of a university management. This study aims to analyze and present perceptions of students towards a measurement of education quality standards and to identify significant groups of students according to their preferences in education quality. Students' questionnaires and focus groups collected the data. Two dimensional and multi-dimensional statistical methods were used to evaluate the results. The outputs show five groups of students based on their perception of the education quality. Examination of students' interest in specific areas, subjects and courses leads to identification of factors which affect their preferences in education. The paper found five significant groups of perceived quality by students. These are Quality receptionists, Business oriented, Expert innovators, Distance learners and Arrangement oriented. Limit of the study is a narrow focus on one private university. This study may encourage other papers to develop and test further the impact of education quality on students' preferences for measurable improvements. The paper is an extension of the conference paper presented on ERIE conference 2017.

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Introduction

It is generally true that the higher education level helps to the development of any society in all countries of the world. This sector is currently, when there is laid emphasis on increasing the quality of the educational process, increasing the employability of graduates, improving interdisciplinarity of individual branches, etc. The sector is more monitored by representatives of the Ministry of Education, Youth and Sports at the national level and also by representatives of organizations and other institutions at the national as well as European level. Primarily, the reason is that the higher education helps to develop the given economy and forms the essential basis for sustainable growth.

The aim of the paper is to analyze and present perceptions of students towards a measurement of education quality standards and to identify significant factors of students' preferences in education quality. The indicators used *are based on students' and academicians' satisfaction with the educational process.*

The paper contains of six sections. The first one is "Introduction", the second one is "Theoretical Background", followed by a presentation of the methodological approach (in the chapter "Materials and Methods"). Subsequently, there is an analysis (the "Results" chapter), and a discussion section (the "Discussion" chapter) that contains recommendations. Finally, authors conclude the paper and summarize the contributions and limitations of the paper (the "Conclusion" chapter) and describe future research in this area.

The paper is an extension of the conference paper presented on ERIE conference 2017 in Prague, Czech University of Life Sciences (Vnoučková, Urbancová, and Smolová, 2017). The paper was extended in the results and discussion in parts focused on the evaluation of statements of respondents related to the quality of education provided in selected statements. The contribution of the article lies the emphasis on the educational process quality in the current knowledge economy described by increasing competition between universities. Accordingly, the discussion part was added and the conclusion was extended in compliance with the presented results.

Theoretical Background

The general goal of the higher education at the national level, including the Czech Republic, is, first of all, to achieve complex knowledge and skills within their branches. We can, however, state that this goal is not always being succeeded. Based on the statement of the Ministry of Education, Youth and Sports (2015) within the "Framework of the Higher Education Development until the year 2020", we can summarize that in 2014, the Czech higher education was at the end of the rapid quantitative expansion, which is positive because since the year 1989, the number of students increased almost fourfold and there significantly increased accessibility for almost all high school graduates with graduation exams who were interested in further studies, but not all of them have been qualified and have competencies to study a university and graduate successfully. Thus, quantity over quality of education was preferred.

The Ministry of Education, Youth and Sports (2015) states that the character of universities has significantly changed and adapted to unusual quantities of students with more diverse previous education, profile and background compared to the era ten years ago. But the transformation is not completed yet, as there is not enough necessary formation and diversification of individual branches. Also, necessary infrastructure is not

created. Furthermore, colleges and universities still face up the big problem with staffing. Considering the preference of the educational quality within the higher education, the emphasis on the specific competencies development (set for each branch), which are exercisable in practice, the increase of co-operation with practice and others, based on the research by Cejpek et al. (2014), 5 basic spheres were determined that help to improve the quality of teaching:

- Sophisticated structure of studying programs, when using outcomes from learning helps to improve the continuity of individual subjects within the curriculum and reduces duplication between them. Benyon (1981), Williams and Howley (1989) or Xu, Duan and Chen (2002) emphasize the importance of the curriculum continuity (even through the individual levels of education) in their studies. Already from a primary school the continuity and good and logical connection between curriculum and study plans is one of the monitored key attributes of education (Sanders et al., 2005; Shields, 2009).
- The pedagogic self-reflection of teachers and understanding how students study open new possibilities to teachers to think about teaching, about active involvement of students and about what and how they learn. Jones (2016), in his research, emphasizes the role of person-level qualities or personality in the educational process quality, concretely the role of perfectionism during teaching by each teacher, which was emphasized previously in the researches by Clark, Lelchook, and Taylor (2010), laying emphasis on three dimensions of perfectionism (high standards, discrepancy and order) at work. In their researches, O´Connor and O´Hagan (2016) emphasize the importance of the regular evaluation of academic staff. Although, according to Weisberg et al. (2009), the teacher's effectiveness is specified by many expert studies as the factor most significantly influencing results and progress of students. But schools rarely systematically measure and evaluate the attribute and rarely draw conclusions from it.
- Increased motivation of students, while especially an active involvement of students into education and providing a formative feedback has a positive influence on the students´ motivation. Researches by Tsinidou, Gerogiannis, and Fitsilis (2010) emphasize the importance of opinions and feedback in the perception of the quality determinants primarily from the point of view of students against the self-assessment on the part of faculties / universities / colleges. These point out that details from students contribute to the educational services quality. It is necessary to pay attention primarily to this group of respondents in the higher education and to reflect the obtained results into the strategic decision-making process.
- Verifying the reality of set study goals, when most often it turned out that subjects are excessive as to their content or time, because many declared goals can´t be realistically taught and/or verified.
- Improvement of the education quality, because as a result there must be really improved the level of obtained knowledge and skills of students within the educational process, and thus also improvement of the quality and competitiveness of graduates in the labor market.

Based on the above mentioned information, we can consider the goals of effective teaching related to the tertiary level of education, which were identified more than thirty years ago by James Clark, to be still valid. Clark (1995) has divided these goals into two groups:

- Cognitive goals – knowledge, organization of instruction, clarity of expression, quality of presentation.
- Affective goals – to stimulate students´ interest, their participation and openness to new ideas, interpersonal relations, communications and fairness.

The realized researches shows that at the present time of the high competition in the area of the higher education, it is necessary to lay emphasis on the development of academic advising, which is, according to the researches by He and Hutson (2016), one of the key functions in higher education nowadays. This leads to linking the theory and practice, which is very appreciated by students according to domestic as well as foreign researches.

The mentioned areas are usually monitored, evaluated and adjusted on the basis of students´ assessment, which is considered to be an essential tool universities use to assess their teaching skills (Simpson and Siguaw, 2000). In this respect, we must mention one basic fact – it is necessary to consider that the validity of students´ evaluation of teaching and related processes can be influenced by the situation when respondents (= students) do not take the evaluation and its results really seriously (Gaillard, Mitchell, and Kavota, 2006).

