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Multimedia Teaching Effectiveness in Natural Science Teaching

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Abstract

The aim of this research is to examine the difference in the contribution of the created multimedia models and the traditional teaching to the quality and durability of the students' knowledge of geographical content at all cognitive levels in the fourth grade of the primary school (10-11 years). This research included a sample of 142 students, divided into two groups: E (experimental) and C (control). The students in the C group were taught in the traditional way and the students of the E group taught using the created multimedia models. The quality of students' knowledge was examined by a post-test, while the durability of knowledge was examined by re-test. Variations in knowledge on post-test and re-test in both groups were observed at cognitive levels. At a higher cognitive level (analysis), students were better at re- testing than at a post-test. In the application of geographic contents in the fourth grade, multimedia teaching (MT) should be given priority over traditional teaching (TT).

Keywords: science teaching; modern technologies; quality of knowledge; student achievement

Introduction

Changes resulting from technological development and the expansion of information resources are reflecting on to the everyday activities of people, and therefore to the teaching process, as well. Accordingly, it is necessary to harmonize the educational process with achievements in the field of technological development. A multimedia-enabled classroom allows the teacher to engage students in the teaching process and make them more active; this process is no longer based exclusively on teacher lecturing, but becomes supported by various media: books, magazines, audiovisual media, television and computers. Multimedia tools can then create a complete and effective learning environment (Mahajan, 2012). The subject content adopted in the initial education that the student did not understand, but only mechanically learned, is not considered as quality knowledge and does not ensure its durability. In order to make students fully use their own cognitive resources, they need to be motivated and this motivation is achieved through multimedia teaching (Park et al., 2015). Technology motivates teachers to experiment and implement new approaches to teaching and learning process (Donnelly et al., 2011), as confirmed by Ertmer et al. (2015), who believe that constructivist beliefs contribute to the use of modern technology in support to the development of desirable skills of the 21st century. Fortunately, the newer generation of teachers is more prepared for the implementation of modern information technologies, thus modernizing teaching and bringing it closer to the interests of today's students (Martinović & Zhang, 2012).

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Research Focus

Over the past two decades, numerous studies have been carried out to determine the effects of multimedia teaching on students' achievements, their motivation for the learning process, and the development of their research skills. Numerous authors (Bargezar et al., 2012; Lam & Tou, 2014; Mayer, 2003; Torres-Ramirez et al., 2014; Tudor, 2013) confirm their positive results by comparing teaching enriched by multimedia with traditional teaching process. The results of previous studies, which applied modern technologies into the teaching process, indicated significant positive effects and a high level of achievement of students who have studied with computers versus classical verbal-textual methods (Cheng et al., 2012; Hançer & Tüzemen, 2008; Khan, 2011; Park et al., 2015; Pinto et al., 2014; Wainer et al., 2015). These results support the assumption that computer education modernizes the teaching process, motivates students and contributes to their activation and better knowledge acquisition. This is in line with Mayer (2003) claim that learning by using computers and multimedia (images, animation and words) allows learners to easily understand the content. Computer animation is also a highly effective teaching tool in demonstrating a process that cannot be directly observed in a natural environment. Rosen (2009) with his conclusion that learning becomes more effective when animation is used in the teaching process also support this claim. Some researchers examined the effects of applying multimedia technology and found that the use of animated movies improves students' achievements (Han et al, 2013; Kaptan & Izgi, 2014). They can increase internal motivation for learning, while the grading process, as an external factor of motivation for students, is regarded as an alternate motivating factor. However, not all researchers agree that usage of multimedia in teaching-learning process provides only positive effects. While some authors argue that the lack of imagination in creating their own mental models is due to the use of multimedia in teaching (Schnotz & Rasch, 2005), others consider that multimedia (as a simplified vision of a phenomenon) can have negative effects as it can contribute to the creation of certain misconceptions, not based on scientific facts (Mayer, 2003). However, this conclusion was disproved by the results of the research conducted by Gürbüz and Birgin (2012) as well as Huang et al. (2008) which confirmed that the use of multimedia and computers in teaching is more effective than the use of classical methods of teaching in terms of removing student misconceptions.

Data and methods

The aim of this research is to determine the differences in the contribution of the created multimedia models and the traditional teaching to quality and durability of the students' knowledge of the geographical contents at all cognitive levels in the fourth grade of primary school.

In accordance with the research goal, the following hypotheses have been defined:

1. MT contributes to the higher quality of the student's geographical knowledge on higher cognitive levels than TT.
2. Students achieve longer-lasting knowledge at higher cognitive levels when geography lessons are taught with multimedia models.

