PRESERVICE TEACHER PERSPECTIVE ON PROBLEM SOLVING TASKS

IRENA MIŠURAC
Faculty of Philosophy, University of Split
MAJA CINDRIĆ
Department of Teacher and Preschool Teacher Education, University of Zadar

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There is a strong link between teaching activities in teaching mathematics and students' outcomes. Activities that teachers and students conduct in mathematics are encouraged to specific mathematical competence of students. In the present research, we wanted to establish to what extent the Croatian class teachers know the guidelines of teaching mathematics and their awareness of the importance of performing activities that encourage contemporary mathematical processes. The goal of the research was to establish which activities teachers carry out when teaching mathematics in order to foresee the competences to be developed in their pupils. We have done our research on a sample questionnaire of 400 class teachers that teach mathematics 4 classes a week. To determine which activities were conducted by teachers with students in class mathematics and how often, we defined 26 activities for teachers to determine the intensity of their use on the Likert scale from 1 (never) to 5 (almost always). We selected 15 activities typical of modern teaching of mathematics and 11 activities typical of traditional teaching, which we offered in mixed order in the survey.

In like manner, we worked out 26 competences (15 competences emphasized by contemporary teaching of mathematics and 11 emphasized on traditional teaching), while teachers marked the number of competences they considered to be important for pupils.

In order to test the theoretical assumption on the difference in access to teachers who work in a modern or traditional way, we conducted a process of factor analysis. The factor analysis clearly distinguished the two groups of activities and two groups of competences, and as expected the way to the variables that saturate the first factor consists of contemporary activities/competences and variables that saturate the second factor consists of traditional activities/competences. This confirms our theoretical setting of modern and traditional approach to teaching mathematics.

We noticed that most teachers carried out traditional activities more ferquently than the

contemporary ones, but that most of them evaluated contemporary competences with better scores than traditional ones.

Key words: *Preservice teachers, problem solving, traditional teaching*

INTRODUCTION

Mathematics as a subject has a special place and significance in the educational system, practically all developed countries. This specialty is reflected in the fact that this is a subject that is being taught from the very beginning of compulsory education, followed by a continuation of the over all general education, a large number of weekly working hours and which is generally the compulsory subject in the state graduation exam. The aforementioned shows that mathematics is recognized as one of the bases of the education system, as a necessary element of every culture and as a subject that is the basis for almost all specific learning content in the various branches of human activity. Despite the importance and meaning of mathematics, student scores cannot be fully satisfactory. The results of students in PISA survey in 2006 and 2009 conducted in Croatia indicated underdeveloped mathematical knowledge, competence and value in the use of mathematical knowledge. Similar results were obtained by students in Bosnia and Herzegovina in TIMS in 2007. The fact is that most developed countries are not fully satisfied with the results of their students in math. Therefore, educators, counsellors, psychologists, mathematicians, teachers, professors, parents and politicians have performed extensive research to find the cause and determine ways to combat and eliminate failure in mathematics. Their long reflection, research and experimentation led to a change in the concept of teaching mathematics in schools from the concept that dominated the traditional teaching of mathematics, which was characteristic of the second half of the 20th century, the concept of modern mathematics teaching characteristic of the end of 20th and the beginning of the 21st century.

The traditional concept of teaching mathematics involves a school in which the role of the teacher is as an unquestionable authority, highly hierarchical, where the assignment of teachers to transmit knowledge to students and to guide them trodden paths of knowledge to understand new mathematical fact. That concept in teaching mathematics can be displayed briefly as a model of teaching and learning that relies primarily based on the work of teachers, which is dominated by individual approach to teaching and assessing of mathematical knowledge, and nourishes and emphasizes the competitive spirit among students (DeShawn

Kemp, 2007)

In the traditional teaching of mathematics to encourage and develop procedural knowledge and skills, and the teaching is focused on the adoption of certain amounts of content with the prescribed curriculum and applied mathematical theoretical knowledge in solving a number of standardized, typical mathematical problems. Educators have traditionally placed a heavy emphasis on the development of declarative and procedural knowledge (Miller and Hudson, 2007), while the conceptual mathematical knowledge is neglected. Fosters the learning formulas and algorithms memorized, and special attention, especially in the initial teaching of mathematics attaches developing and automation of computational skills in students. In order to achieve the desired level of automation as soon discarded vivid aids for computation, so that the "traditional approach to teaching numeracy vehemently opposed the use of fingers in addition and subtraction" (Vlahovic-Štetić, VizekVidovic, 1998, 3). In the traditional approach, believes that students are relying on your fingers in calculating the gain permanently available aid for which will not even try to reach the desired level of automation computing. Through traditional teaching mathematics students learn mathematical content through separate lecture topics, within which the application of the learned practicing maths textbooks, and finally checked content acquired through written tests with similar missions.