Materials and Methods

This paper was prepared using a method of analyzing secondary and primary resources, knowledge synthesis, induction, deduction and comparison. Secondary resources, scientific monographs and articles dealing with the topic were analyzed. Websites of institutions that actively deal with the issue were also analyzed. In order to cover all relevant studies, a variety of keywords for quality, education, learning, student and similar other ones were used. The research is descriptive and empirical in nature because the primary data were collected using the survey method through the fact finding techniques such as questionnaires and interviews.

Data Sample

The second part of this paper analyses and evaluates the results of the primary survey. The data for the evaluation of current education and learning in a Czech private university were collected in a primary quantitative survey by means of questionnaire investigation. The survey was carried out among students and academic staff. The student dataset comprised in total 2,265 students and 168 teachers. The evaluated subjects contained the areas of Business Economy, Economics, Management, Marketing and Human Resource Management. Only students who passed the entire education and evaluation process (i.e. attended all lessons, seminars and lectures) of the mentioned selected areas were part of the survey. The data were collected using CAPI (computer assisted paper interviewing) and subsequently processed in Microsoft Excel; incomplete questionnaires were deleted. The final data source was analysed according to identification questions, and descriptive statistic was used.

Only the students who regularly and periodically attended classes were part of the survey (participation in classes is voluntary for students, not all of students attended classes or participated in the research). The results thus do not evaluate students who did not pass the entire process of education and tuition.

The respondents were structured as follows out of the valid data: Students' gender: 841 (43.01%) male, 1,414 (56.99%) female (10 students did not marked their gender); students' professional experience: 1067 (47.54%) work in the area

of study, 1,177 (52.46%) do not work (21 students did not answer); students' future intention to work in the area of study: 1,213 (53.77%) plan to work in the area of studied subjects, 338 (14.98%) do not plan to work in the area of studied subjects and the remaining ones (31.13%) do not know.

Research Design

The data collection instrument included questions to measure education activities of the university in focus. The questions were designed based on theories (see the theoretical background) and similar research studies.

Each student filled a questionnaire for each subject which he/she participated in. Students evaluated all the compulsory subjects and all optional subjects they had attended. Optional subjects are part of the studies only for full-time students. Part-time students attended and evaluated only compulsory subjects. Students always filled the questionnaire in the last lecture of each subject. The questionnaire addressed three main areas (other than identification questions). Those were lessons and their content, the course/subject and its structure and usefulness, and the teacher's quality. Other than the quality of education, the questionnaires also measured study materials, texts and presentations, the teacher's personality and abilities, the technology used in the educational process, connection with practice, technical and organizational facilities and equipment.

All the primary data were evaluated using descriptive statistics. In addition, the dependence among qualitative characteristics was tested to see whether there are relations between searched attributes, to verify the data obtained and their further analyses (Hendl, 2006). Multivariate statistical methods and analyses were used to lower the number of possible single approaches and practices. Factor analysis was used to analyse the data.

Within the multivariate statistical methods, the factor analysis was used to establish factors that summarise behaviour of respondents (students) into meaningful groups.

The process of calculation and interpretation of results was used according to Hebák, Malá, and Hustopecký (2006). The analysis was used due to the aim to classify the analysed competencies, when there was a number of variants of answers per each question. Newly designed factors should simplify the total results of the questioning. Factors explain variability and dependence of considered variables. The factor analysis is used to create factors which summarize evaluation of the educational process into coherent groups. The factor analysis was used based on statistically significant correlations. The basic conditions of attributes to enter the analysis were fulfilled according to Hendl (2006). The analysis was used as confirmatory statistical method, when based on the correlation analysis the preposition to create fractional areas where perception of students is interconnected was designed. Theoretical factors were created and later tested by factor analysis. The factors were created with regard to their merits in terms of theory and practice in the educational process. The factor analysis is more heuristic method which requires deep understanding of examined issue and also knowledge and experiences with the method. Therefore, the method is sometimes rejected by statistics as less exact, inconclusive and subjective. On the other hand, many researchers in social sciences (i.e. sociologists) use factor analysis quite often and trust it (Palát, 2012). Also in the area of learning and development research, the method is used quite often and favoured by researchers (Anderson, 2009). It is a subjective method and the results depend on the researcher. But the whole area of learning and education may be classified as subjective. It is necessary, of course, to pay attention to the basic data which shows the original objective results. This study was created in this manner. The resultant data from the analysis were compared to the reactions of respondents to minimize distortion. These perquisites preceded the design and calculation of results of this study. The results respect above mentioned facts. Factors are constructed based on their content and relations between similar students' responses and their simultaneous use.

Before using the factor analysis a correlation matrix was created and then it was further analysed for suitability of further calculations using multivariate methods. At first the correlation analysis, then the principal components analysis and subsequently the factor analysis using Varimax rotation were used for calculations. The level of correlation coefficients were sufficient according to Anderson (2009) and Hendl (2006). Moreover, 86.93% of correlations in the correlation table were statistically significant. The KMO (Kaiser-Meyer-Olkin test) value reached over 0.8 which is considered as meritorious and thus adequate for factor analysis.

The number of monitored variables (factors) was reduced using the Varimax method. For the selection of substantial factors the Kaiser-Guttman rule was applied (i.e. substantial factors having a value within the range higher than 1) and subsequently Sutin test was applied. The correlation coefficients are in the interval from <-1;1>. If the correlation coefficient is positive, it is a direct proportion (negative – indirect proportion). For the evaluation, the value of variable correlation higher than 0.3 (moderate correlation) according to Anderson (2009) was used. Statistically significant results were presented at the significance level 0.05. To evaluate the results, IBM SPSS statistics was used. The factor analysis was conducted to find groups of responses of students regarding their perception of educational process. The goal was to find groups of variables with significant appearance at the same time to reveal main orientation of groups of students. The results may help with set up of personalized study program focused on the key expectations of students and stakeholders to maintain student learning outcomes.

According to Anderson (2009), the factor analysis was used only as verification. The emphasis on the factor analysis results is laid on the meaningfulness and substantiation of factors in terms of theory and practice in human resource management. In case of human resources research, this method is often used by researchers and provable in work with people (Anderson, 2009). Just because of the fact that factor analysis is often used in human resource research, it was also used to prepare this article. The aforementioned facts were respected in its application and it has been interpreted knowing the theory of issues (Urbancová, Šnýdrová, 2017; Urbancová et al., 2016). As mentioned above, the answers were analysed, the main directions and areas discussed and highlighted by respondents were summarised to form factors of main topics drawn from the respondent´s perceptions.

