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THE EFFECT OF WAR EVENTS ON MATHEMATICS TEACHING AND LEARNING [1]

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Abstract

This research was initiated by the general impression of the authors that elementary and secondary school pupils showed a different success rate in the acquisition of mathematical knowledge during the post war school year 1999/2000, compared to the recent previous pre-war school years. As the Ministry of Education Federal Republic of Yugoslavia, in that time, proclaimed the end of the official school year, on March 25th 1999, because of the NATO air strikes, the curriculum could not be completed. The NATO strikes on Federal Republic of Yugoslavia lasted from March 23rd to June 9th 1999. In this paper we focused our attention on the two factors that contributed to the lower success in mathematics in the next school year, 1999/2000, at the elementary and the secondary school levels: the organization of the teaching process and psychological problems, both implied by the war events.

Keywords: acquisition of mathematical knowledge, psychological aspects, pedagogical aspects

1 Introduction

Some historical distance was needed for our research to be presented to the scientific world. Following contemporary scientific opinion (e.g., Schoenfeld,2000; Kadijević,2001), we started our main investigation a few years ago in the city of Niš, Republic of Serbia. Niš is the second largest town in Serbia. Some additional research we completed few years latter and we submit that result in our Conclusion here. As we assume that the readers might not be sufficiently informed about the historical data imposed on our research, we shall set some explanatory statistics below.

The late 1980s brought the downfall of communism in almost all European countries. In some countries such as USSR, Republic of Czechoslovakia and Socialistic Federal Republic of Yugoslavia (SFRY) it was followed by the secession of the republics in the 1990s. But SFRY, the so–called, second Yugoslavia, was the only one among them that was not the member of any military block.

The history of SFRY says the following. The Republic of Slovenia was the first to announce its independence, Republic of Croatia and Republic of Bosnia and Hercegovina followed. The painful disintegration process in SFRY lasted from 1991-1992. The new Federal Republic of Yugoslavia (FRY), the so–called, third Yugoslavia, was made by the reintegration of the former Yugoslav republics of Serbia and Montenegro, on April 27th

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1992. The war whirlwind crossed the republics of Slovenia, Croatia, Bosnia and Hercegovina. Unregulated legal and property matters, as well as economical and social issues, and unsolved problems of ethnic minorities, contributed to the expanding of the conflict all over the former Yugoslavia, SFRY.

In the light of such relations, there were conflicts with national minority members, ethnic Albanians in Kosovo and Metohia. Unregulated national relations caused by a long history of tendencies of Albanians to secede from Serbia led, at first, to the imposition of economic sanctions to the FRY, and later to the direct threats of NATO air strikes. Those threats culminated during March 1999. On March 23rd 1999, the state of emergency was proclaimed in the FRY. The first danger alert for the air attack was heard at 8 :15 pm on March 24th 1999. The next day, on March 25th the first bombs hit the city of Niš.

The Ministry of Education made a decision to interrupt and administratively finish the school year on March 25th 1999 because of the imminent danger to the country. That way the lives of pupils of elementary and secondary schools would not be exposed to the direct danger in school buildings. Final grades for the school year 1998/99 were given on the basis of the grades previously registered in the evidence books. Two problems emerged connected to this: pupils either benefited from the existing social circumstances and thus got higher final grades that they deserved, or they were deprived to improve their grades and get higher ones. The first problem was more common in the elementary schools. Secondary school pupils, with the different teaching/learning dynamics, were more commonly exposed to the problem of having lower grades, which did not satisfy them.

On March 25th the city of Niš was attacked from the air. The cruising missiles and air bombs seriously damaged, or destroyed two military barracks, a large number of civilian buildings in the neighborhood, (and also in the nearest neighborhood of the secondary school where we conducted our research), as well as the city airport. The black wave of air strikes continued round the clock every day. From the moment that the 'Bulgarian corridor' was opened, on May 12th, the worst period for the citizens of Niš began. The 'Bulgarian corridor' allowed the NATO forces to use the territory of Bulgaria for the attacks. By air, Niš is only 5 minutes' flight away from the Bulgarian border, and after that the citizens of Niš were exposed to air strike alerts for up to 22 hours a day.

On May 8th cluster bombs were thrown on Niš for the first time. This happened at 11:20 am, in the big central market, the biggest market in the center of the town, and also in the Central City Hospital. Civilians were killed and wounded! Damage was registered on a large number of civilian objects, as well as on several hospital buildings in the Central City Hospital, the building of the University of Niš, a health facility building and one school.

Niš suffered several air strikes a day: for example, on May 12th, 27 missiles and 19 containers with cluster bombs were thrown over Niš, especially upon the densely populated, strictly residential area of the town – Duvanište. Fortunately, there were no casualties in that attack. Only several people were wounded.

After the war, from time to time, leftover cluster bombs have been found in the parks, fields, and gardens of Niš. Unfortunately, from one such remaining cluster bomb, a man was killed in his own garden in 2001. It is likely that some other unexploded bombs could be found in the future.

