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# Developing teacher students' pedagogical problem-solving thinking by design-based research

## Thesis of doctoral (Ph.D.) dissertation

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## Introduction

There can be perceived an educational approach worldwide what aims to improve the quality of education by focusing the development of teacher's personality - ability - and activity system. (OECD 2005, Barber and Mourshed 2007). Pedagogical knowledge system of teachers consists of theoretical and practical components and both are significantly interwoven by their education views (Falus 2004). The definition of 'good teacher' is not easy as it includes many general emotional and behavioural aspects as well as special knowledge, skills, values and views (Sallai 1994, Falus 2003). For this reason, it has been a question for decades how the candidates of this career could be effectively prepared for such a complex profession. However, the national and international scientific results pointed out many driving forces of the structural and content transformation of teacher training. I highlighted those elements that are relevant for my research:

- An integrative approach and complex development of theoretical and practical knowledge related to the profession are needed (Bárdossy 2014).
- It is necessary to strengthen the role of teaching practice in the training system, the main environment of the candidates' learning process must be the school and the classroom (McIntyre 1994, Borko, 2004, Falus 2006a, Zeichner 2010). For this changes, new training system and curriculum are needed (Ball and Bass 2003, Grossman és McDonald 2008).
- In the practice-oriented, problem-centred training it is also necessary to give candidates the possibility to get to know reflective techniques and to improve their own pedagogical practice by continuously analysing it with the support of an expert colleague (Calderhead 1989, Falus 2006a, OECD 2011, Bárdossy 2014).
- Becoming a teacher is a process which starts before the teacher education and ends with the retirement. Therefore pre-service, induction and in-service phase should be built on each other is to provide teachers ' continuous professional development (Falus 2006a).
- It is necessary to describe the main standards of teacher's profession, which define the directions and focal points of preparation as well as the continuous development of the teaching career and provide a comparison of the teaching skills, knowledge and attitudes (Falus 2007, 2010, 2011).
- The induction phase has a paramount importance of the career path. Exiting from the training institution as well as from the practice-school protected environment, and adapting the workplace (to the new role and the new colleagues) is a rather complex challenge that requires considerable time and support. For this reason, it would be advisable that the training institution should be in close cooperation with the subsequent workplace (Szivák 1999, Nagy 2004, Feiman-Nemser 2001, 2003, European Commission 2010, 2013, Sallai 2015).

The results of these changes can be seen in Hungary (competence-based teacher training, dual training, lengthening of school practice, mentor system, teacher career models), however, there's still plenty elements of the teacher education system that need further development such as developing teacher candidates' problem solving skills (Hunyady 2010, Sáska 2015, Arató 2015, Falus 2015).

## The research problem

Numerous researches focused on the pedagogical challenges of teachers over the last few decades. According to the date (based on national and international standards), teachers' biggest challenges include the individual treatment of students with special needs, the aggression - and conflict management as well as the motivation of students (Szivák 1999, Imre 2004, Sági és Varga 2011, Mrázik 2012, Ritter 2015, Szemerszki 2015, Fehérvári 2016).

The systemic and content deficiencies of teacher training can be discovered with the lack of preparation of pedagogical challenges. Previous national surveys have pointed out that students are largely dissatisfied with the teacher education, they miss more effective preparation for challenges related to classroom organizational tasks and they feel that the theoretical courses of university can not really be utilized in the teaching process. Teacher candidates also think, that the training does not pay attention to competence development which would be needed in order to be able to control an effective teaching-learning process. On the one hand this may be due to the fact that many elements of the teaching profession are essentially related to the practice and can therefore be improved mostly in real classroom environment. It is not surprising after all that teacher candidates and novice teachers find the school practice the most effective element of the training system. (Kocsis 2003, Lukács 2002, N. Kollár 2008, 2011, Jancsák 2011, 2012). On the other hand the training curriculum offers the educational, psychological and methodological modules which are isolated from each other and only a small part of them can built into the practice. (Feiman-Nemser 2001, Hagger and McIntyre 2006, Cooper 2011, N. Kollár 2011). Therefore one of the major challenges of the induction period is to overcome the theory-practice discrepancy and reduce the gap between the theoretical knowledge (acquired in teacher education) and the real classroom practice (Hagger and McIntyre 2006, Vick 2006, Zeichner and Liston 1996).