This approach to mathematical content did not lead to satisfactory results, because in this way the students have learned the knowledge and skills they do not know and fail to apply in real, personal or professional contexts. "Limitations and disadvantages of traditional lecturing classes are becoming more visible and more dramatic with increased production of information and transfer of knowledge and memorizing content become useless" (Jurdana-Sepicand Milotic, 2005, 20). Therefore, in the past twenty years, increasing implemented various reforms in mathematics education, who are trying to raise the level of understanding of mathematical concepts and content, and the level of mathematical thinking, and that instead of promoting the adoption of greater amounts of knowledge and the development of numeracy skills, are increasingly turning to the development of student competencies and preparing students to apply mathematics in realistic contexts. Reformed teaching of mathematics, which is trying to raise the quality of mathematics education and improve student achievement and results in terms of actual conceptual understanding of mathematics and the application of skills and knowledge of its content, we describe the expression contemporary mathematics classes.

The teaching of mathematics is much less attention paid to the amount of acquired content, and a lot more understanding of mathematical terms and concepts, discovering relations and developing competencies required for the application of mathematics in everyday life, raising the mathematical culture of pupils and students introduced in the abstract sphere (Prodanovic, 1981).

So that students really need to understand mathematics is to discover and develop (build), which requires a lot of their own students' engagement, discovery, exploration, and the classroom environment rich communication and collaboration. Modern teaching mathematics such preferred learning style and views of learning, teaching and assessment of mathematics that shift the focus of the curriculum with memorization, mechanical learning, adoption and application of facts and processes on a conceptual understanding and logical, creative thinking. Therefore, the main goal of modern mathematics education is no longer the final transfer of mathematical knowledge, but, according to Bruner principle that learning is an act of discovery (Bruner, 1961)., And that learning path discovery increases internal motivation and intellectual power of students, rather than training students for independent learning (Dakić; Elezovic, 2003.), and for detecting and establishing relations, for reasoning and logical reasoning. The focus of learning mathematics is no longer in memory of concepts and procedures, but on the understanding of mathematical concepts and the student's own discovery of mathematical relationships and the application of what students know and learn in a variety of realistic, problem situations. It starts from the fact that "learning procedures without conceptual understanding is pointless and ultimately useless. Anyway, machines can do procedures far better than humans" (Addington et al, 2000, 1074). Conceptual understanding of mathematics implies the knowledge and understanding of the concepts, structure and processes, application of skills in realistic contexts, critical and self-critical thinking and reasoning, connecting with everyday life, create your own strategies to solve problems and displaying mathematics different mathematical symbols and forms. Modern teaching mathematics is based on a clear and unambiguous set of standards in mathematics education, in both the selection of content, as well as in the selection of competencies that the students must develop.

Contemporary education mathematics has set clearly defined competencies which it should strive in the teaching of mathematics at all levels of education. "Ambitious standards are required to achieve a society that has the capability to think and reason mathematically and a useful base of mathematical knowledge and skills" (NCTM,

2000, 29), and such a society is necessary in countries that want to be competitive on the world market. For this reason, it is important to investigate what the teaching of mathematics in this country and realize that mathematical competence encourage and develop in our students, to our current situation indicate the direction of change we need to make in order to raise the level of mathematical competence of our students and their competitiveness in the global market.

RESEARCH

In the empiric part of the research, we wanted to establish which teaching concept (contemporary or traditional) was performed by class teachers in Croatian schools. We were interested in their knowledge of contemporary teaching of mathematics guidelines and the awareness of the importance of conducting activities that encouraged the desired mathematical competences (processes).

The goal of the research was to establish which activities were conducted by teachers in their teaching of mathematics in order to assume the competences to be developed in pupils through such activities.

The research was conducted with a survey questionnaire on a sample of 400 class teachers.Our assumption was that teachers were somewhat familiar with the contemporary guidelines of teaching mathematics, but that their teaching practice still remained to a great extent traditionally orientated.