Models were created for selected teaching units from the theme "Work, Energy, Production and Consumption". The classes in both groups were applied in duration of 12 school periods. In the C group classes were held in classical approach, based on the oral presentation of the teacher, the use of textbooks and worksheet. E group students studied the content using MT: with the help of presentations prepared for research, using existing video materials, but also with the help of games and videos recorded for research purposes, in order to better understand individual phenomena and processes. The presentations were full of photos that followed more detailed explanations, documentary films (for example, how to obtain rubber or glass), animated videos with a dose of humor were used that stimulated curiosity of students and made educational content more interesting. Some of the videos had a striking message and strongly influenced the students and contributed to them thinking about the impact of man on his own environment and the ways we could pollute it or the way we could change our current condition. Repetition lessons were organized through a quiz presented in a presentation with numerous effects and animations that contributed to a more relaxed atmosphere at a time so that the students did not even notice how much the material was revised and affirmed in that way. In E group students learned content using textbooks and worksheets as well.

Sample of Research

This study included 142 students of the fourth grade (10 and 11 years old) from two primary schools in Sombor, Serbia. Both groups had the same number of students (71 each), which were equal in their knowledge based on the pre-test results, average grades from the subject *Nature and Society*, and average grade of student's overall success at the end of the first semester of the fourth grade.

Instrument and Procedures

The research technique was testing, and the instrument was a test (pre-test, post-test and re-test). All three tests were designed by the author of this research. The maximum number of points on the test was 58 points. Each test had 18 assignments divided into six levels of knowledge according to the revised Bloom's taxonomy: knowledge, understanding, application, analysis, evaluation and creation (Andreson et al., 2001).

Data Analysis

Statistical analysis of the data collected during the research was performed using the SPSS software version 19.00, using the following statistical results: t-test independent samples, Mann- Whitney non parametric test, Levene's equality of variances test, analysis of the variance of repeated measurements and Wilks-lambda multivariate test.

Results

The obtained results showed that the E and C groups are uniform on all three variables. By analyzing pedagogical documentation, it was established that the average grade at the end of the first semester of the fourth grade in the C group is 4.44 and in the E group is 4.53; the average grade at the end of the first semester of the fourth grade from the relevant subject in the C group is 4.30, and in the E group is 4.51 (*in Serbia, a numerical assessment is applied where the numerical assessment is formed on the basis of a five-grade scale (1 - fail, 2 - sufficient, 3 - good, 4 - very good and 5 - excellent*).The difference between the overall school success rate in the fourth grade of both groups was tested by the Mann-Whitney U test. The results show that the value of Mann-Whitney U test is U = 2339.5 with p = 0.46 is not statistically significant. The difference between the students successes at the end of the first semester of the fourth grade is also tested by the Mann-Whitney U test. The results show that the E and C groups do not differ in overall school achievement and achievement from the relevant subject at the midterm of the fourth grade.

Pre-test

The Cronbach Alpha pre-test coefficient is 0.81. The value of Levene's equality of variances test (Table 1) is statistically significant ($p = 0.03$, $p < 0.05$), which suggests that variance of the subpopulation in the sense of the dependent variable is non-homogeneous. After the initial testing, it was confirmed that the C and E groups were equal this parameter (the average grade of the pre-test in the E group is 2.82, and in the C group is 2.44). The applied t-test for an unequal variance, ($t = 0.91$, $p= 0.36$), is not statistically significant, indicating that there is no difference between the pre-test groups in general. Statistical analysis of results does not show statistically significant differences between groups, the conclusion is that E and C groups are equal in the amount of acquired knowledge from the relevant subject.

The difference in the quality of students' knowledge in E and C groups at the pre-test at different cognitive levels is shown in the table below (Table 2). After the initial examination, it was observed that the average grade of the students from the relevant subject at the end of the first semester of fourth grade class contrasted with the results achieved by the students in E and C groups at the pre-test. Pre-test questions included certain parts of the material from the relevant subject from the previous grades. The success of the students from both groups, as well as the average grade from the mentioned subject, indicate a high lev-

Table 1. The differences in the quality of knowledge between student E and C group on the pre- test

Pre-test	Levene's equality of variances test		t- test of equality of variances						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean diff	The standard error difference	Limits 95% confidence intervals	
								Lower	Higher
Assumed equal variations	4.68	0.032	0.912	140	0.363	1.12	1.23	-1.31	3.55
Equal variations are not assumed			0.912	132.67	0.363	1.12	1.23	-1.31	3.55

Table 2. The differences in the quality of students' knowledge in the E and C group on the pre- test at the same cognitive level