Consequently, it is obvious that there is a missing link in teacher education. This link should provide the improvement of candidates' system thinking by self-case reflection in order to transfer their knowledge into the practice and develop their own problem-solving strategies.

Teacher profession is quite diverse and consists of several components so the reflection of own pedagogical cases is essential during the training process. Behind the complexity of pedagogical situations there are different features of the phases of learning-teaching process (Jackson 1968, Clark and Peterson 1986, Killon and Todnem 1991), the multidimensional field of classroom situations (Doyle 1979, Lampert, 2001, Hammernes et al. 2005), the multi-level structuring of teacher roles and tasks are society, school, class, and student (OECD 2005). Classroom situations are multi-dimensional atmosphere where events (taking place in parallel and at different levels) should be seen, followed and controlled by the teacher simultaneously, therefore pedagogical problem situations are highly subjective, and context-dependent phenomena (Kelemen 1967, Ungárné 1978, Lampert 2010).

The management of pedagogical situations is an essential and everyday task of the teaching profession since the whole process is seen as a problem-solving and a series of decisions (Shavelson 1973, Calderhead 1993). New teachers face many unexpected, unusual situations during their pedagogical practice. They usually do not understand the situation in which they

are in and take superficial, short-term decisions which leads to the emerging of problematic situation over again. This process continues until the novice teacher starts to become an expert by the development of problem-solving process (perception, problem identification and analysis, solutions collection, decision making, implementation) (Berliner 1988, 2004, Tsui 2009). With the emergence of schematic thinking and routine action, more experienced teachers are able to deal with situations that seem to be difficult for beginners, but due to the ongoing economic and social changes, they face new and emerging challenges as well. This justifies, among other things, that during teacher education students should receive thinking techniques and framework with which they can handle their own pedagogical situation instead of getting concrete solutions for typical situations.

Psychology defines problem as a situation when the individual can't response to a given stimulus successfully, because (s)he does not know the solution path (Lénárd 1964, Bransford and Stein 1994). Based on this definition *pedagogical problem* is the situation which related directly or indirectly to the teaching-learning process and the teacher perceive it as a problem. Instead of problem solving skills constructivist pedagogy speaks about knowledge of general problem solving process and special abilities (as the manifestations of knowledge systems) associated with the context of the problem (Nahalka 2002). In this respect, the educational program contributes to the improvement of teachers' thinking skill related to pedagogic problematic situations during the reconstruction of general knowledge of problem solving. This is called during the research pedagogical problem-solving thinking.

The design-based research examines the possibilities of the development of (future) teachers' problem solving thinking based on a special educational program developed during the research. This educational program has a Hungarian and English version as a supplementation of the thesis (Orgoványi-Gajdos 2014, 2016).

## The main features of the research

*The research strategy*

The type of the research is a so-called design-based research which is getting more and more popular in international contexts. The relevant international literature also calls '*design research*' or '*development research*' (Reeves et al. 2011). It focuses on the innovation developed for the needs of the given environment.

The literature emphasizes pragmatism as the philosophical background of the research opposed to the relativistic focus of quantitative research and the realistic of qualitative research. The design process can be altered and adapted to the needs of the environment, thus providing a fairly flexible framework for researchers. (Reeves 2006, Gravemeijer and Cobb 2006, Nádasi 2013). This pragmatic approach that brought this kind of research strategy in the scientific world in 1990s to link the ongoing development processes and the academic research. The most important features of design research can be summarized as follows: pragmatic, interventionist, grounded, iterative, includes the involvement of practitioners, process oriented, utility oriented, theory oriented (Collins 1992, Cobb 2001, Shavelson et al. 2003, Van den Akker 2007, Hogue 2013).