Activities teachers perform in working with pupils during math lessons

It is known that there is a connection between curricular activities in teaching the concept of mathematics and the output of pupils. More frequent performance of a certain activity leads to the development of those competences being applied in such activity. Teachers encourage determined mathematical competences in pupils with the activities carried ou by them during math classes. In order to establish which activities teachers carried out with pupils during math lessons and how often they were performed, we defined 26 activities (Table 1) for which teachers had to determine the intensity of their application on the Likert Scale from 1 (never) to 5 (almost always). We chose 15 activities typical for contemporary teaching of mathematics (marked with the letter S) and11activities typical for traditional teaching (marked with the letter T), that we ~~have~~ offered in the questionnaire in mixed sequence.

In order to test our theoretical assumption on the difference in the approach of teachers working in a traditional manner ~~by~~ performing contemporary, in other words traditional activities, we have conducted a procedure of factor analysis in those 26 activities from the questionnaire. The factor analysis procedure clearly distinguished two groups of activities and expectantly so that the variables that saturate the first factor make up contemporary activities, while the variables that saturate the second factor make up traditional activities. This confirmed our theoretical proposition in the contemporary and traditional approach to teaching mathematics.

It must be mentioned that in filling this part of the questionnaire, examinees decided mainly on high frequency scores in almost all activities. We presumed this to be normal in a situation when they felt that the quality of their work was evaluated in one way or another. Being aware of this, we considered that in the analysis and interpretation of the results small differences were to be noticed in the acquired average values for they told us of the tendency of implementing traditional, contemporary activities respectively.

Table 1 shows the results acquired for each single activity in the sequence as set in the questionnaire, and in the last two lines the average value (arithmetical M average) for all contemporary, that is all traditional activities respectively.

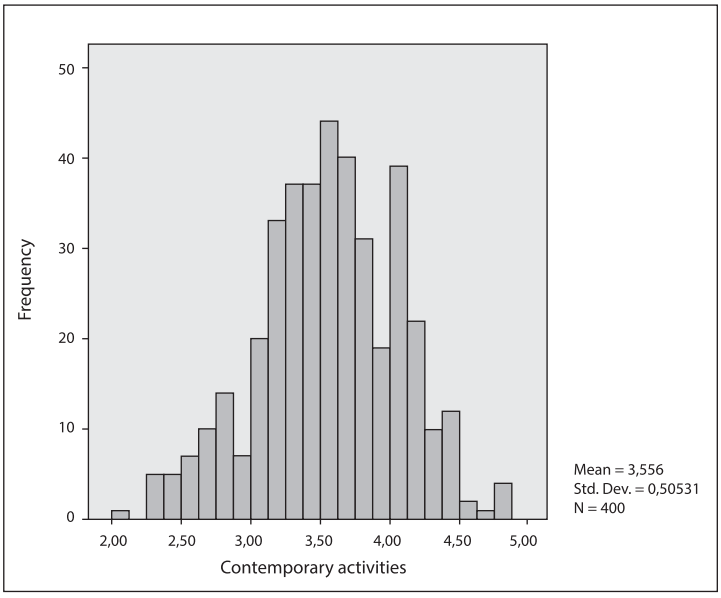
It is evident from the acquired results that the average score of traditional activities (M=4.2) is much higher than the average score of contemporary activities (M=3.56). considering that the score shows how often certain activities are used, we concluded that during math lessons our examinees performed traditional activities more often than contemporary ones. As a certain type of activity encourages and develops exactly determined competences, we can conclude that the activities of examinees together with students encourage more the traditional than the contemporary competences.

The scores of examinees ~~in~~ using contemporary activities were from 2.07 (very rarely) to 4.87 (almost always). The scores in traditional activities were at intervals from 2.7 (sometimes) to 5.0 (almost always). The distribution of examinees according to average values given to contemporary activities are seen in Graph 1, while the distribution of examinees according to mean values given to traditional activities are seen in Graph 2.