Every day during the air strikes tension was accompanied by the horror of darkness: the disintegration of the electrical power system followed. On May 2nd, and May 15th electric power installations were targeted by the so–called 'glass bombs'. Another attack with heavy bombs hit them on May 23rd. The damage was followed by black outs lasting for days in the whole of city of Niš, home to more than 300 000 citizens. Long after the air strikes stopped, planned black outs disturbed normal city life.

The days spent in the shelters, under the howling sounds of danger alerts, exerted a terrible influence upon all the people who experienced them. The war statistics of Niš is

very grim:

- Number of air strikes: 40
- Number of air striking days: 29
- Number of missiles thrown on the town: 324
- Number of containers with cluster bombs: 36
- Number of civilians killed in the air strikes: 21
- Number of civilians wounded: more than 300
- Total length of air strike alerts: 1254 hours (68,37% of the total time of the war)
- Average daily length of air strike alerts: 17 hours (per day)
- Numbers of buildings destroyed: more than 120
- Numbers of buildings damaged: more than 3400

The numbers are specified for the city of Niš only. Air strikes lasted for full 78 days, until June 9th, 1999.

Further on, will to introduce the school year organization and grading system in Serbia in that time.

2 The School Year and Grading System in Serbia

The school year in Serbia is divided into two semesters. It starts on September 1st and ends between May 15th and June 16th, depending on the year level and kind of school (especially for secondary schools). The end of the first semester is about 23rd December and the beginning of the second semester is about 15th January. The winter holiday break always lasts three weeks.

In this research, our attention was focused on two successive winter semesters in two successive school years, 1998/99 and 1999/2000. Their duration was unchanged by the war events. The war in 1999 interrupted 1998/99 school year during the spring semester.

The school system in Serbia uses typically the following type of grades: 5(excellent), 4(very good), 3(good), 2(sufficient), 1(poor), meaning that a poor grade at the end of the school year is not sufficient for the pupil to proceed to the next class or to earn the diploma. Meanwhile, it is allowable for a pupil to have a 'poor' mark during a part of the school year, even at the end of the first semester. But, if a pupil has a 'poor' mark in mathematics, for instance, all throughout the school year, he/she will be graded 1 in mathematics at the end of that school year. Pupils with more than two poorly graded subjects fail the year, i.e. repeat the same year. Those with not more than two poorly graded subjects must take an extra exam for each of the poorly graded subject in order to proceed to the next year level. The pupil must pass the extra exam/(s) usually at the end of the summer holiday. If these extra exam/(s), both or just one, are not completed satisfactorily (if there are two, then each of them separately), the pupil must repeat the year level.

The standards for grading in the Serbian school system, both in the elementary and secondary schools, requires the teacher to assess the pupil not less than four times per school year on average.

The main grade is the one at the end of a school year which is a compilation of all the grades the pupil earned during the whole school year.

The pupil must also be graded at the end of the first semester and this was the result relevant for our research.

The two pointed grades are, at the same time, the only cumulative grades for the previous periods. So, the grades we discuss in this paper are the cumulative first semester grades.

In some courses (like mathematics and languages, for instance) the teacher may use different methods of grading throughout the semester, but he or she has to give and grade two written papers for the entire class per semester. He/she also has to grade oral answers of each pupil for the assessment periods during the school year. Other methods are welcome but not mandatory.

Our questionnaire for teachers included a few questions concerning these methods. We did not test the consistency of teachers in their grading over time. The important thing is that our groups, both experimental and control, were consistently graded, each class by the same teacher, in two successive school years, two successive mathematical courses.

The hypothesis that teachers' assessment was different in the school years 1999/2000 and 1998/99, at the end of the first semester, could be set but we did not test it. To compensate for this aspect of the assessment problem, four teachers were included in our observation.

Each semester, in Serbian school system, consists of two terms. The ending date of the first one is not precisely determined. Also, there was no discontinuity in the teaching process between the two terms composing the winter semesters of our observation.

3 The Applied Design of Experiment

Our observation was designed as a multi-stage statistical experiment (e.g., Wackerly et al.,1996).

At the first stage we chose two schools from Niš, one elementary and one secondary, at random. The location of the chosen elementary school is in the central part of the town and the school was not damaged in the NATO strikes. The chosen secondary school is located in the so called 'north-western industrial zone' of the town. This school building was damaged in the NATO strikes and was not completely repaired until the beginning of the 1999/2000 school year.

Elementary schools at Serbia in that time were organized on the basis of eight grades. The first four were fully taught by generalist teachers. The grades 5 through 8 are and were taught by specialist teachers for each of the specific courses. This means that mathematics is taught by mathematicians. Likewise, the same teacher could teach mathematics to the same class of pupils from the fifth year up to the eighth, if this rule is not disturbed by some reason. Secondary schools in Serbia are organized into three or four year grades. The latter teaching principle applies to secondary schools also.