As statistics or statistical software may group variables which seem similar, there still may be mistakes in groupings. Therefore, all results were manually controlled to make sure the internal consistence of all factors is high and all variables which form each factor are valid and coherent. These prerequisites preceded the design and calculation of the study results. The results respect the above mentioned facts to design and interpret coherent factors which may help with further evaluation and assessment of analysis of students´ perceptions and behaviour.

During the research the procedures followed were in accordance with ethical standards and Czech law relating to the use of sensitive information.

Results

The chapter presents results of a study focusing on the identification of variants of perception of a quality education by students. Firstly, overall perception of the education al process by students is presented. Secondly, the factor analysis is used to group similar statements of students to form valid factors describing ways of students´ perception of the educational process. The chapter ends with a discussion of results and a comparison with other studies that have been undertaken.

Firstly, students' evaluation of the educational process is presented. Bellow in the Figure 1 the results show average students´ perception of different attributes of their perception of the educational process. Most of the attributes are evaluated positively (students evaluated each criterion on the scale where 1 is the best and 5 is the worst; the Figure only shows values up to 2.5 because no higher values were found).

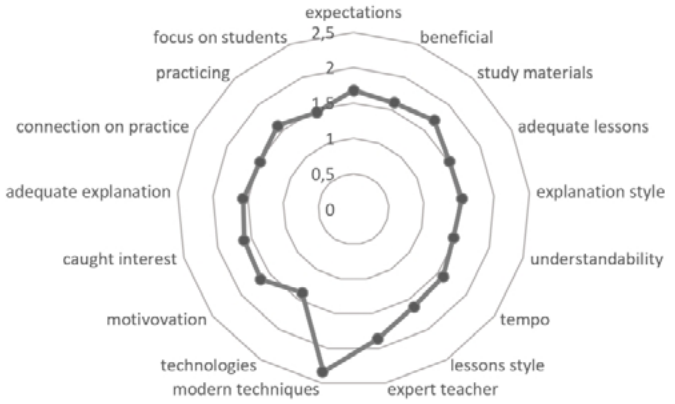

Figure 1: Evaluation of the educational process by students (source: Authors´ processing)

As we can see in the Figure 1, all analyzed statements are fluctuating around the level 1.5, the only difference is the use of the modern techniques. The modern teaching techniques received poorer evaluation than other searched statements (the average is 2.355, modus 1 and median 2). Other values were in the interval <1.386; 2.342>. Standard deviations do no exceed 1.172. This greatest difference has appeared in the variable related to the modern teaching techniques used by a teacher. Students' responses varied most in this criterion. That means that some of the teachers are evaluated as fully using modern teaching techniques, but there are some who use only standard and classical teaching techniques. On the other hand, the overall results do not show serious weaknesses. Students evaluated all areas of the educational process at a very good level of satisfaction. This indicates mostly agreement and conformity of responses and also perception of the educational process by the interviewed students. As only students who participated in entire lessons and courses were interviewed, one may conclude that the results should reflect the real process of the education, lessons and seminars.

Further analysis of usage of modern teaching techniques revealed that it is not dependent on practicing; the association analysis shows there is no relation. Attention of students can be attracted by any teaching techniques, but students are attracted by discussion and practical application of studied theory.

Factor analysis was used to further analyze the results. First a correlation analysis was conducted. Given that a sufficient quantity and quality of correlation coefficients was found in the correlation table, a subsequent analysis was conducted: i.e. factor analysis. Correlation matrix was not added in the text, as it has more than 700 cells and it could not fit in the paper body. The level of correlation coefficients were sufficient according to Anderson (2009) and Hendl (2006). Moreover, 86.93% of correlations in the correlation table were statistically significant. The KMO (Kaiser-Meyer-Olkin test) value reached over 0.8 which is considered as meritorious and thus adequate for factor analysis.

According to the evaluation of the calculated data, a total of 6 significant factors were identified following the evaluation of the survey. One of them only slightly exceeded the value of 1.0 and for this reason it had been eliminated from further assessment. In total, therefore, there were identified 5 significant factors that meet the criteria according to this methodology: Quality receptionists, Business oriented, Expert innovators, Distance learners and Arrangement oriented (see the Table 1).

Compo-nent	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumula-tive %	Total	% of Vari-ance	Cumula-tive %
1	8.103	31.165	31.165	7.293	28.052	28.052
2	1.789	6.882	38.047	1.779	6.842	34.894
3	1.389	5.342	43.389	1.675	6.440	41.334
4	1.162	4.468	47.857	1.347	5.181	46.516
5	1.053	4.051	51.908	1.344	5.169	51.685

Table 1: Resultant variance of the factor analysis (source: Authors´ calculation)

To make calculations of the factor analysis, the final table was adjusted to leave out variables that were repeated in the factors and did not form a unique factor composition. In addition, variables that hardly reached the required minimum values in order to be included in factors were omitted.

Similar statements of students' evaluation were sought during the monitored education, describing subsequent responses regarding their evaluation that depends on the preferences of individual goals and personal preferences. Based on these elements, the overall perceptions of the groups of students and their responses to the set questions have been described. Identified division helps to establish appropriate criteria in the study plan and teaching-learning process to encourage students to study and progress. The goal was to find groups of variables with significant appearance at the same time to reveal main orientation of groups of students.

The analysis revealed five major categories of students' attitudes, which explains the 52.7% of the total sample. Analysis grouped variables into factors in the composition shown in the Table 2 below. Significant dependencies are in bold. Factors are constructed based on their content and relationships to similar variable and their simultaneous use.

The first factor is formed by variables that summarize students who are fully interested in the educational process and its components. The Factor is formed of 13 initial statements regarding quality. They evaluate areas of quality lessons, subjects and teachers. This group is not specified by gender of job position. Students grouped by Factor 1 perceive subjects as beneficial and filling their expectations, they evaluate lessons as understandable, tempo and style suits them. Additionally, this group also positively evaluates teachers, stating that they attract their interest, motivate them to learn, connect theory and practice, focus on students´ needs and pay attention to practicing. On the other hand, this group of students does not care for demands for exams. They are interested in learning process, quality of education rather than exam demands. Additionally, they do not care about teaching techniques and technologies. They focus on the content of each subject or course. Therefore, this group formed by Factor 1 can be named Quality receptionists.

It is positive to reveal that this group is rather large; the factor explains almost one third of behavior of students (28.1%). It is very pleasant to work with this group and teach in such classes. They also positively evaluate quality of a study program and the benefits brought to them by education.