Cognitive level	Group	$\bar{X}$	SD	t	p
Knowledge	E	7.81	1.42	1.700	0.091
	C	7.42	1.29		
Understanding	E	4.78	1.52	0.607	0.545
	C	4.62	1.66		
Application	E	6.26	2.15	0.893	0.373
	C	5.92	2.36		
Analysis	E	4.64	1.54	1.296	0.197
	C	4.24	1.93		
Evalution	E	3.62	2.16	0.369	0.713
	C	3.76	2.39		
Creation	E	3.39	2.65	0.015	0.988
	C	4.4	3.08		

el of student's knowledge. On the other hand, a significant drop in the student's performance after the pre-test was noted. Such low average marks on the pre-test can be explained by the fact that teachers usually require reproduction of the acquired knowledge from students, while there is no functional application of knowledge and opinion at higher cognitive levels.

After analyzing the quality of the students' knowledge of both groups at the same cognitive levels, it is possible to say that the E and C groups achieved similar results at all cognitive level on the pre-test: knowledge ($t = 1.700$, $p = 0.091$), understanding ($t = 0.607$, $p = 0.545$), application ($t = 0.893$, $p = 0.373$), analysis ($t = 1.296$, $p = 0.197$), evaluation ($t = 0.369$, $p = 0.713$) and creation ($t= 0.015$, $p= 0.988$). Based on the analyzed arithmetic mean scores obtained at different levels of pre-test knowledge, there is no difference noted in the E and C group. At the same time, the statistical analysis does not show statistically significant differences between the groups, so the conclusion is that E and C groups are equal in their knowledge of the relevant subject.

Post-test

The Cronbach Alpha post - test coefficient is 0.84. The contribution of MT to the quality of students' knowledge in the E and C group on post-test at different cognitive levels is shown in Table 3. Post-test results show that E group students achieved better results at all levels compared to the C group. The E group students achieved almost the same number of points on the level of knowledge both in the pre-test and in the post-test, while the levels of understanding, application, analysis and evaluation increased the number of points compared to the pre-test. Although the number of points achieved was slightly increased on the post-test compared to the pre-test, the difference is statistically significant.

Table 3. The differences in the quality of students knowledge in the C and E group on the post- test at the same cognitive level

Cognitive level	Group	$\bar{X}$	SD	t	p
Knowledge	E	7.28	1.97	4.737	0.000
	C	5.42	2.66		
Understanding	E	5.51	2.42	4.096	0.000
	C	4.01	1.87		
Application	E	6.39	2.44	6.196	0.000
	C	3.95	2.24		
Analysis	E	6.1	2.60	5.573	0.000
	C	3.8	2.20		
Evalution	E	3.89	2.30	6.312	0.000
	C	1.94	1.94		
Creation	E	2.97	2.12	4.164	0.000
	C	1.59	1.59		

Table 4. The difference in the total number of points achieved in the E and C group on the pre- test and the post-test

Group		Mean	SD	N	r	p
E	pre–test	31.51	6.39	71	0.71	0.000
	post-test	32.09	9.75	71		
C	pre-test	30.39	8.13	71	0.67	0.000
	post-test	20.71	7.61	71		

A decrease in the level of knowledge on the level of creation is visible in both groups, although in the C group drop in the post-test scores is more pronounced compared to the pre-test. After analyzing the quality of the knowledge of students from both groups at the same cognitive levels on the post-test, it is possible to say that E group achieves better results than the C group of students at the level of knowledge ($t = 4.737$, $p = 0.000$), understanding ($t = 4.096$, $p = 0.000$), application ($t = 6.196$, $p = 0.000$), analysis ($t = 5.573$, $p = 0.000$), evaluation ($t = 6.312$, $p = 0.000$) and creation ($t = 4.164$, $p = 0.000$). The obtained results indicate that there are statistically significant differences in the post-test achievements in group E.

In Table 4, the mean values of the points scored on the pre-test and the post- test in both groups are presented.

ly significantly better result on the post- test than on the pre-test.

In the E group, the average number of points achieved was slightly increased in the post-test compared to the pre-test, but the difference is statistically significant. In the C group, differences are also statistically significant, although the number of points achieved is significantly lower on the post-test.