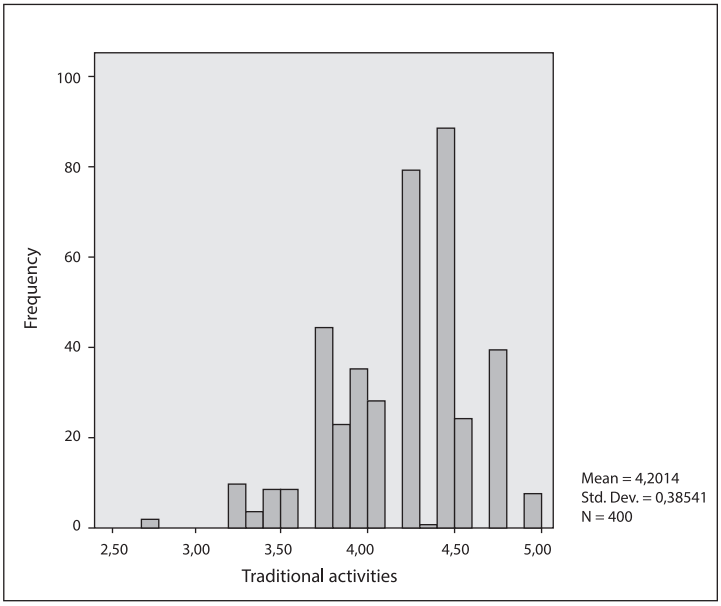
Table 1: Indicators of descriptive statistics of implementation frequency of single activities at mathematics lessons

CLAIM	*Mean*	*Median*	*Std. Deviation*
use text books and workbooks in learning new contents (T)	4.56	5.00	.720
perform problems in which various mathematical contents are applied (S)	4.23	4.00	.624
solve problems on the blackboard (T)	4.21	4.00	.685
solve interesting but more complex problems	3.,68	4,00	.681
practice basic arithmetic problems (T)	4.67	5.00	.541
prove mathematical statements to each other (S)	3.33	3.00	.822
compare various manners of presenting mathematical contents (S)	3.41	3.00	.827
write on various mathematical themes (S)	2.60	3.00	.925
use images, tables or graphs in showing data (S)	3.17	3.00	1.010
practice contents that studied during the lesson or were studied previously at the previous lesson (T)	4.61	5.00	.591
ponder on the way of thinking (S)	3.69	4.00	.825
think of applying mathematics in everyday life (S)	3.79	4.00	.855
solve problems in silence (T)	4.04	4.00	.742
compare different strategies with which students solved problems (S)	3.38	3.00	.844
compete in the speed of solving problems (T)	3.85	4.00	.839
assure each other with arguments on the correctness of thinking (S)	3.46	3.00	.816
connect mathematics with other subjects (S)	3.85	4.00	.813
solve simple calculation tasks (T)	4.43	5.00	.729
check the correctness of students conclusions (S)	4.27	4.00	.695
study by heart names and definitions of mathematical concepts (T)	3.12	3.00	1.010
show mathematical contents in their own manner (S)	3.42	3.00	.758
practice computational skills (T)	4.35	4.00	.663
verbally explain reflections to other students (S)	3.67	4.00	.781
students alone search for strategies that explain life problem solving tasks (S)	3.41	3.00	.802
repeating definitions of mathematical concepts (T)	3.46	4.00	.909
practice exercises from text books or workbooks (T)	4.57	5.00	.633
All contemporary activities together	3.5560	3.6000	.50531
All traditional activities together	4.2014	4.3000	.38541

Graph 1: Distribution of examinees according to mean value of contemporary activities



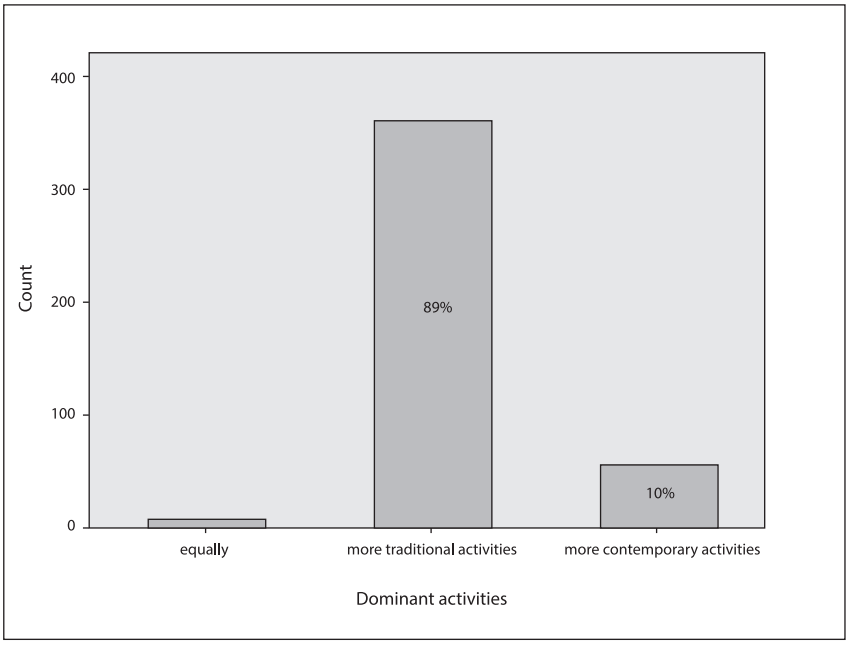
Graph 2: Distribution of examinees according to mean values of traditional activities



We notice that the values assigned to contemporary activities are distributed uniformly around their mean value, while traditional activities are more centered, more examinees assigned them equal, high values respectively. Examinees agreed more in the appraisal of the traditional activities and most of them assigned a higher score than 4.0 (used frequently) to traditional activities.