The second stage was to choose at random the year levels to be included in the experiment. We chose the sixth year level in the 1999/2000 school year of the elementary school and the fourth year level of the secondary school in the same school year. The pupils thus selected were included in the experimental group. Likewise, the control group had to consist of pupils of the same year level from the previous generations from the chosen schools. We included four previous generations in the control group.

The third stage was to choose classes, at random, from the selected generations of pupils. After that, the cluster sampling was applied to each of the chosen classes. Finally, we had to clear the sample from pupils who had not been in the same class, usually not in the same school, in two successive school years, for instance, in 1998/99 and 1999/2000.

The elementary school experimental group consisted of 146 pupils and the control group of 213 pupils. The experimental group of the secondary school consisted of 263 pupils and the control of 349 pupils.

4 Teaching Mathematics in the 1999/2000 School Year

In order to identify the objective circumstances under which teachers taught mathematics during the post-war school year, we composed a questionnaire for teachers.

The fact is that the 1998/99 school year was interrupted suddenly after the first night of NATO strikes, i.e., 25th March was proclaimed, by a special decision of the Ministry of Education, the end of the school year. The necessity of immediate interruption of the school year implied a certain amount of unprocessed teaching material that had been planned to be taught during the last term of the school year. Before the beginning of the 1999/2000 school year, the Ministry of Education identified a few courses as those of special interest. That meant that they should be comprehensively compensated for losses in teaching material during the war school year. All mathematical courses were among them. The reason was obvious. The mathematical courses continue from one year level to the next. So, some reduction, or abbreviation, had to be imposed on both missed part of the curriculum from the war school year and the current one and teach them both in the post war school year.

The main task of the questionnaire was to identify the methods of reduction. Another task was to find out how teachers had made their pupils learn the curriculum material that belongs to the previous grade. It was important to find out this fact, because the recommendation of the Ministry of Education was not to grade pupils' knowledge concerning the curricula of the previous, war school year, and taught in the post war school year.

Another task of the questionnaire was to find out if the teachers from schools not included in the experiment taught mathematics in the 1999/2000 school year in the similar way as those whose pupils were included in the experimental group.

5 Psychological Aspect of the Problem

We could talk about the psychological specificities of the age categories of the pupils included in our research, taking into account developmental, which are expected, and accidental, i.e. unexpected, factors that influence the level of material acquisition. The research itself was inspired and based on specific preconditions of the war framework that had been finished previously. It had the characteristics of existential danger and general insecurity. We dealt with the description of developmental and accidental factors, considering that war, as a specific, highly intensive factor, need not be particularly described, concerning the intensity of its influence on the people's lives, as well as their future development and organization. Both factors involved had their own problems and motivated us to talk separately about them, but the issue of war danger was common to and influenced both of them.

Developmental psychology of the entire life period offers the picture of normal developmental phases that are characterized by the periods of crises. This means that there is disharmony and imbalance. Those crises are characteristic of a certain age and they can lead to different life-style changes. Furthermore, accidental crises, influenced by some intensive and unexpected life events represent an additional difficulty to overcoming life problems and establishing a balance in the normal functioning of a person.

A life event is defined as 'the change in the outside reality that engages this level of persons adaptation abilities, which overcomes everyday routine', (Kobasa, 1979). Individual reaction to the same life events can be completely different. The results concerning tolerance to frustration, which emerged in the previous research of the same authors, (Ilić, Šumonja and Popović, 2001; Popović and alias, 2001) empirically showed that the pupils who showed a lower threshold of frustration tolerance had less persistent grades in mathematics. This was specifically significant for the pupils with grade '4' which had shown the biggest vulnerability

and susceptibility to grade changes. Many people would, in a situation in which their life is in danger, feel intensive fear that would prevail over their cognition and block their intellectual functioning. Life events that a person cannot control, are more important and have a greater influence on personal stability and mental health.

From the global point of view, although younger children can react more tempestuously to accidental crises, thanks to their relaying on the strength of their parents' authority, they can actually overcome those life problems easier. At about the age of 12, according to developmental psychologists e.g., Piaget (1977), pupils have control over formally-logical cognitive and structures in their knowledge. For a child of this age, it is extremely important to have a feeling of security and personal safety in the family and society in general. With some understanding of the events, children of this age have a greater sense of the events which increase their feeling of security; just like the presence of parents/authorities itself decreases tension and unpleasant feelings born of uncertainty and fear.

As for secondary school pupils, there are some differences. They are more mature and have greater personal and family responsibilities. During the period of adolescence, young people often do not show acute disturbance profiles because of a new situation, but they can feel the consequences for a much longer period. The characteristics of a 'double chaos', one inside and the other outside of them, represent an additional problem in the period when they are entering the adult world (Djuričić,1997). Their rights, as well as their obligations, during this period are very complex, and they often do not feel ready to accept them. At that time, the adolescent uses his or her wider perception abilities, and is not satisfied only with observing and registering things. They want to explain, understand and connect them with other facts. Unlike the child who feels subjugated to adults, the adolescent considers his/her abilities equal to those of adults. In that sense, stress factors have an important impact on their mental state.