Statements	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
sex (female=1)	-.158	-.183	.044	**.658**	-.053
job in business	.064	**.844**	.002	-.066	.003
plans for job in business	.051	**.833**	.022	.037	-.017
subject filled expectations	**.660**	.127	-.005	.127	.108
subject is beneficial	**.506**	.244	-.013	.270	.062
study materials are available	.204	.008	.187	**.475**	-.006
adequate lessons	**.767**	-.004	.080	-.045	.150
adequate explanation style	**.795**	-.004	.088	-.029	.116
understandability of lessons	**.784**	.089	-.002	.012	.027
suitable tempo	**.684**	.115	.085	.040	-.056
suitable lessons´ style	**.796**	.030	.038	.018	.135
expert teacher	.121	.044	**.751**	.099	-.016
use of modern techniques	.039	-.015	**.742**	.006	**.426**
use of modern technologies	.293	-.002	.217	.067	**.650**
motivates to learn	**.598**	.101	-.021	.278	.258
attract interest	**.641**	.088	.098	.192	.185
adequate explanation	**.801**	.003	.188	-.023	.041
connection on practice	**.598**	.097	-.103	.252	.270
practicing	**.595**	.078	-.143	.228	.293
focus on students	**.608**	.015	.223	.090	-.033
exam demands are adequate	.042	-.004	-.008	-.049	**.543**
Name of the group	Quality receptionists	Business oriented	Expert innovators	Distance learners	Arrangement oriented
% of variance	28.052	6.842	6.440	5.181	5.169

Table 2: Resultant factors – students´ behaviour (source: authors' calculation)

The second factor groups together students who already work or plan to work in the studied subject area. The factor shows that those students are a specific group with a specific behaviour. The factor analysis did not show enough details to see, what the specifics are, but the closer analysis of the data shows the group (identified by the factor analysis as 6.8% of the sample of students) is divided into two solid parts of almost the same size. The first part is focused on their business practices and finds hard to adapt to the new or different ways of thought subject content. Sometimes, they even have a problem with teachers' authority, as they perceive themselves as experts. The other part of the Factor 2 is completely opposite to the first part. Those practitioners enjoy deepening their practical knowledge and support their own theories. They closely cooperate with the lecturer and share their ideas. Additionally, they deeply appreciate new ways of teaching techniques and possibilities.

The second factor may be named Business oriented. As described, it is a factor divided into two parts. Both parts must be closely attended. The focus should be paid to the identification of their focus to address their preferred teaching techniques to reach expected synergy and sharing ideas between a teacher and students.

The third factor revealed a group of students who are interested in expert knowledge and skills together with expert use of the modern teaching techniques. They perceive and demand the expert quality of education on the part of teacher and also by technical support. Totally 6.4% of sample of students behave in this manner. Therefore, the factor may be named Expert innovators. Those students are not oriented on exam demands, they focus on specific new knowledge gained and its form in terms of providing new information. Factor 3 describes students who are searching for something new, innovative and special that moves them forward. This group is very demanding for teaching. On the other hand, it is a good motivation for teachers to focus on new added value in all lessons given. Thus, it leads to the constant innovation of teaching-learning process.

Factor 4 shows a connection with female students. They have special demands on studies, e.g. distance study materials, voluntary participation or individual exam terms to have time for family and kids. Totally 5.2% of students behave this way. As the sample contained 62% of female, that means a significant part of female respondents that behave in this manner. They are oriented on the support by study materials. This group is not interested in teaching process, teachers´ quality, experiences or style, neither lessons nor practicing. They probably do not place presence at the lectures and contact learning at the first place. On the contrary, they mostly self-study, and thus study materials are the most important thing for them. Therefore it is possible to name this factor Distance learners. It is necessary to count also with this type of students within the design of the educational process. In current economy where the demands for employees are very high and sometimes they have to change their job position quite often even to different sector or area, it is necessary for them to be able to develop their knowledge and skills at the same time "on the run". There may be even more of this kind of students in the future. Moreover, female students usually have families to take care of during studies and it is even more demanding. Thus, accessible and quality study materials for self-study are a necessity for them.

The fifth factor includes students oriented more on technical arrangements of the education rather than its content. They appreciate the use of the modern teaching techniques and technologies and look forward to innovative style. Additionally, they search for perceived or actual difficulty of the subject and for learning skills necessary for passing an exam successfully. They search for a link between the content of a subject and its fit to the exam requirements. Because of this combination, the factor may be named Arrangement oriented. In sum, 5.2% of student sample evaluate primarily these areas and are important to them.

The analysis of the quality of the educational process evaluation revealed five homogenous groups of students. Identification of these groups may help to design the educational process in the way of focusing on practice, addressing the needs and preferred teaching techniques by students and teachers especially when students are already experienced in a taught subject and importantly to prepare quality materials for self-study for students who are not able to attend all lessons and to clear the expectations on exams for students who does not link the taught subject to its practical implications.

Discussion

With regards to the results of the research we can summarize that students participating in the research have different criteria, which are important for evaluating the educational process quality. That is why their answers were put into 5 basic groups describing students' emphasis. It is necessary to realize that such a feedback from students is important not only in particular ongoing subjects, also at the end of such subject, but also for the entire course of their studies. Because there is a subjective distortion of evaluation for example due to the failure during exams. The importance of the continuous feedback, which, in the case that a school management reflects it, can help to improve the quality of the educational process, provided by students during and after their studies corresponds to the recommendation by Tsinidou, Gerogiannis, and Fitsilis (2010). According to Thatcher et al. (2016), institutions in the higher education sector should draw conclusions from the individual assessments by students, as emphasized by O´Connor and O´Hagan (2016) when assessing teachers, and adjust their subsequent strategic development, because, as indicated in the researches by Shahjahan and Morgan (2016), an assessment of the education learning outcomes brings the possibility how to improve own competitiveness in the higher education sphere. Nowadays, this is important for private as well as public universities according to the research by Ashraf, Osman and Ratan (2016).

The achieved results showed that groups of questioned students primarily lay emphasis on a content of each subject, possibility of using knowledge in practice, which is in accordance with He and Hutson (2016), the competence of teachers and reaching study goals through available materials, which is also in accordance with the previous results of researches at selected Czech universities according to Cejpek et al. (2014) or foreign researches by Delaney (1997) or Ognjanovic et al. (2016).