Re-test

The Cronbach Alpha coefficient for the re-test is 0.83. After the analysis of the quality of the knowledge of the students from both groups at the same cognitive levels on the re-test (Table 6) it is possible to say that the E group achieved better results on the level of knowledge ($t = 10.859$, $p= 0.000$), understanding ($t = 7.875$, $p = 0.000$), application ($t = 5.525$, $p = 0.000$),

Table 5. The differences in the results of the E and the C groups on the pre-test and the post-test

GROUPS		Mean	SD	Stand. error of the mean	Limits 95% confidence interval		T	f	Sig (2 tailed)
					lower	higher			
E	Pre-test	- 0.58	6.89	0.82	-2.22	1.05	-0.71	70	0.48
	Post-test								
C	Pre-test	9.68	6.45	0.77	8.15	11.20	12.64	70	0.000
	Post-test								

On average, the respondents of the E group achieved a better result at the final test by 0.585 points than on the pre-test of knowledge with slightly higher variability of the results. C group students achieved an average worse result on the post-test by 9.676 points than on the pre- test. The correlation coefficient for the E group $r = 0.709$ is statistically significant ($p = 0.000$), which indicates that there is statistically significant correlation between the results of the pre-test and post- test of knowledge of the C group.

Testing of the differences between the results of the E and the C group on the pre-test and post- test was carried out through the t-test and shown in Table 5. The results indicate that there are differences in achievements on the pre-test and the post-test both in the E and in the C group. The results indicate the existence of differences between the results of the pre-test and the post-test of knowledge of the E group students. E group participants achieved a statistical-

evaluation ($t = 0.202$, $p = 0.202$) and creation ($t = 5.819$, $p = 0.000$). At the level of the analysis, both groups achieved an almost similar result ($t = 1.605$, $p = 0.111$), so that the difference is not statistically significant, indicating that there are no differences between the groups at the level of the re-test. The obtained results indicate that there are differences in achievement on the re-test in favor of group E (except at the level of analysis).

The difference between the results of the E and the C group in the post-test and the re-test was determined by the coefficient of correlation of the post-test and the re-test and are shown in Table 7.

On average, the respondents of the E group achieved a better result on the re-test for 10.147 points more than on the post-test with slightly lower variability of the results. C group respondents achieved on average, 9.24 points more on the re- test than on the post-test with significantly less variability in the re-

Table 6. The differences in the quality of students' knowledge in the E and the C group on the re- test at the same cognitive level

Cognitive level	Group	$\bar{X}$	SD	t	P
Knowledge	E	8.22	1.75	10.859	0.000
	C	5.04	1.75		
Understanding	E	7.74	1.89	7.875	0.000
	C	5.21	1.93		
Application	E	6.16	2.01	5.525	0.000
	C	4.21	2.18		
Analysis	E	8.8	1.92	1.605	0.111
	C	8.16	2.72		
Evalution	E	4.71	2.55	0.202	0.000
	C	2.40	2.17		
Creation	E	6.62	1.54	0.022	0.000
	C	4.93	2.052		

Table 7. The differences between the results of the E and the C groups in the post and re-test

Group		Mean	SD	N	r	p
E	Post-test	32.09	9.75	71	0.64	0.000
	Re-test	42.24	7.66	71		
C	Post-test	20.71	7.61	71	0.52	0.000
	Re-test	29.95	7.29	71		

sults. The correlation coefficient for the E group r = 0.62 is statistically significant (p = 0.000), which indicates that there is a statistically significant link between the results of the post-test and the re- test of knowledge in the E group. The correlation coefficient for the C group r = 0.52 is statistically significant (p = 0.000), which indicates that there is statistically significant correlation between the post-test and the re- test results in the C group.

Testing the difference between the E and the C group results on the post-test and the re-test was performed using the t-test and shown in Table 8.

The value of the t-test for the E group is statistically significant (p = 0.000), indicating that there are differences between the results of the post-test and the re-test in the E group. The value of the t-test for the C group is statistically significant (p = 0.000), indicating that there are differences between the results of the post and the re-test of the C group. The results indicate that there are differences in achievements in the post-test and the re-tests, in both E and C group (after three months there has been a significant increase in knowledge).

The analysis of the variance of the repeated measurements of the results obtained on the pre-test, the post-test and the re-test were compared. Table 9 shows their mean values and standard deviations.