Adolescents of around eighteen, in the fourth year level of secondary education, included in our research, were mainly recruited during their third school year. During the war, there existed a very real possibility of their military mobilization. In that sense, the pupils were under intensive stress, and its consequences were represented by problems in memorizing information, and forgetting learned material. The pause five months long caused difficulties with meeting school obligations, especially since high expectations were placed on pupils. Contemporary psychology considers forgetting as an active, not a passive process. Experimental findings confirm that forgetting is faster when a person is not asleep (Djordjević, 1982). Thus forgetting not only erases the tracks because of inactivity. It emerges because of the interference with inhibition or erasing of old impressions by the new ones, which are mostly present during the period of existential insecurity. Pupils have problems in new situations, faced with new tasks included in their learning material, especially if a prior level of knowledge is assumed.

6 Pedagogical Aspect of the Problem

The teaching of mathematics and the process of acquisition need a specific pedagogical approach e.g., Batler & Vren (1967). This aspect was emphasized in the post-war education in mathematics.

We have already explained that there was some quantity of left out material due to the violent ending of the 1998/99 school year in all courses, including mathematics.

The specific position of mathematics at the beginning of the 1999/2000 school year has already been explained above. Here we want to discuss the pedagogical specificity imposed to both teachers and pupils in mathematical courses under the consideration.

The sixth grade level pupils in 1999/2000 had to learn the teaching material that was

left out in the previous school year, so that they would be able to learn the subject matter of the sixth or the following school year levels. (This problem can be generalized for other elementary school years also.)

The quantity of the teaching material that was unprocessed during the previous 1998/99 school year was 20 – 30% of the total material for the school year, depending on the study group (class) and the teacher's curriculum. If such an amount of the material was not acquired, the program continuity in teaching mathematics would be impossible to attain. But, this acquisition is very important for pupils' success in elementary school mathematics, as well as in later education.

Compensation for covering unprocessed material also has another pedagogical goal. According to pedagogical psychology observations, the transfer of learning is extremely important for the organization of the school system. The most important factor for its occurrence is learning a certain subject matter making sense of it. For that reason, mathematics has a higher 'transfer value'. This is because its understanding depends on the correct understanding of its meaning and the insight of relationships between the given information.

Transfer in learning can be considered as one of the key educational and pedagogical psychology problems. Research conducted so far in the world and in Serbia deals with transfer in general and especially in the mental abilities area (Ausbel, 1978; Clarizio, 1977; Cronbach, 1970), and among other things, focus on the research of individual differences in transfer changes, as well as the basic preconditions that are needed for the transfer to take place. Empirical research of our researchers (Nešić, 1998) demonstrates the existence of extended transfer effects, which can lead to hypotheses about the integrative influence of developmental, educational and transfer effects on the primary mental abilities changes. There are certain age categories during which 'zone of proximal development' (Vygotsky, 1977, 1996) shrinks. If development is inhibited in these phases, the conditions for further adequate development do not exist. If stress interfered with the 'zone of proximal development', it would be more difficult to collect all the elements needed to step into the next phase. If war and existential insecurity were considered an interruption in this process, this would provide another reason to talk about interrupted learning and development processes in Serbia. The existence and influence of transfer, according to the findings of Nešić, could be followed even after those specific periods, after the completion of the 'zone of the proximal development', which produces extended transfer effects in learning and forgetting.

During the 1999/2000 school year, deprived of a certain part of knowledge establishment and repetition, and being under pressure from the teacher to process more material in a short period of time, pupils found themselves in a 'pedagogical vacuum'.

Interactive modalities, which involve presenting new material gradually, represent the best form of the teaching/learning process (Ivić, Pešikan, Antić, 2001). The level of psychological maturity of pupils, especially in elementary school, does not guarantee an awareness of the need for independent study unless children's understanding of the material is constantly assessed.

In the case of secondary school pupils, the fourth year level secondary school course in mathematics is mostly an advanced course. The high level of abstraction which characterizes this course requires of students to be capable of abstract thinking, as well as to possess sufficient knowledge of mathematics from the previous three school year levels. Furthermore, the last one is a necessary condition for the fourth year course to be successfully accomplished. For this reason, both teachers and pupils had to complete a serious task, to achieve a satisfactory level of understanding and memorizing of a great amount of knowledge.

In spite of all the difficulties, the teachers were mostly left to find their own way of overcoming the problem. No written instructions, no workshops and no other organized activities were offered to teachers.

According to their own answers, most teachers gave assignments on the whole teaching

material throughout the 1999/2000 school year, in spite of the recommendations of the Ministry not to assess the made up material from the previous school year. They gave the following explanation for their action: from the pedagogical point of view, pupils would not put enough effort into adopting the information being taught, if they are not motivated (or forced) by evaluation.

7 Observation Results

We recorded the grades in mathematics at the end of the first semester at two successive year levels, of each pupil who was included in the experiment designed as it had been explained above.