The educational design has a complex problem and the research aim is to develop useful and effective solutions while following and documenting the whole process from planning to evaluating (Nádasi 2014). According to Dutch researchers the educational design research is '*to design/develop an intervention (such as programs, teaching-learning strategies and materials, products and systems) with the aim to solve a complex educational problem and to advance our knowledge about the characteristics of these interventions and the processes to design and develop them*.' (Plomp and Nieveen 2007, 12).

Steps of design research are defined along three main pillars in the literature: preliminary, prototyping and assessment phase (Plomp and Nieveen 2007). The first phase involves the preparatory of the research as the researcher identifies and analyses the problem by the literature review providing the content validity of the next stage. The second stage is the innovative phase in which the researcher develops a program, strategy or tool that can be used to handle the problem analysed. This design development includes the circular steps of trial and correction by formative evaluations. The final phase is the summative assessment in which the researcher collects responses on: whether the product can be used in the context and the workers are willing to use or whether the substance is effective. (Plomp and Nieveen 2007).

*Phases of the research and its methods*

In the first stage the literature review and the theoretical framework of the program were shaped. During the prototyping phase the blueprint version was developed. The last part of the research covered the assessment part with impact evaluation. This presentation focuses on this part and the overall outcome of the research.

The structure of the research and the thesis follow the design research process. During the *preparation phase*, on one hand the national and international literature background were synthesized in the field of educational science and psychology concerning problem solving

process, teacher education and teacher competencies. On the other hand, I analysed the curriculum documents of the Eszterházy Károly College (from July 1, 2016 as University) as the empirical part of the research was done in this teacher training institution. The preparatory took place between autumn 2013 and spring 2014. My goal was to examine whether the college responded to the situation in the research problem and, if so, how. All of these steps have also contributed to the content validity of the developed educational program.

The *development phase* started in the summer of 2014. At that time the first manuscript of the complex education program related to the case analysis seminar was completed, containing both theoretical and methodological material for one semester and it was divided into 14 occasions. The pilot of the program took place in full time master level education with 14 participants. The final version of the program was created after the correction process (Orgoványi-Gajdos 2014). The research method in the pilot phase concentrated on student feedback and the teacher's reflective journals. After that a shortened version was also made for students of distance learning who had only one contact day (1x8 hour) for this course. This summarized version contained the basic philosophy of the original program as well as the most important techniques that help to think through the problem solving process: Defining the problem and the aim (de Bono 1996); Information gathering: Objective and subjective method, Fishbone method (Ishikawa 1982); Generating alternatives: SCAMPER method (Eberle 1984); Decision making: For and against method (Lewin 1947); Future-wheel method (Glenn 1972).

The first step in the *summative evaluation* phase was the development of the measuring methods of the educational program. The satisfaction, the attitude and the impact assessment of the blocked educational program lasted with a total of ten seminar groups (159 students) from the spring semester of 2015 until the spring semester of 2016. The evaluation consisted of two parts. The first record of the courses took place when the students (N=159) completed a paper-based questionnaire in which is scaled and open-ended questions were included. The second stage of the evaluation was made up of online questionnaires at least three months after the given course for longitudinal examination, which only contained open-ended questions.

The summative evaluation phase has performed several functions in the research. On the one hand it was suitable for satisfaction with the structure, content, usefulness and efficiency of the education program, as well as the attitude-related examination. On the other hand, the sample was divided into five additional sub-samples based on participants' learning experience for the purpose of a comparative study. The first category I called *student teacher*. It collects those participants *who* do not yet have individual experiences as a teacher just the training school experience. *Novice teacher* had 1 to 3 years of teaching. *Competent teacher* had far more significant 4-8 years of teaching experience. According to the literature, obtaining a high level of teacher competences requires at least 7-9 years. (Berliner 2005). Therefore, the *expert teacher* category collects those who had at least 9 years of teaching experience. The Berliner's allocation for this section would end here but I was interested in whether there are differences among teachers with more teaching years of experience. One additional category was made called Master teacher with more than 16 years experiences. Comparative studies were well supported by the fact that the 159 participants presented in approximately the same number of elements in the five sub-samples. The design of the sub-samples allowed the research to

perform statistical calculations using SPSS analysis software. The focus of the analysis was the relationship between the number of years spent in teaching and the variables being studied (structure, content, usefulness and efficiency of the education program). The question focused on how the results strengthen or complement the national and international earlier studies.