Conclusion

The present paper analyses and assess the education quality process in a selected private Czech university. The paper focuses on the perception of the education quality by students. The results show that analysed students assess the educational process quality according to 5 main identified factors, which describe their behaviour, thus what is crucial for them when assessing each subject. The first factor, "Quality receptionists", is formed of 13 variables, which have a high predicative value for students as the coefficients range from 0.506 to 0.801 and are focused not only on the evaluation of the context of the subject by students but also on the personality of the teacher, which is, according to the results from the researches by Cejpek et al. (2014), crucial for ensuring the quality of the educational process. The second factor, "Business oriented", is formed by work within the branch and plan rotation (0.833 – 0.844). This factor is closely linked to the practice and lays emphasis on the fact if students already have own experience working in the branch they study, and thus developing their existing knowledge and experience (primarily in the combined level of studies). On the contrary, the factor "Expert Innovators" focuses on the fact if students think a teacher is an expert in his/her branch, respectively, he/she has a practical experience with his/her subject according to student´s assessment and if obtained knowledge is applicable for students in their practice. This influences their further decisions to continue to the next study grade or further education within MBA, Ph.D., etc. The factor "Distance Learners" show a group of students, for whom it is important to have enough high-quality study materials (text, presentations, case studies, etc.), and factor "Arrangement Oriented" identify that these students currently lay emphasis on using modern techniques and technologies in education, which is in accordance with the results of the researches by Borges and Stiubiener (2015).

The theoretical contribution of the article lies in general identification and evaluation of the factors of the education quality at the higher education. The practical contribution of this article lies in presenting the concrete results from students' and academicians' evaluating the educational process at a private university. The results are important for ensuring continuity of the assessment process of academic staff and preparation of the new study program according to the students' perceptions. Besides this study there are several promising directions for further research. It would be useful to include the influence of the students' results at the particular exams of subjects and their final results before the practice at the state final exams and their subsequent success when looking for a job in the labour market.

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MACROECONOMIC IMPACT OF EXPENDITURES ON HIGHER EDUCATION: REGIONAL INPUT-OUTPUT ANALYSIS

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Highlights

- *An additional one billion CZK of expenditures in education in an individual region causes - in a relative point of view - the most significant impact in the Liberec Region*
- *The South Moravian Region reaches the highest absolute impact of additional expenditures on output*
- *Education services record the lowest output multipliers compared to ICT, R&D and tourism*

Abstract

This paper deals with the regional input-output analysis and its application to evaluation of the macro-economic impact of expenditures on higher education. Regional input-output tables represent newly developed tool which can be used for the assessment of the regional economic impact of the particular industry and its institutions. The regional input-output tables were experimentally constructed by the Department of Economic Statistics at the University of Economics for all 14 Czech regions. Employing them, we can demonstrate the impact of expenditures on higher education on the macro-economic indicators and employment. This paper deals with 1 billion Czech crowns expenditures on higher education sent by the Ministry to the hypothetical higher education institution. Finally, the impact of higher education expenditures is compared with the impact of expenditures to another industries (ICT, R&D and tourism).

Keywords

ESA 1995, gross value added, higher education institution, input-output model, output, regional input-output tables

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Introduction

Economic impact of education can be measured and evaluated in several ways (see Fig. 1). Mazouch and Fischer (2011) analyse the social and economic impacts of higher education for the whole economy and for the individual regions as well. There are different ways how to evaluate the impact of higher education and its institutions (HEIs) on the social and economic situation of the region. For example, Mazouch and Fischer (2011) constructed the macro-economic models which assess the impact of education level on the aggregate regional data on GDP, gross value added, labour productivity, employment, unemployment and wages etc. Education level could be measured by different approaches. Luger et al. (2001) pointed out impact of HEIs on creation of jobs (both university and non-university), attraction of students and visitors and their consequent spending, formation of human capital and development of new technologies (both with the impact on productivity increase) and also formation of regional milieu, influencing stimulation of entrepreneurial activities and attraction of high skilled workers (see Fig. 1). From his approach, we select just direct purchases of HEIs and their multiplier effects on the economy for our analysis.

Impact of production of any individual product (including educational services) could be measured, within the national accounts framework, by two main approaches. By the supply side, we can quantify the production and value added of any product and contribution to the level of GDP (so-called direct approach, direct impacts). By the expenditure (usage) side, we consider the input-output analysis which allow us to quantify the impact of change in final use (consumption, investment or export) of given product on the production side, in particular output and value added (so-called indirect approach, indirect impacts), see also OECD (2003). A short overview of recent results achieved by these approaches at the field of ICT impact analysis is brought by Fischer and Vltavská (2016b).

In this paper, we use the expenditure side impacts. Traditionally, the impact of 1 *additional* million or billion crown is analysed; for ICT products, see Fischer and Vltavská (2012), for tourism see Fischer et al. (2016) and for R&D expenditures see Fischer and Vltavská (2017).

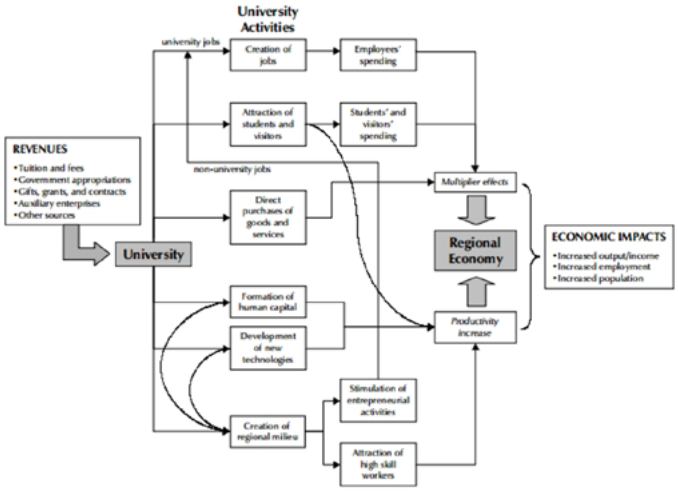

Figure 1: University impact mechanism (source: Luger et al. (2001))

Recently, the Czech tertiary education was being faced by the demographic decline (Mazouch, 2013) and the goals presented in the proposals of tertiary education reforms (Fischer and Finardi, 2010) also led to the transition of the Czech higher education "from quantity to quality". That was the reason we used in our previous research less traditional approach and tried to estimate the impact of the *decline* in expenditures on tertiary education

system, represented by the closedown of one HEI (Vltavská and Fischer, 2015). This paper used input-output modelling at the national level. Using national input-output tables, it is not possible to distinguish the impact of HEI's closedown to the economy of different regions. As Sixta and Vltavská (2016) showed, the technical-economic relations differ in individual Czech regions (using NUTS 3 classification). It means that recent estimates based on national input-output tables should be improved by the regional input-output tables. As the regional tables has been experimentally estimated within the research activities at the Department of Economic Statistics (University of Economics, Prague) and published (Sixta and Vltavská, 2016), we can make this improvement. Some preliminary results for selected regions have been already published (Fischer and Vltavská, 2016a).