The following terms have been adopted: the elementary school pupils who were included in the experimental group were tagged the *ESE* subgroup; the secondary school experimental subgroup was tagged the *SSE* subgroup. For the control group, the following abbreviations will be used: *E 1996-1997*, and so on, meaning that we are talking about the elementary school pupils belonging to the control group who attended the fifth grade during the 1995/96 school year and the sixth grade during the 1996/97 school year. The secondary school pupils belonging to the control group from the same school years, 1995/96 and 1996/1997, attending the third grade in 1995/96 and the fourth grade in 1996/97 were tagged *S 1996-1997*.

The first semester evidence books do not have the highest priority for the archive. Because one of the evidence books for the *S generation 1996-1997* had been damaged, this generation was not under our consideration.

The discrete grades accepted in the Serbian school system are only the codes for the absolutely continuous random variable, the knowledge of students. Obviously, they are not fully objective, but they have a long tradition and more than that, they are in official use.

The grades of the experimental group revealed that 78 pupils from the *SSE* had worse results in mathematics at the end of the first semester in the fourth grade, during the 1999/2000 school year, than in the same grading period of the third grade, and that only 38 of them had better results. In the *ESE* subgroup those features were 58 to 17. Specific changes are presented in Figures 1 and 2.

We set the hypothesis:

THE RESULTS OF THE TEACHING-LEARNING PROCESS IN MATHEMATICS ARE SIGNIFICANTLY WORSE IN THE POST-WAR SCHOOL SEMESTER WHEN COMPARED TO THE PRE-WAR SEMESTER.

In order to verify this hypothesis we split the testing procedure. We compared the pupils' knowledge according to the grades, in two successive school years, in each subgroup of pupils described above, both in experimental and control groups. For this purpose, we applied two tailed t-test for paired samples. The results are presented in Tables 1 and 2.

To make sure that the experimental group had the same potential for learning mathematics, as well as that the teachers who taught the experimental group were not those who caused the registered significant difference, we applied two tailed t-test for independent samples comparing control subgroups' means to the experimental group's mean. The results are presented in Tables 3 and 4. Also, we compared the variances of the grades, applying the F-test, among each subgroup of the experimental group and the control group, in the two grading periods. These results are also presented in Tables 1 and 2. The variances of grades in the corresponding control subgroups from each generation were compared with

[5]Scientific number format: $4.96\text{E}-07 = 0.000000496$

Table 1: Comparison of means and variances in two successive winter semesters for the *ESE* subgroup and all the *E* subgroups

Generation	Mean		Variance		Significance for means	Significance for variances	Correlation coefficient
	V	VI	V	VI			
1995-1996	3.09	3.18	1.66	1.97	0.49948	0.31310	0.84653
1996-1997	2.90	2.87	1.62	1.18	0.82283	0.19528	0.78445
1997-1998	3.00	3.09	1.33	1.48	0.41351	0.38541	0.86380
1998-1999	3.25	3.18	1.62	1.72	0.28702	0.37471	0.85354
1999-2000	3.40	3.05	1.70	1.69	**4.96E-07**[5]	0.48447	0.81088

Table 2: Comparison of means and variances in two successive winter semesters for the *SSE* subgroup and all the *S* subgroups

Generation	Mean		Variance		Significance for means	Significance for variances	Correlation coefficient
	III	IV	III	IV			
1995-1996	2.22	2.29	1.30	1.52	0.24989	0.19814	0.85900
1997-1998	2.14	2.18	1.31	1.72	0.58135	0.07280	0.85650
1998-1999	1.83	1.73	0.89	0.67	0.20724	0.06759	0.52247
1999-2000	2.21	2.06	0.98	0.95	**0.00179**	0.40434	0.71528

the grades of the experimental group separately, each *E* subgroup to the *ESE* and each *S* subgroup to the *SSE* subgroup. The results are also presented in Tables 3 and 4.

We tested all the hypotheses on the same 5% significance level.

In Table 1, the comparison of grades of the *E* group in the first four rows are presented. It can be concluded that there were no significant differences between the grades of the pupils inside each *E* subgroup when compared with the results in the fifth and in the sixth grade for the same *E* subgroup. Meanwhile, significant difference is recognized in the war generation (*ESE* group) (bold font in the last row, cell 'Significance for means'). More than that, it is 4.96E-07 significant that the pupils' success in the sixth grade was less than in the fifth one. The grades in the two consecutive school years were highly or very highly correlated in all the subgroups. The correlations are presented in the last column of Table 1.

Table 1 shows that there were no significant differences in the variances of grades, according to the proportions of variances, in the two successive school years. The significance was much greater than 0.05 in each case of comparatione.

The same matched pairs analysis for the secondary school pupils is presented in Table 2. It is obvious that the only significant difference in means was recorded and that it happened in the *SSE* group of pupils, generation 1999-2000 (bold face cell). It can be seen also that no variances were significantly different for the same generation of pupils, both in each *S* subgroup and the *SSE* group separately. Furthermore, according to the significance of variances, we can conclude that the war generation (*SSE*) was more stable than all the *S* subgroups.