*Triangulation in the research process*

During the research I put huge emphasis on triangulation, which was achieved on the following levels and by the following methods.

The *research strategy* basically included a mixed-method: qualitative and quantitative paradigms (Sántha 2015). Within the combined paradigm the complex model of exploratory sequential design was used (Sántha 2009, 2015), which meant that sequential qualitative – quantitative – qualitative paradigms have changed each other during the research for which the design-type provided a perfect framework (Nádas 2014).

The *theoretical triangulation* was provided by the wide range of national and international literature apparatus which gave the theoretical background of the developed educational program.

The *personal reliability* of the summative evaluation was supported by the sampling since the ten courses were made up of heterogeneous groups of participants. Furthermore the personal triangulation was also provided at the questionnaire data coding process by inter-coding.

The *methodological reliability* was presented by using several methods simultaneously: reflective diary, questionnaires, document analysis. Within the questionnaire method the variety of technique was also used: open-ended question, Likert-scale, one-choice question (Sántha 2015).

*The temporal triangulation of data collection* was also performed as ten courses were held in different time between the spring of 2015 and the spring of 2016.

**Thesis points of the research**

Hypotheses referred to the summative phase of the research due to the design nature of the study. They were connected to the satisfaction and impact assessment of developed educational program, and the techniques relating to student attitude. The last group of hypotheses concerned the relationships between the variables and teaching experience.

**I. Hypotheses of student perception regarding general features of the educational program:**

*H1: Participants were satisfied with the general curriculum features of educational program (objectives, content, structure, nature).*

*H2: The attitudes are positive related to case-based learning.*

*H3: The most important elements of the educational program include techniques that support the solution process according to the participants.*

**II. Hypotheses relating to the student's attitudes on techniques of problem solving:**

*H4: Students who participated in the research have not known or used the techniques of the educational program previously.*

*H5: Students who participated in the research have a positive attitude towards the five-step problem solving model.*

*H6: Students who participated in the research have positive attitude towards the techniques and methods belonging to the steps of the problem solving model.*

**III. Hypotheses about student views related to the impact of the educational program developing problem-solving thinking:**

*H7: According to the opinion of the participants the educational program contributes to knowledge transfer assures the co-ordination of pedagogy-psychology as well as theory-practice.*

*H8: According to the participants the educational program largely contributed to development of the convergent, divergent and reflective thinking skills.*

*H9: According to the participants of the research the interactive nature of educational program contributes largely to peer-learning.*

*H10: According to the participants of the research the educational program assures the improvement of own problem-solving strategies concerning to their pedagogical situations.*

**IV. Hypotheses related to students' opinion concerning the effect of the educational program:**

*H11: The perception of own success relating to the steps of problem-solving process increases in proportion with the years spent with teaching.*

*H12: There is no correlation between the teaching experience and the prior knowledge regarding the techniques used in the educational program.*

*H13: Student teachers and novice teachers need problem-solving techniques due to the lack of their schemata or routines.*

*H14: Problem-solving techniques are found to be the most useful by beginner teachers, while the judgment of utility decreases in line with the increasing teaching experiences.*

**Results of the research**

During the *preparatory phase* of the research, I examined and synthesized the national and international literature related to the research problem, I also analysed the curriculum documents of teacher education of the Eszterházy Károly University. I found that teachers faced challenges, regardless of their teaching experience, however beginner teachers seem to be less effective problem-solvers than their experienced peers due to the absence of elaborated schemata and routines.