The aim of current paper is to estimate the macroeconomic impact of public expenditures on higher education, represented by the state support of 1 billion Czech crowns sent by the Ministry of Education, Youth and Sports to hypothetical higher education institution. The impact is estimated for almost all regions of the Czech Republic and compared to the impact of expenditures on another industries (ICT, R&D, tourism).

The higher level of modelling the HEI's operation impact on the economy was presented by Blackwell, Cobb and Weinberg (2002). However, their approach needs very detailed set of the input data (on students, budget flows of the university, off-campus expenditures of students, parents, relatives and alumni) including some conditional data. This data set is not available for the Czech Republic although the annual reports of the HEIs are very extensive including detailed tables and although the different student surveys (e. g. EUROSTUDENT) are at a disposal.

Materials and Methods

The analysis is based on symmetric input-output tables and symmetric input-output model (Zbranek and Sixta, 2013), which represent an extension of the core of national accounts for analytical use (according to Hronová et al, 2009). Symmetric input-output tables are derived from a supply and use tables and they are compiled in two different ways – product by product and industry by industry. These two possibilities of the compilation come from the definition of the intermediate consumption matrix. The structure of the symmetric input-output tables constitute on three quadrants – intermediate consumption matrix, final usage (final consumption expenditures by institutional sectors, gross capital formation, export) and items of gross value added plus import (see Hronová et al, 2009).

Input-output model represents the discipline that is used among different groups of users. There are many analysis focused on the impact of some administration effect into the economy (Sixta and Fischer, 2015) or environment (Růžička et al, 2013) which used input-output tables of the national economy. Thus, regional input-output tables bring new possibilities how to improve such analysis just for one region of the country.

Similarly as in the previous model presented by Vltavská and Fischer (2015), we analyse the macroeconomic impact of 1 billion of money transferred to the HEIs by the Ministry of Education, Youth and Sports. The key indicators analysed are production, gross value added and compensation of employees. Moreover, the model informs about the impact into the commodity structure of the indicators mentioned. Besides, one can estimate not only the primary impact on the indicators but also the consequent impact on the decreasing final consumption expenditures. The analysis is based on 'ceteris paribus' assumption. Thus, it does not expect any other factors to the results. Detailed model and its assumptions are described by Vltavská and Fischer (2015).

For the modelling of the partial impact in individual region in the individual years we use simple static input-output model and the Leontief inversion

$$\Delta \mathbf{x} = (\mathbf{I} - \mathbf{A}_D)^{-1} \Delta \mathbf{y} \,, \qquad (1)$$

where

$\Delta \mathbf{x}$ ..... vector of the production change,
$\mathbf{I}$ ..... identity matrix,
$\mathbf{A}_D$ ..... matrix of technical coefficients which is derived from the matrix of the usage of domestic products under the intermediate consumption,
$\Delta \mathbf{y}$ ..... vector of partial change of final consumption,
$(\mathbf{I} - \mathbf{A}_D)^{-1}$ ..... Leontief inversion.

The model uses regional input-output tables (hereafter: RIOTs) of the year 2011 since this is the only year for which were RIOTs compiled. These tables were prepared according to the European System of Accounts ESA 1995 (Eurostat, 1996) as the project which was focused on this problem started in January 2013, i. e. before the revision of national accounts and employing standard ESA 2010. However, the methodology first published by Sixta and Vltavská (2016) is fully transferable into ESA 2010 (European Union, 2013). The significant advantage of RIOTs represents the look into the detailed structure (using Classification of Products CPA, 2 digits level) of individual region from the side of intermediate consumption, gross value added, final consumption expenditures by individual sectors, import and export (both international and interregional) etc[1]. As RIOTs are primarily used in regional input-output analysis they are split into imported products and domestically produced ones. It means that RIOTs of all Czech regions are divided into import matrices and RIOTs for domestic output. These tables can be used for researchers analysis as well as for the policy making decision by regional politics.

This analysis is prepared for all regions where the public HEI is located. Thus, results are prepared for 13 regions of the Czech Republic except Karlovy Vary Region where no public HEI is located. Moreover, this paper examines the changes in these regions in comparison with the results for the Czech Republic. For all regions we assume HEI with the same annual budget of one thousand million Czech crowns sent by the Ministry. The amount of 1 billion represents approximately 5% of the total budget for educational activities at public HEIs in the Czech Republic. Ministry expenditures are recorded as final consumption expenditures by government institution in particular product (CPA 85 – Education services).

Results and Discussion

Table 1 presents the overall impact of HEI on the economy. The results show that even if the ministry expenditures are the same for all regions, the impact on individual region differs. From the purely economic point of view the most significant impact (from the point of view of percentage) is recorded in the Liberec Region. The output of the region increases by 0.4% (1.2 bn CZK) and the final consumption expenditures increase by 1%. Smaller regions where one public HEI is located increase by 0.2 or 0.3% in the output and from 0.5 to 0.8% in the final consumption expenditures. There regions covers South Bohemia, Plzen, Usti,

1 See Dept. of Economic Statistics website (in Czech): http://kest.vse.cz/veda-a-vyzkum/vysledky-vedecke-cinnosti/regionalizace-odhadu-hrubeho-domaciho-produktu-vydajovou-metodou/

Olomouc etc. The output of regions with more than two public HEIs increases by 0.1% (approximately 1.2 bn CZK) and the final consumption expenditures increases by 0.3%. The impact on the whole Czech economy (expressed as a percentage) is naturally lower.