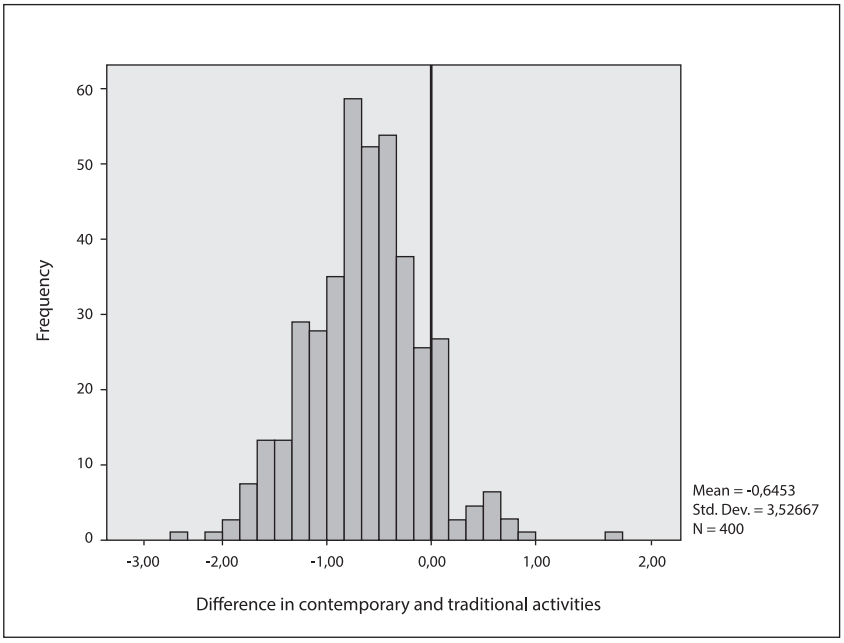
To have a better comparison of the teacher's relationship towards traditional and contemporary activities, we compared for each examinee the value he/she assigned to contemporary activities with the value he/she assigned to traditional activities. We were thus able to determine if each examinee was using more frequently traditional or contemporary activities. Graph3 shows the distribution of examinees according to the domination of traditional, contemporary activities in his/her work respectively. It is obvious that the biggest number of teachers (357 of them) valued traditional activities with higher score than contemporary activities, they conducted traditional activities more often than contemporary ones respectively. Only 39 teachers used contemporary activities more frequently, while four of them used traditional and contemporary activities equally.

Graph 3: Distribution of examinees according to the domination of traditional, contemporary activities respectively



Furthermore, we calculated for each examinee the difference between the value he/she assigned to contemporary activities and the value he/she assigned to traditional activities. So far as the value of the difference is positive, the examinee uses contemporary activities more frequently, while if negative, the examinee uses traditional activities more frequently. The acquired results are shown in Graph 4.

Graph 4: Difference in the values of contemporary and traditional activities



Even though teachers most often carry out traditional activities rather than contemporary ones, with most of them the difference in average values is not higher (less than 1). However, many teachers (93 of them or 23%) valued traditional activities much higher than contemporary ones, the acquired difference was more than 1 respectively. We also noticed that teachers who used contemporary activities more often (right from the red line) also used traditional activities considering that the difference in mean values is here relatively low (mainly less than 1).

Mathematical competences that teachers consider important

We started from the assumption that attitudes and convictions of class teachers on what is worth the effort in teaching and what the student needs in life also have an influence in the teaching process and the output results of the pupils. Teachers will give more time and attention during their lessons to knowledge and competences they consider important rather than the knowledge and competences they themselves do not consider very important. It is very likely that pupils will develop better the competences their teachers consider valuable and necessary for them, and will insist more on developing these competences and use more the activities that encourage them and aspire in deepening them.