I found that pedagogical problems can be considered as complex problems in which both situational and personal components are determinants. Since the entire pedagogical process is passed through a series of problem solving it can be considered as a key element in the teaching profession. The problem-solving activities of teachers are related to the real pedagogical process therefore it can be improved by the teaching practice. This problem-solving process can be developed by the analysis of specific pedagogical situations. Through Problem-solving general knowledge is re-constructed hinged on the discovery be achieved.

Being the location of the research, Eszterházy Károly University possesses a number of elements that contribute to the students' theoretical or practical preparation. However the document analysis revealed the absence of the integrative approach, which would help the students to transfer their knowledge into practice in order to handle pedagogic situation more effectively.

The aim of the *development phase* was to create an educational program which focused on the improvement of teacher candidates' problem-solving thinking skill. There are a five-step problem-solving process and its techniques in the middle of the developed training program During the pilot of the educational program the following findings were presented. The education program was conducted by students who did not have their own teaching experience and their own pedagogical cases therefore the thinking techniques were tested by the analysis of some fictional situations I chose. So the students were not real participants in these cases and therefore they often felt more difficult to identify and analyse the situation. In conclusion the educational program needs to fit with or beyond the school practice. It has become clear some restructuring need for the content and the structure of the program too by the feedbacks of the students.

The *summative evaluation phase* was based on the shortened version of the educational program including all the techniques relevant to the problem-solving process and to which the study underlying was directed. The total of 159 students participated in this evaluation process. Concerning the general curriculum features of the educational program, the following statements could be said. Mentioning only one word about the whole program 37% of the students said "practical", and 36% of them said "interactive". Similarly, the most positive aspect of the program was the "practicality" (27%), and the "specific case analysis" (25%) according to the answers. Negative observations were only given to the circumstances of the seminars (the timing and the condition) but the features of the educational program were not criticized. These date were also supported by skating questions. The answers of the questions touched the aim, the structure and the content of the program, and were between 4 and 5 on the five-degree scale. The fact that somebody was a "case-bringer" in the course during the small groups activities

influenced these results in a positive way (see the practical nature of the course: r=0,381, p=0.000; the content usefulness: r=286, p=0.001).

The factor analysis showed that the knowledge synthesis, the practicality, the knowledge expansion and the case-based learning proved to be the most important components of the educational program. It also became clear that the program provided useful knowledges for the participants and they would like to apply them in their pedagogical reflective practice. Although there were a couple of techniques that students have already encountered in isolation, the problem-solving circle as a process model were not really known and the different techniques were also new to the participants.

According to the answers (N=159) the educational program resulted in a positive change in certain cognitive areas. On a five-degree scale the improvement of problem solving methods (A=4,69) and knowledge (A=4,63) got the highest average value. The students felt that this knowledge can be utilized both theoretically and practically (A=4,69) in the pedagogical practice. The least considered components by the students were the following: the integration of the pedagogical and psychological knowledge (A=4,01), the coordination of the theory and the practice (A=4,22). However, the judgment of this variables was related to whether the student had a problem or whether (s)he was in a similar situation than the analysed one (r=0.333, p=0.000). There were unanimous positive opinions related to the impact of the course examined by open question. The highest part of the feedback focused on the application of methods and techniques (30%), but the analysed situations had a massive effect (23%) on the participants and the changes of their cognitive processes (23%).

Concerning the participants' teaching experiences significant differences of the opinions were drawn between the answers of open-ended questions. Most of the *student teacher* highlighted the interactive nature of the course (26%) related to the most attractive feature of the program. The *novice teacher* group appraised the analysis of the real-world situations and the concrete solutions (33%). The dominant part of the answers was the applicable knowledge by the reflection of the *competent teachers* (23%), the *expert teachers* (38%) and *master teachers* (45%). Speaking about the impact of the course the majority of *competent teachers* highlighted the more conscious approach to the future problems (28%), while the highest number of students from the *novice teacher* groups referred to the exemplariness of concrete cases and solutions (26%). It seems that novice teachers need real-world examples and concrete solutions with recipes while experienced teachers rather appreciate the content-independent thinking techniques. Behind this result there can be the reason that novice-expert researches showed: during perception process novice teachers are more tend to stop on surface of the problems and therefore they think that similar situations can have similar solutions.