Correlation coefficients are presented also, and it can be seen that the grades of the *SSE* group are highly correlated in the two successive school years.

Independent samples analysis between the *E* subgroups and the *ESE* group presented in

Table 3: Comparison of means and variances in two winter semesters from the same school levels for the *ESE* subgroup and all the *E* subgroups

	War generation		Generation compared with the war generation			
	1999-2000		1995-1996		1996-1997	
	V	VI	V	VI	V	VI
Mean	3.40	3.05	3.09	3.18	2.90	2.87
Significance for means			0.204834	0.646489	0.054080	0.413782
Variance	1.70	1.69	1.66	1.97	1.62	1.18
Significance for variances			0.483223	0.269453	0.457184	0.125269

	War generation		Generation compared with the war generation			
	1999-2000		1997-1998		1998-1999	
	V	VI	V	VI	V	VI
Mean	3.40	3.05	3.00	3.09	3.25	3.18
Significance for means			0.078842	0.887200	0.325578	0.461008
Variance	1.70	1.69	1.33	1.48	1.62	1.72
Significance for variances			0.207035	0.331551	0.391086	0.460807

Table 4: Comparison of means and variances in two successive winter semesters for the *SSE* subgroup and all the *S* subgroups

	War generation		Generation compared with the war generation			
	1999-2000		1995-1996		1997-1998	
	III	IV	III	IV	III	IV
Mean	2.21	2.06	2.22	2.29	2.14	2.18
Significance for means			0.926569	0.083855	0.577698	0.419235
Variance	0.98	0.95	1.30	1.52	1.31	1.72
Significance for variances			*0.033387*	*0.001068*	*0.032591*	*5.92E-05*

	War generation		Generation compared with the war generation	
	1999-2000		1998-1999	
	III	IV	III	IV
Mean	2.21	2.06	1.83	1.73
Significance for means			**0.000438**	**0.000623**
Variance	0.98	0.95	0.89	0.67
Significance for variances			0.264080	**0.015759**

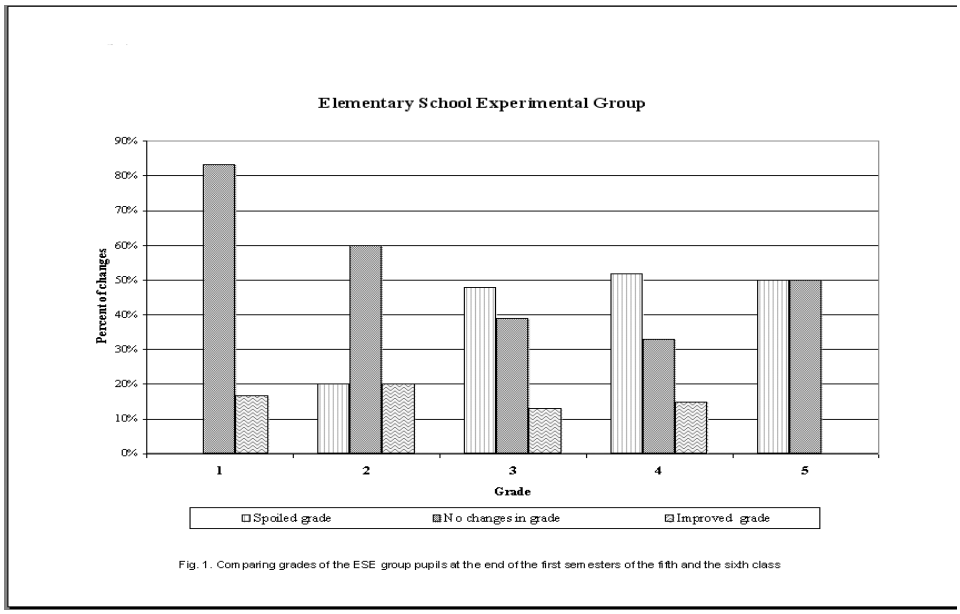

Figure 1: Changes in grades of the elementary school pupils at the end of the first semester

Table 3, proves that there were no significant differences between the control group generations and the war generation both in means or variances. This conclusion emphasizes our hypothesis that the historical moment, NATO's war against Yugoslavia, produced a high disturbance of the post-war teaching/learning process.

The secondary school independent samples analysis, presented in Table 4, implies an even more drastic conclusion. The *S 1998-1999* generation is the only one that was significantly different when compared to the *SSE* generation. Although significantly lower results were found for both the third grade and the fourth grade than the *SSE* group, even for this generation no significant decrease in success could be identified.

We point out the significant difference in proportions of variances between the *SSE* generation and the *S* generations. The variances of the fourth grade grades in 1996 and 1998 are greater than those of 2000, and the third grade grades in 1995 and 1997 were greater than those of the *SSE* in 1999. So, it is important to note that the *SSE* generation showed less variance than most of the *S* generations (with the exception of *S 1998-1999*). This fact emphasizes the meaning of the decrease in grades in the post-war school year.