In order to establish which mathematical competences teachers consider important for pupils, we defined 26 mathematical competences for which teachers had to determine the intensity of their importance from 1 (completely unimportant) to 5 (very important) on the Likert Scale. We chose 15 contemporary competences (knowledge and skills emphasized by the contemporary teaching of mathematics) which we here marked with the letter S, and 11 traditional ones (emphasized by traditional teaching of mathematics) marked with the letter T, and in the questionnaire we mixed them in arbitrary order (Table3).

We again noticed that the examinees chose high scores on the Likert scale more than earlier, and gave equal scoresto all or almost all of the mentioned competences. We assumed that class teachers were asked to express their opinion on which competence was important with pupils, and probably did not wish to risk in announcing some of them as unimportant, and giving relatively high scores. However, considered the quantity of samples, we consider that even from small differences in the evaluation of single competences quality conslusions can be drawn. Therefore, in the analysis and interpretation of the results small differences in the acquired mean values should be regarded for they tell us of the tendency of favoring traditional, contemporary competences respectively.

We tested once more our theoretical assumption on the difference in the approach of teachers who worked in a contemporary or traditional manner by applying another factor analysis procedure. The results of confirmatory factor analysis confirmed the two-factor structure in that part of the survey (the first excreted factor fully saturated contemporary competences which the second factor fully saturated traditional competences).

We checked the reliability of our measurement scale by calculating the coeffici-

ent of inner existence reliability the Cronbach alpha coefficient for both excreted factors. We evaluate as excellent the contemporary competence value of 0.9, and thus conclude that our measurement instrument is very reliable in measuring the appraisal of contemporary competence importance. Concerning traditional competences, we evaluate the Cronbach alpha value coefficient of 0.8 as very good measurement instrument reliability, which means that the measurement instrument is reliable even in the measurement of the importance evaluation of traditional competences.

Table 2 shows the results acquired for every single competence in the same sequence as in the questionnaire (abbreviations are used which indicate which competence group they refer to), and the last two lines show the mean value for all contemporary, all traditional competences respectively.

Table 2: Indicators of teacher's descriptive statistics of appraisal on the importance of single competences

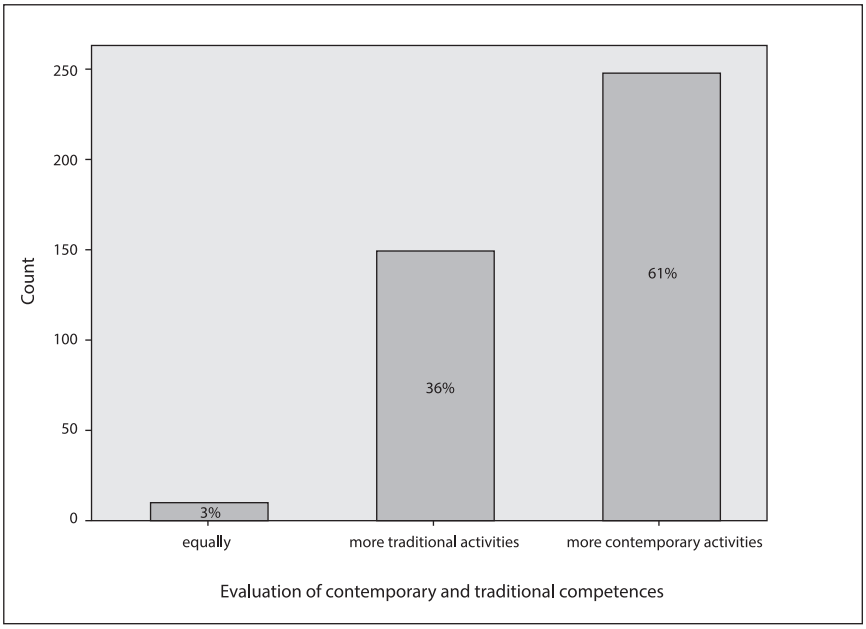
	Mean	Median	Std. Deviation
calculation speed (T)	3.69	4.00	.858
skill in solving complex life issues (S)	4.20	4.00	.680
use of various ways of showing mathematical contents (S)	4.18	4.00	.687
automatization of arithmetic operations (T)	4.27	4.00	.774
logical thinking (S)	4.75	5.00	.482
connecting math with different life situations (S)	4.42	4.00	.647
developed competitive spirit (T)	4.01	4.00	.835
good memory of mathematical concepts and rules (T)	3.97	4.00	.783
orally expressed manner of thinking (S)	4.27	4.00	.716
proper linguistic answer to asked questions (T)	4.02	4.00	.769
correct conclusion making (S)	4.45	4.00	.573
manner of thinking expressed in written form (S)	3.84	4.00	.764
skill of finding one's own strategies in problem solving (S)	4.28	4.00	.727
mastering all textbook contents (T)	3.82	4.00	.764
showing mathematical contents with tables, graphs and pictures (S)	3.70	4.00	.828