The longitudinal study supported all the results mentioned before. Three typical categories were mentioned concerning the main features of the program: real, concrete cases; useful problem-solving techniques and methods; interactivity and exchange of own experiences. All of the respondents remembered at least some of the techniques learned by the program. The short, individual case presentation and analyses described by the students shed light on which techniques were applied to their pedagogical practice and how. Case studies have also created an opportunity to follow students' metacognitive processes. Typically the whole problem-

solving process was interpreted in a complex way or they came closer to solve their situation by a detailed application of a technique.

Overall, participants in the study evaluated the educational program in several ways and with several methods. Students were fully satisfied with the purpose, the structure, the content, the practicality of the program and the realities of the arranged situations. The main features of the program were obviously usefulness, practicality and applicable knowledge. The main aim of the education programme was to give (future)teachers thinking techniques that can help them for a complex analysis of school situations and help them to find their own pedagogical strategies. This aim was maximally achieved by the program, since the most important part of the program was the application of the methods, techniques used and a more conscious approach of the new problem situations. However, a number of other benefits also became part of the programme for which the assumptions do not appear, but the participants have a significant stock of feedback. A number of reflection received at the agreed level in relation to the different points of view and the usefulness of concrete solutions. In addition, personality, self-confidence, routine and attitudinal change have also been significant in the text responses to changes in their personality.

**Justification of thesis points**

According to the result of the study the following statements can be said relating to the thesis.

**I. Hypotheses of student perception regarding general features of the educational program:**

*H1: Participants were satisfied with the general curriculum features of educational program (objectives, content, structure, nature).*

I examined the hypothesis with Likert-scales and open-ended questions. Participants were satisfied with the curricular features of the educational program. The averages of the responses were in all cases above 4, most of them are close to 5 on the five-degree Likert-scale. Students were the most satisfied with the aim, the content and the structure of the program. This was supported by open-ended questions as well. The critical answers were independent to the educational program and focused on the environment and the organization of the courses (location, duration, time). On the basis of all this results I consider the hypothesis to be justified.

*H2: The attitudes are positive related to case-based learning.*

The results of the research have shown that the participants have highly valued that the techniques were getting known by a real situations experienced by themselves. Two third parts of the participants (25.3%) referred in some way to self-based learning as one of the most positive elements of the program and during the longitudinal examination it was one of the most dominant reflections concerning the course. This aspect of the education programme was shaped by factor analysis too. As far as the sub-samples are concerned the beginner teachers' positive attitudes were particularly prominent, most of them mentioned the concrete solutions of the real situations as the most important impact of the course. This form of learning was much more authentic for teacher candidates as well than a simple description of a case.

*H3: The most important elements of the educational program include techniques that support the solution process according to the participants.*

The hypothesis was examined by open-ended and closed questions. The hypothesis has only partially been confirmed, because it turns out that the effect of program was much broader than only the techniques they learnt. 14.5% of the participants referred specifically to methods or techniques as the most positive element of the course, most of them formulated in a wider sense and evaluated the practicality of the program (26.6%). Case-based learning (25,3%) and the interactivity of the courses (15,2%) were also highly mentioned. The feedback from the students informed that the course related to the program not only provided the techniques, but also the opportunity to learn new perspectives, to provide concrete solutions, to increase self-confidence, and to develop system thinking.

**II. Hypotheses relating to the student's attitudes on techniques of problem solving:**

*H4: Students who participated in the research have not known or used the techniques of the educational program previously.*

The hypothesis was measured on a Likert-scale and only partially proved. Some of the techniques had already been known before the course, but more participants pointed out that

they did not encounter them in such a process and their thinking was not so systematic and conscious. Most of them knew the For and against (decision-making) technique (70%) and it was used mostly before the course. The least known technique was the SCAMPER method (9%), and the Future wheel (16%).