		CZE	Pha	Stc	Jhc	Plz	Ust	Lib
P.1	Output (basic prices)	0.0	0.1	0.1	0.3	0.3	0.2	0.4
D.21-D.31	Net taxes on products	0.0	0.0	0.1	0.1	0.1	0.1	0.1
P.7	Import	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Resources	0.0	0.1	0.1	0.2	0.2	0.1	0.3
P.2	Intermediate consumption (purchasers'' prices)	0.0	0.0	0.0	0.1	0.1	0.1	0.1
P.3	Final consumption expenditures	0.0	0.2	0.3	0.6	0.7	0.5	1.0
P.5	Gross capital formation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P.6	Export	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Final use	0.0	0.1	0.1	0.2	0.2	0.1	0.3
		Krh	Par	Vys	Jhm	Olm	Zln	Mrs
P.1	Output (basic prices)	0.3	0.3	0.3	0.1	0.3	0.3	0.1
D.21-D.31	Net taxes on products	0.1	0.1	0.1	0.0	0.1	0.1	0.1
P.7	Import	0.0	0.0	0.1	0.0	0.1	0.0	0.0
	Resources	0.2	0.2	0.2	0.1	0.2	0.2	0.1
P.2	Intermediate consumption (purchasers'' prices)	0.1	0.1	0.1	0.1	0.1	0.1	0.0
P.3	Final consumption expenditures	0.7	0.8	0.8	0.3	0.6	0.8	0.3
P.5	Gross capital formation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P.6	Export	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Final use	0.2	0.2	0.2	0.1	0.2	0.2	0.1

Table 1: The total macroeconomic impact of 1bn expenditures on HEIs, % (source: own calculation)

Note: CZE – the Czech Republic, Pha –Prague, Stc – Central Bohemia Region, Jhc – South Bohemia Region, Plz – the Plzen Region, Ust – the Usti Region, Lib – the Liberec Region, Krh – the Hradec Kralove Region, Par – the Pardubice Region, Vys – the Vysocina Region, Jhm – the South Moravian Region, Olm – the Olomouc Region, Zln – the Zlin Region, Mrs – the Moravian-Silesian Region

		CZE	**Pha**	**Stc**	**Jhc**	**Plz**	**Ust**	**Lib**
P.1	Output (basic prices)	1 240	1 205	1 183	1 189	1 168	1 184	1 157
D.21-D.31	Net taxes on products	22	23	34	19	21	26	19
P.7	Import	98	82	100	82	77	84	95
	Resources	1 361	1 310	1 317	1 290	1 267	1 294	1 271
P.2	Intermediate consumption (purchasers'' prices)	361	310	317	290	267	294	271
P.3	Final consumption expenditures	1 000	1 000	1 000	1 000	1 000	1 000	1 000
P.5	Gross capital formation	0	0	0	0	0	0	0
P.6	Export	0	0	0	0	0	0	0
	Final use	1 361	1 310	1 317	1 290	1 267	1 294	1 271
		Krh	**Par**	**Vys**	**Jhm**	**Olm**	**Zln**	**Mrs**
P.1	Output (basic prices)	1 192	1 149	1 160	1 228	1 156	1 150	1 205
D.21-D.31	Net taxes on products	20	26	22	16	15	21	23
P.7	Import	85	80	82	75	89	91	82
	Resources	1 297	1 256	1 264	1 319	1 260	1 261	1 310
P.2	Intermediate consumption (purchasers'' prices)	297	256	264	319	260	261	310
P.3	Final consumption expenditures	1 000	1 000	1 000	1 000	1 000	1 000	1 000
P.5	Gross capital formation	0	0	0	0	0	0	0
P.6	Export	0	0	0	0	0	0	0
	Final use	1 297	1 256	1 264	1 319	1 260	1 261	1 310

Table 2: The total macroeconomic impact of 1bn expenditures on HEIs, mil CZK (source: own calculation)

Table 2 presents the different look on the results: one can see the impact of 1 bn expenditures on HEIs to the absolute values of regional national accounts indicators. The highest absolute impact on the output is achieved in the South Moravian Region (1 228 mil CZK) and identically in Prague and the Moravian-Silesian Region (1 205 mil CZK). In all these regions it means the increase of the output by 0.1% (table 1). On the contrary, the lowest increase of the output is seen in the Pardubice Region (1 149 mil CZK which means 0.3% of output).

	CZE	**Pha**	**Stc**	**Jhc**	**Plz**	**Ust**	**Lib**
A	1	1	2	2	2	1	1
B to E	50	49	33	48	33	49	22
F	22	20	20	19	17	18	18
G+H+I	29	24	23	23	21	21	17
J	17	15	10	10	11	11	9
K	12	6	4	7	7	5	9
L	26	20	21	19	18	19	19
M+N	33	26	25	23	23	21	22
O+P+Q	1 045	1 040	1 039	1 035	1 033	1 036	1 037
R to T	4	4	4	3	3	3	3
Total	**1 240**	**1 205**	**1 183**	**1 189**	**1 168**	**1 184**	**1 157**
	Krh	**Par**	**Vys**	**Jhm**	**Olm**	**Zln**	**Mrs**
A	1	1	1	2	1	1	1
B to E	46	25	42	48	22	23	49
F	19	16	17	22	18	18	20
G+H+I	19	18	17	29	20	18	24
J	15	12	8	16	8	8	15
K	9	7	4	10	6	5	6
L	19	16	19	24	17	18	20
M+N	22	18	16	32	23	21	26
O+P+Q	1 038	1 033	1 032	1 040	1 036	1 035	1 040
R to T	4	3	3	4	3	3	4
Total	**1 192**	**1 149**	**1 160**	**1 228**	**1 156**	**1 150**	**1 205**

Table 3: Total change of output, mil CZK (source: own calculation)

Note: A - Agriculture, forestry and fishing, B - Mining and quarrying, C – Manufacturing, D - Electricity, gas, steam and air conditioning supply, E - Water supply; sewerage, waste management and remediation activities, F – Construction, Services: G - Wholesale and retail trade; repair of motor vehicles and motorcycles, H - Transportation and storage, I - Accommodation and food service activities, J - Information and communication, K - Financial and insurance activities, L - Real estate activities, M - Professional, scientific and technical activities, N - Administrative and support service activities, O - Public administration and defence; compulsory social security, P – Education, Q - Human health and social work activities, R - Arts, entertainment and recreation, S - Other service activities, T - Activities of households as employers and producers for own use.

The impact of the public expenditures on HEIs differs in individual regions and industries. Table 3 illustrates the total change of output of individual industries according to the officially published regional data by the Czech Statistical Office. The Central Bohemia Region represents the region which is the closest to the average by the structure of the Czech Republic. Prague differs the most as many HEIs are located here. The most significant impact is detected among industries in which HEIs take parts (more than 1 bn CZK in each region). Thus, industries Public administration and defence (O), Education (P) and Human health and social work activities (Q).

Besides the structure of output, the structure of gross value added differs among regions (table 4). It is given by the availability of regional producers to satisfy specific regional demands. When analysing the impact of expenditures on HEIs, the highest impact on gross value added is investigated in the South Moravia Region (909 mil CZK) and the Plzen Region (902 mil CZK). The impact on Prague is higher (895 mil CZK) than the average of the Czech Republic (880 mil CZK).