calculation capacity without the assistance of specific materials (T)	3.99	4.00	.755
memorizing mathematical words, rules, signs and formulas (T)	3.73	4.00	.858
spotting mathematics in the world around us (S)	4.12	4.00	.730
skill in solving arithmetic operations (T)	4.28	4,00	.597
managing in real life problem situations (S)	4.38	4.00	.643
connecting different parts of mathematics in a rounded whole (S)	4.26	4,00	,659
skill of proving one's claims (S)	4.11	4,00	,736
capacity of longstanding and patient practicing (T)	4.18	4,00	,654
skill in formulating arguments in discussions (S)	3.94	4,00	,771
orderliness in writing mathematical expressions (T)	4.06	4,00	,852
skill in imagery procedure of problem solving (S)	3.83	4.00	.765
All contemporary competences together	4.181	4.2000	.40574
All traditional competences together	4.001	4.0000	.41898

We notice that the examinees gave the category of contemporary competences somewhat higher scores (M= 4.18) than to the category of traditional competences (M= 4.0). The examinees considered as the most important competence in teaching mathematics to be that of logical thinking (M=4.75), correct performance of tasks (M=4.45) and connecting mathematics with different life situations (M=4.42), which are all contemporary competences. They considered as least important competences those of calculation speed (M=3.69), showing mathematical contents with tables, graphs and images (M=3.70) and memorizing mathematical words, rules, signs and formulas (M=3.73). Since this result is out of step with the earlier established fact that during lessons examinees used traditional activities more often than contemporary activities, we considered that this should be further analyzed. We, therefore, divided the examinees into those who evaluate contemporary competences as positive and those who evaluate traditional competences as positive, examinees who equally evaluate contemporary and traditional competences respectively.

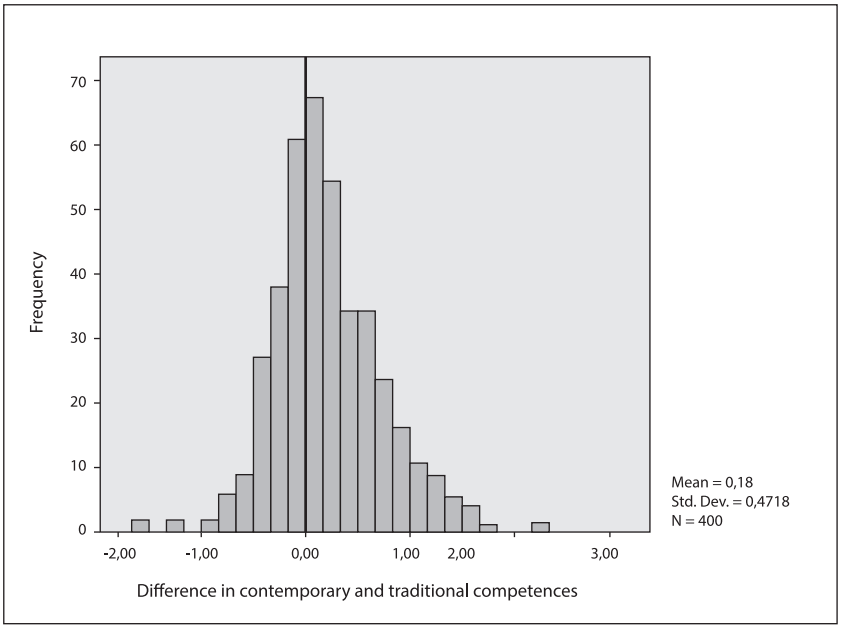
We were interested in knowing how many examinees gave a higher evaluation to contemporary, traditional competences respectively, and we showed the results in Graph 5. The results show that 145 examinees evaluated traditional competence as more positive, while 245 examinees evaluated contemporary ones, and 10 examinaees evaluated equally traditional and contemporary competences.