H5: Students who participated in the research have a positive attitude towards the five-*step problem solving model.*

The educational program was built on the five-step process problem solving model and the techniques associated with the steps. The hypothesis was measured by three and five degree Likert-scales as well as by a one-choice question and the related open-ended question. The model was new for the majority of students (65%) and most of them (82%) declared that they have wanted to apply their own pedagogical practice. 25% of the students reflected it as the most useful technique of all. Participants agreed that the model contributes to raising of awareness of the steps of problem solving and its visual form helps to direct their thinking process.

*H6: Students who participated in the research have positive attitude towards the techniques and methods belonging to the steps of the problem solving model.*

The hypothesis was measured by attitude scales and one-choice questions. Techniques and the Five-step problem solving model were equally good for the students (more than 80%of the participants declared). Also more than 60% of the participants would like to apply them to their pedagogical practice. The Five-step problem solving model (25.5%) and the For and against decision-making technique (24%) were found as the most useful method for the students. More than half of the participants (56%) said that there was no technique that would not be useful to for pedagogic problem solving. The positive attitude towards the methods was also illustrated by the five-degree Likert-scales as the average value concerned to the questions was above 4.5. These answers were confirmed by longitudinal study too. During the factor analysis a so-called knowledge expansion factor was identified which covered the variables of the techniques and knowledge related to the problem-solving process.

**III. Hypotheses about student views related to the impact of the educational program developing problem-solving thinking:**

*H7: According to the opinion of the participants the educational program contributes to knowledge transfer assures the co-ordination of pedagogy-psychology as well as theory-practice.*

The hypothesis was examined by attitude scale. The average value of the agreement reached the value 4 out of 5, but all of these variables received the lowest average, and the deviation between the feedbacks was also significant. The results showed that the knowledge transfer is more implicit and hidden impact of the course therefore participants were less aware of it. The factor analysis also supported this fact as the most dominant factor was called the synthesis of knowledge. Speaking about the sub-samples, the teacher candidates felt the least the coordination of theory and practice. The main reason of it was that the experienced teachers' cases were analysed mostly during the courses.

*H8: According to the participants the educational program largely contributed to development of the convergent, divergent and reflective thinking skills.*

The average and the deviance concerning the development of divergent (A=4,55, σ=0,639) and convergent (A=4,39, σ=0,720) thinking skill were judged nearly the same way. The views on the effects of thinking skills of the educational program were mostly shared by the reflective aspect (A=4,22, σ=0,745). One of the reasons for this is the implicit nature of knowledge transfer. The significance of the implicit effects was supported by the result of the factor analysis too, where the most dominant feature seemed to be the knowledge synthesis mentioned in h7. The other reason is that students have worked in pairs with a specific case of a group member and the problem-owner could feel more the reflective nature of the course.

*H9: According to the participants of the research the interactive nature of educational program contributes largely to peer-learning.*

The hypothesis was examined by Likert-scale, but the result was also supported by the answers of open-ended questions. Participants significantly agreed (*A*=4,61) that the education programme has ensured the possibility of peer learning. Students also reported in a remarkable proportion that knowing each other's point of view was one of the most positive elements of the course therefore they had the opportunity to evaluate their own pedagogical experiences from another point of view and to place their view in a broader context. The longitudinal study also gave importance of the exchange of experience.

*H10: According to the participants of the research the educational program assures the improvement of own problem-solving strategies concerning to their pedagogical situations.*
The statement was supported by the feedbacks of explicit and implicit questions and showed that the educational program helped to develop own strategies of problem-solving (the value was 4.5 out of 5). The hypothesis was largely supported by the longitudinal study too in which students reported how they applied the problem-solving methods through their own cases and how these methods became part of their own pedagogical practice.