Let us highlight additional observations from Figures 1 and 2.

We have already mentioned that these figures present changes of grades. We compared the grades of pupils in both experimental subgroups, the *ESE* and *SSE*, at the end of the two successive winter semesters. We stratified pupils of *ESE* and *SSE* subgroups according to their grades at the end of the winter semester in the 1998/99 school year, the pre-war one. Then, in such generated subgroups of pupils, we searched for individual changes in grades for a pupil in both, decreasing and increasing, directions at the end of the post-war semester. The results were calculated in percentages for each stratum and changes are presented in the figures. The decreasing direction is noted as the 'spoiled grade' and the increasing direction as the 'improved grade'.

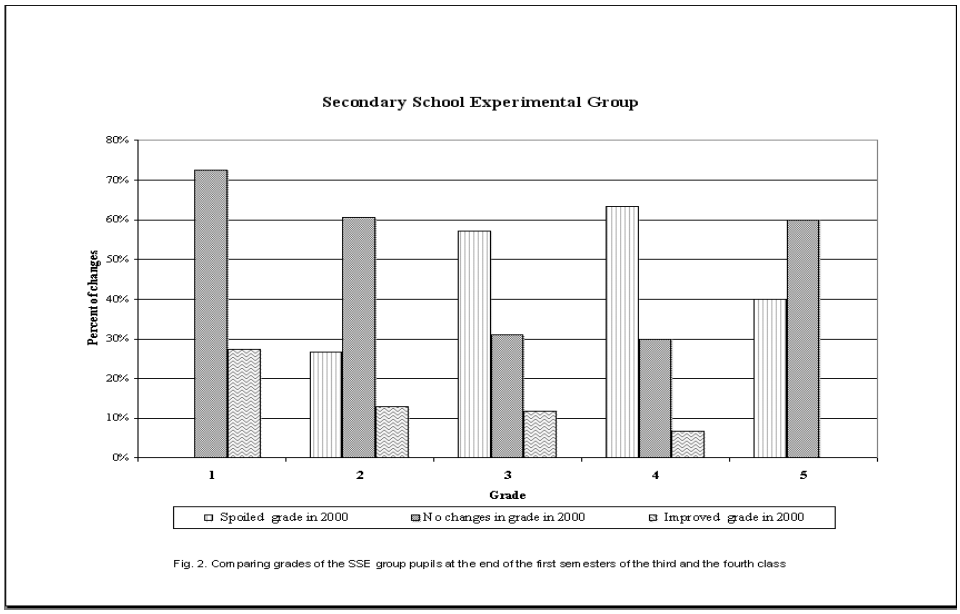

Figure 2: Changes in grades of the secondary school pupils at the end of the first semester

8 Comments on the Questionnaire

Data from the questionnaire for teachers were not statistically treated. The results are summarized below.

According to the data registered by the questionnaire, during the first semester of the 1999/2000 school year, between 10% and 20% of the total number of lessons in mathematics were used to compensate for the topics from the previous school year. However, most of these topics were taught in a concise form. Some of the topics that the teachers considered low priority for the future mathematical courses were not taught at all. Likewise, most teachers put the emphasis on students' understanding of the subject matter without demanding complete proofs of all the assertions. Teachers illustrated the material with a reduced number of examples and practice lessons than usual.

All teachers evaluated pupils' knowledge of the compensated material, except one. They did that by means of written tests, although some of them used both written and oral answers to compile the overall grades. All teachers claimed that their evaluation criteria remained unchanged but they asserted that they only evaluated the knowledge of the basic principles of the compensated topics.

The necessity of shorter presentation of the topics normally planned for the 1999/2000 school year was obvious. According to the teachers, the same methods were applied in this case as those that were applied in the case of compensation.

It is interesting to mention that all the interviewed teachers noticed that only the pupils with 'positive grades' (not equal to '1') were interested in additional instruction, which was not obligatory, during the post-war semester. Most teachers gave additional lessons to '5'- and '4'- graded pupils only, although the 'poorly graded' ones were the primary target group for that kind of help.

At the end of the questionnaire teachers were to conduct a short evaluation of the teaching/learning process during the first semester of the school year 1999/2000 by means of an essay answer. Their answers can be analyzed as follows: the general opinion was that the

Table 5: Comparison of means and variances in two successive winter semesters for the *SSE* subgroup and the *S 2001-2002* group

Generation	Mean		Variance		Significance for means	Significance for variances	Correlation coefficient
	III	IV	III	IV			
1999-2000	2.21	2.06	0.98	0.95	**0.00179**	0.40434	0.71528
2001-2002	2.80	2.37	1.82	1.38	**3.44E-06**	0.06984	0.74067

work was extremely fatiguing and that pupils needed a lot of time to get accustomed to their duties. They felt they were forced to be taught and to learn, and they even registered aggressive behavior as a response to obligations. The atmosphere in the classroom was more tense than in the previous school years and the impression was that the pupils were not interested in what they were being taught. The overall conclusion was that the previous, pre-war years' knowledge had disappeared from the pupils' memory to a great extent.