Expenditures on HEIs influence not only economic indicators of individual regions but the employment as well (see also Sixta, 2017). The increase of HEI budget will mostly influence the

employment in Prague (by 2.5 thousands persons). It represents 0.27% of employment in Prague. On the other hand, the lowest increase of employed persons in absolute value by 1.6 thousand persons is found in the Vysočina Region (0.74%) and the South Moravian Region (0.3%).

	CZE	Pha	Stc	Jhc	Plz	Ust	Lib
A	1	0	1	1	1	0	0
B to E	15	17	11	14	11	16	7
F	8	8	7	7	7	8	8
G+H+I	12	11	11	11	10	10	8
J	9	7	3	4	5	5	4
K	7	3	2	4	4	3	5
L	13	10	14	11	11	10	11
M+N	13	10	9	8	10	8	8
O+P+Q	801	826	805	836	842	828	833
R to T	2	2	2	2	2	2	2
Total	**880**	**895**	**866**	**898**	**902**	**890**	**886**
	Krh	**Par**	**Vys**	**Jhm**	**Olm**	**Zln**	**Mrs**
A	1	0	0	1	1	0	0
B to E	17	10	13	15	8	8	17
F	8	7	7	7	7	7	8
G+H+I	9	8	9	13	9	9	11
J	8	5	3	9	4	3	7
K	5	3	2	5	4	2	3
L	11	10	9	13	9	10	10
M+N	9	6	5	13	10	7	10
O+P+Q	826	841	846	831	844	840	826
R to T	2	2	2	3	2	2	2
Total	**895**	**893**	**896**	**909**	**896**	**889**	**895**

Table 4: The total impact of 1 bn expenditures on HEIs on gross value added, mil CZK (source: own calculation)

	Pha	Stc	Jhc	Plz	Ust	Lib	Krh
persons	2 452	1 945	1 762	1 726	2 049	1 825	1 375
%	0.27	0.35	0.59	0.62	0.58	0.94	0.55
	Par	**Vys**	**Jhm**	**Olm**	**Zln**	**Mrs**	
persons	1 757	1 654	1 654	1 689	1 752	1 778	
%	0.75	0.74	0.30	0.62	0.67	0.34	

Table 5: The total impact 1 bn expenditures on HEIs on employment, persons, % (source: own calculation)

Output multipliers present other result of the input-output analysis. Multipliers present the importance of backward linkage of individual industry in each region. For the illustration we present multipliers of CPA 85 (Education services). The results show (Table 6) that the strongest backward linkage in education reach the South Moravian Region, Prague and Moravian-Silesian Region (around 1.2). On the contrary, the weakest linkage reach the Pardubice Region and the Vysočina Region (1.5). The multiplier in the South Bohemian Region says that 1 mil. CZK invested into the education lead to the increase of output in the South Bohemian Region by 1.2 mil. CZK.

Finally, we can compare the multipliers of HEIs educational expenditures with multipliers estimated within our previous research, see Fischer and Vltavská (2012), Fischer et al. (2016) Fischer and Vltavská (2017).

The output multipliers are the lowest for the education services, also with the lowest absolute differences between regions. The reason consists in fact that education services have the highest share of compensations of employees and on the contrary the lowest share of the intermediate consumption on the gross value added. And just the intermediate consumption has the key effect at the multiplication process, because the purchases of goods and services used as intermediates lead to the production at other industries. The highest multipliers are estimated for Prague and the South Moravia Region, where many education institutions provide the services and part of them is out-sourced from another institutions. Multiplying effect in Prague also leads to the highest impact on employment (see table 5).

Region	ICT			R&D	Education	Tourism			
	26	61	62	72	85	55	56	79	93
Pha	1.25	1.38	1.48	1.47	1.21	1.92	1.51	2.18	2.05
Stc	1.23	1.26	1.61	1.40	1.18	1.77	1.56	1.96	1.86
Jhc	1.19	1.31	1.53	1.24	1.19	1.71	1.55	2.00	2.00
Plz	1.37	1.28	1.44	1.39	1.17	1.84	1.59	2.07	2.02
Ust	1.26	1.39	1.55	1.87	1.18	1.96	1.52	1.98	1.98
Lib	1.18	1.22	1.51	1.62	1.16	1.65	1.40	1.94	1.98
Krh	1.21	1.38	1.47	1.74	1.19	1.62	1.51	1.92	1.86
Par	1.29	1.52	1.64	1.81	1.15	1.68	1.46	1.82	1.92
Vys	1.19	1.20	1.53	1.54	1.16	1.75	1.49	1.86	1.87
Jhm	1.36	1.46	1.41	1.36	1.23	1.85	1.72	2.20	2.23
Olm	1.18	1.23	1.51	1.67	1.16	1.78	1.58	2.02	1.96
Zln	1.23	1.22	1.48	1.28	1.15	1.66	1.49	1.92	1.90
Mrs	1.25	1.38	1.48	1.47	1.21	1.92	1.51	2.18	2.05

Table 6: Output multipliers, 2011 (source: own calculation)

Note: 26 - Computer, electronic and optical products, 55 - Accommodation services, 56 - Food and beverage serving services, 61 - Telecommunications services, 62 - Computer programming, consultancy and related services, 72 - Scientific research and development services, 79 - Travel agency, tour operator and other reservation services and related services, 85 - Education services, 93 - Sporting services and amusement and recreation services

Among ICT industries, the lowest level of multipliers at NACE 26 (Computer, electronic and optical products) is influenced by the high share of imports on production (which causes lower domestic multipliers; multiplication effect is realised abroad). In terms of multiplication effect, R&D expenditures are better than education expenditures (at R&D, more material and services should be purchased comparing to education). In tourism, the most efficient is multiplication within traveling and recreation comparing to food and accommodation services. It is also caused by the structure of gross value added and the structure of intermediate consumption.

Conclusion

The aim of this paper was to estimate the indirect impacts of the Czech tertiary education on the economy of the Czech regions, as the example of usage of recently developed regional input-output tables. Using this approach, we estimated the impact of expenditures on higher education institutions and the small differences within the Czech Republic. Comparing the results we can conclude, that the most significant impact of HEI's operation is for the South Moravia Region in terms of absolute changes of the total output and total gross value added of the region.

These results detects only purely macroeconomic impact of higher education expenditures on the regions. Further analysis should be focused on wider social and economic impacts. Nevertheless, recently estimated regional input-output tables seem to be a very useful tool for economic analysis of the Czech regions and for such regional industry impact analysis.

At the end of our paper, we compare multipliers of another selected industries, investigated within our previous research. Multipliers estimated for education services are lower than the ones for ICT Services, R&D expenditures and tourism.

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