**IV. Hypotheses related to students' opinion concerning the effect of the educational program:**

*H11: The perception of own success relating to the steps of problem-solving process increases in proportion with the years spent with teaching.*

To verify this hypothesis a seven degrees Likert-scaled question was used. The standard deviation between responses was very significant so cross-referencing was not figured out talking about the problem-solving cognitive processes. Only a very little significant correlation was drawn at the last (action) step of problem solving ($r=235$, $p<0,05$).

*H12: There is no correlation between the teaching experience and the prior knowledge regarding the techniques used in the educational program.*

It was important to examine the techniques used in the educational program from the teaching experience and their prior knowledge point of view. I It was assumed that there was no such relationship, and the knowledge of the techniques was random. The data supported the

hypothesis's claim. There is no correlation or tendency so the prior knowledge of the techniques is not related to the teaching experience of the participants.

*H13: Student teachers and novice teachers need problem-solving techniques due to the lack of their schemata or routines.*

It was assumed that participants with no or only a few years' teaching experience would have need methods and techniques for solving problematic pedagogic cases in the absence of schemata and routines. The data highlighted that these two categories should be handled completely separate. Although in average terms every sub-sample had positive attitude to the techniques learned during the program, the answers showed that regarding the use and usefulness of think techniques and methods novice teachers are more sceptical than their peers with no teaching experience. A significant part of the beginner teachers (33%) appreciated most the detailed discussion and the concrete solution of the real situations during the course. The reason of this can be that novice teachers' perception and information-processing cognitive system of the pedagogical situations relate to the surface of the pedagogic phenomenon, therefore instead of content-independent techniques they are waiting for the concrete solutions.

*H14: Problem-solving techniques are found to be the most useful by beginner teachers, while the judgment of utility decreases in line with the increasing teaching experiences.*

This hypothesis was not confirmed. On the one hand, as it was explained in previous hypotheses (H2, H13). Although novice teachers had a positive attitude towards the techniques in the average, they seemed to be the most sceptical as they claim specific solutions for the real pedagogical problems. On the other hand, teacher candidates and master teachers were the most satisfied with the techniques. Although the correlations were not very strong the parables set by the points indicated that teacher candidates and master teachers had similar needs speaking about problem solving. It could be because the former group has no schemata at all and the latter had too much routine that can be inhibitory factor too.

**New educational results of the research**

My research has brought new achievements along the three main areas of the education sciences. On the one hand, an educational program has been developed that supports teachers' problem-solving process through thinking techniques and methods. I wanted to choose a form of research in which the practical and scientific aspirations represented at the same time and which meets the requirements of scientific thesis. Therefor I choose the design-research as a research strategy which increasingly popular in the international context but hardly ever known in Hungary. That is why one of the difficulties was the lack of Hungarian literature. Therefore my dissertation also results the contribution of the Hungarian educational-design-based research methodology. Due to the flexible nature of the research type I worked with several samples. A sample of nearly 160 postgraduate students has created a possibility to conduct comparative studies based on teaching experience on the attitudes of the educational program and problem-solving techniques. The results confirmed, shade and supplement the former international researches about novice and experienced teachers. The analysis of the variables by sub-sample has also proved that the education program is found to be useful for all stages of teacher education in the broad sense.

*Further researches*

During the research of the satisfaction and attitudes of the target group it has been proved that the developed educational program fully complies with its aims.

However the summative investigation showed some tendency related to novice-expert researches that should be examined more specifically by an additional research. There are usually a positive linear relationship between the teaching experience and the teacher's problem-solving effectiveness. However, a different results occurred in my research. The test data revealed that the two edges of the sample (teacher candidates and master teachers) have the same needs of problem-solving methods. It indicates that the lack of routine and too automated schemata can also be also a barrier of effective problem solving. Although the resulting correlations are very weak, a more specific research could be used in order to enlarge these contexts and to illustrate better these trends and the background of them.

I hope my thesis could be a further step in the design-based research strategy and the promotion of practice-oriented educational research. Since there is no Hungarian literature in the field of pedagogical design research, some of the further research should focuses on the translation of international publication, as well as the establishment of the framework for Hungarian educational design research.

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