As we have previously stated, the questionnaire included not only the four teachers in our experimental groups, but also other 28 teachers from different places in Serbia (Vrbas, Novi Sad, Belgrade, Zemun, Kikinda, Gornji Milanovac, Valjevo, Nova Varoš and some other towns). Their similar answers encouraged us to think about the teaching/learning process in mathematical courses in the post-war school year as very similar to the one examined in Niš.

9 Conclusion

The set hypothesis was asserted at 5% significance level. We found that the pupils' success in mathematical courses was significantly worse at the end of the first semester of the post-war school year 1999/2000 than it had been at the end of the first semester of the pre-war school year 1998/1999. Moreover, we found that this was not the case when we compared the pre-war generations of pupils in two successive school years.

In spite of approximately the same potential for mathematical learning, according to the results of the fifth grade elementary school pupils and the third grade secondary school pupils, the results in mathematical courses in the post-war semester were worse than ever recorded in our control group when we compared the results of the same pupils in the two successive school years.

The fact that the results were collected in the period that immediately followed the war events, cannot be ignored when we explore possible connections between stressful experiences and the decreasing success rate in the acquisition of mathematical knowledge at school. In fact, we wonder if the consequences of the war events are much deeper than we explained above. We surveyed this from the point of the additional short research in 2001/02 school year. In that moment, we examined 113 secondary school pupils who had attended the fourth grade of the same secondary school included in our post-war research. This extra examination is summarized in Table 5 and Figure 3. We use the abbreviation *S 2001-2002* for this group of pupils. We should point out that these pupils were first grade secondary school pupils during the 1998/99 school year.

As it can be seen, the significantly lower success in mathematics for *S 2001-2002* group was registered at the end of the first semester in the forth grade than in the third one. The matched pairs analysis proved the difference for means by 3.44E-06 significance. On the other hand, the variances were not significantly different and mathematics course grades were highly correlated in two successive school years also.

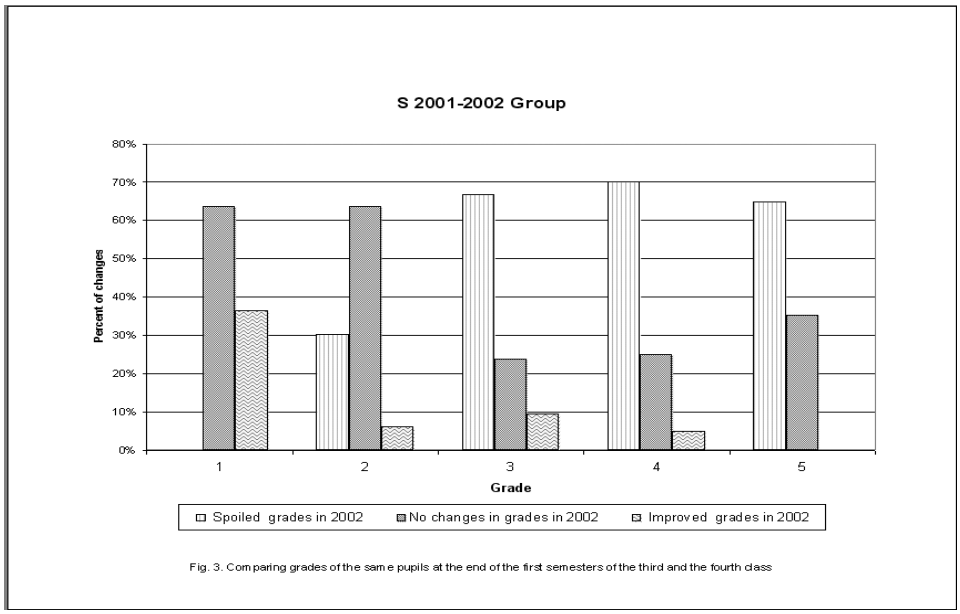

Figure 3: Changes in grades of the secondary school pupils at the end of the first semesters in 2000/01 and 2001/02 school years

We can see that it was not the lack of time only, for teaching and learning the material, that could be accused for the registered decreasing results in mathematics courses after the war events. The psychological reasons are those which made a great deal of trouble in teaching/learning process of mathematics courses. Teachers were to recognize this feature as well as the nature of mathematical thinking, learning and teaching to overcome this evident problem together with his or her students.

Of course, our findings are not definite, they are rather suggestive, and, as it is usual concerning research in mathematical education, evidence is cumulative, moving towards conclusions that can be considered to be beyond a reasonable doubt.

Nowadays, from the time distance of the terrible events, it is not possible to investigate deeply, especially from the psychological point of view, let alone the pedagogical one. But, we decided to offer the information collected in the past and interpreted in the present time in order to enable those who are in the similar situation of violent ending of the school year, no matter why, and especially for the purpose of possible theoretical investigation in this region. We also offer the methodology for comparing similar investigations if they are necessary.

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