Graph 5: Distribution of examinees according to competence category with higher evaluation (traditional or contemporary)



We calculated the difference in the mean values each examinee gave to contemporary and traditional competences, and we showed the value of those differences in Graph 6. A positive value of difference means more positive evaluation of traditional competences. The higher the value difference, the further the examinee is from the zero line (red) that marks equal evaluation of contemporary and traditional competences. In Graph 6, we can see that most of the examinees (243) were placed to the right of the zero line, which means that they gave higher values to contemporary than to traditional competences. In observing the size of the mentioned differences, we noticed that in 220 exmainees the difference was less than 1, that the importance of traditional and contemporary competences was not essentially different. A difference higher than 1 was acquired only with 23 examineesand these were mainly (with 21of these) in favor of positive evaluation of contemporary competences.

Graph 6: Distribution of examinees according to the difference in value of additional contemporary and traditional competences



Such a result is somewhat surprising considering that the examinees, in that part of the questionnaire where they declared how frequently they used single categories of activities, showed that they used more frequently traditional activities in teaching mathematics rather than contemporary ones. A more frequent use of traditional activities surely encourages traditional competences, which indicates a discrepancy between what the examinees declaratively state and what is really encouraged in teaching. The acquired results in the categories of competences important for pupils indicate the fact that our class teachers know the concepts of contemporary teaching of mathematics, that they recognize the importance of the development of contemporary competences. We also conclude that they find these competences more acceptable than the traditional ones and evaluate them more positively when a more declarative stance is demanded from them. However, knowing determined concepts is not the same as applying them in the teaching practice. Continual efforts should therefore be made in order to really implement the concepts of contemporary teaching in the teaching practice through the application of adequate activities which will really encourage contemporary mathematical competences in pupils.

Regardless of the observed paradoxes between activities that some teachers perform during lessons of mathematics and competences and which they consider to be important for their pupils, we have looked at the correlations between the categories of contemporary and traditional activities and competences evaluated by the examinees. Those correlations are expressed in Pearson's coefficients of correlation and we have observed that there exists a statistically significant positive correlation between contemporary activities and contemporary competences ($r=0.482$; $p<0.01$), which shows the conncetion between evaluating the significance of contemporary competences in examinees and their more frequent use of contemporary activities. There is also a statistically significant correlation between the frequency of using traditional competences ($r=0.378$; $p<0.01$), which indicates the connection in the use of traditional activities and the evaluation of traditional competences with class teachers. We, however, observe the existence of a very gentle, bordered correlation between traditional activities and contemporary competences ($r=0.099$; $p<0.05$), which shows that some examinees, who during their lessons often perform traditional activities, highly evaluated the contemporary competences of pupils. We observe a similar, gentle and positive correlation between the results of contemporary activity application and the evaluation of traditional competences ($r=0.177$; $p<0.01$)from which we conclude that some examinees who frequently use contemporary activities highly value traditional competences in pupils. A possible explanation of this paradox could be looked for in the fact that almost all examinees also highly valued contemporary and traditional competences. However, the connection observed between contemporary activities and contemporary competences, traditional activities and traditional competences respectively, is much bigger than the connection between contemporary (traditionaol) activities and traditional (contemporary) competences.

CONCLUSIONS

Taking into consideration that the activities teachers and pupils perform during lessons of mathematics encourage and develop exactly determined competences in pupils, it is clear that there is a consider able connection between activities and competences. The implemention of certain contemporary activities encourages contemporary competences, and the implementtaion of traditional activities encourages traditional competences.

We noticed that most teachers performed traditional activities more ferqu-

ently than contemporary ones, but that most of them evaluated the contemporary competenceswith higher scores than the traditional ones. The number of teachers that more frequently carried out traditional activities (357 or 89%), was far higher than the number of teachers who more frequently carried out contemporary activities (39 or 10%). By contrast, the number of teachers that evaluated more positively traditional competences in pupils was lower (145 or36%) than the number of teachers who evaluated positively contemporary competences in pupils (245or 61%). We interpreted this discrepancy with the fact that teachers are aware of the importance of contemporary mathematical competences but their teaching continues to encourage traditional instead of contemporary competences in pupils.

The acquired results once more confirm the perceived gap between the teachers' daily teaching in the classroom and their declared assurance of what is important for their pupils. Even though teachers have shown to know the competences preferred by contemporary methodics of the initial teaching of mathematics and understand its importance in the life of their pupils, they have not changed their teaching practice in sufficient measure so as to really encourage the contemporary competences in pupils.

The conducted research certainly indicated the need of offering assistance to teachers in enabling them to adopt the contemporary manner of teaching with which they could develop the contemporary competences of pupils, and one such manner is by all means problem teaching.

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