The average number of points scored on the pre-test is higher by 9.676 points than on the post- test in the C group, and on the other hand, the E group achieved higher results in the post-test by 0.585 points. In the C group, the differences in the average number of points scored on the pre- test and the re-test were 0.436 points and in the E group they amounted to 10.732 points. Multivariate analysis of variance that was implemented by several tests, of which the Wilks' Lambda test was the valid one for our research, the significant impact of the experimental method on the test results was determined. The value of the Wilks'Lambda multivariate test is 0.370, Levene's test

Table 8. The differences in the results of the E and C groups in the post-test and re-test

GROUPS		Paired differences					T	df	Sig. (2-tailed)
		Mean	SD	Stand. error of the mean	Limits 95% confidence interval				
					lower	higher			
E	post-test	-10.15	7.63	0.91	-11.96	-8.34	-11.20	70	0.000
C	post-test	-9.24	7.33	0.87	-10.97	-7.51	-10.62	70	0.000

Table 9. Mean values and standard deviations of the pre-test, the post-test and the re-test results

Groups	Test	N	Mean	SD
E	pre - total	71	31.51	6.40
	post - total	71	32.09	9.75
	re - total	71	42.24	7.66
C	pre - total	71	30.39	8.13
	post - total	71	20.71	7.62
	re - total	71	29.95	7.29

for equality of variances is F=118.55 and is statistically significant ($p = 0.000$, $p < 0.05$), while the value of the effect (multivariate partial eta square), 0.63 (a major influence). An analysis of the variance of repeated measurements determined the great influence of the experimental method on the test results.

Discussion

In both groups, the students showed equal knowledge on pre-test at all cognitive levels, and very low knowledge at higher cognitive levels. This is based on the obtained results, as well as on the basis of the number of points achieved at each cognitive level. The students from the E and the C groups reached the highest scores at the first three cognitive levels (knowledge, understanding, application). The students knew how to theoretically explain a certain phenomenon, but tasks requiring the use of existing knowledge to explain a particular phenomenon, reading a text with understanding, or tasks in which they needed to express their views and explain them were a significant problem for a large number of students. The pre-test results suggest that students have learned the content of the previous three grades in a traditional way, without occasional repetition. The data support the claim that the assessment of knowledge in the education system of Serbia is most often based on the reproduction of knowledge, and that students are required to exclusively remember and reproduce the material presented by the teacher or presented in the textbook. The low students success on the pre-test suggests that in previous grades teachers did not sufficiently insist on applying the acquired knowledge, as well as on analysis and creation in the sense of creating new, better skills, applicable in solving future problems. The results of the study showed that MT influenced the E group students to achieve better post-test knowledge than the C group students. This claim is supported by the total number of points achieved on the post- test in both groups. The E group students were more successful in solving tasks at all cognitive levels in comparison with the achievements of the C group students. It was expected that the number of points achieved in the E group will be considerably higher at the higher levels (evaluation and creation), but as the difference in the number of points achieved between the two groups on these two levels is statistically significant (in favor of the E group) we can state that MT contributed to the quality of knowledge. On the other hand, the C group students achieved better results at a cognitive levels that experimenter did not expect. Possible reason why the students achieved better results at the cognitive level of application, and worse at the cognitive levels of knowledge and understanding was that they did not read the questions carefully, were rushing in task solving etc. This assumption has in favor their better performance on the re-tests, where they had the same tasks, only linguistically modified. Further research should verify this assumption, as well as possible reasons for this phenomenon. It was unexpected that the C group students at the post-test achieved significantly lower results compared to the pre-test and significantly lower results at certain cognitive levels (knowledge, application, analysis, evaluation, creation and somewhat worse at the level of understanding) which can be a significant starting point for further research to try and find out where do variations in achievements at the same cognitive levels come from. The possible reasons for this are the fact that the content is much more complex in the fourth grade than the contents of the previous grades. In general, the C group students at the post-test have accurately solved the tasks that were based solely on memorizing facts, their recognition and reproduction during testing. The total number of points achieved, as well as the success of students in both groups at cognitive levels on the post-test, partially confirms the first hypothesis of the research. The students in the E group have gained more durable knowledge than the C group students. The obtained results are in accordance with the author's assumption that the use of MT will influence the sustainability of students' learning by applying

MT (Cheng et al., 2012, Han et al., 2013, Kaptan & Izgi, 2014, Pinto et al., 2014; Wainer et al., 2015). Based on the results obtained on the re-test, there was no difference in the knowledge of the C and the E groups at the level of the analysis. When comparing students' knowledge in both groups on the re-test and the post-test at the same level, it can be concluded that the E group students forgot the knowledge needed to solve tasks at lower cognitive levels or that the students in the C group in the period of the post-test the and re-test had been further educated. The success of the students from the E group on the re-test is higher than the post-test at the highest level (creation). However, the students of the E group were not better in their knowledge than students from the C group at a lower level of evaluation. The reasons for such oscillations in students' knowledge on the same cognitive level at the post-test and the re-tests should be explored by future studies. What can be concluded from the total number of points on the post-test and the re-test is that the E group students achieved a higher number of points. This is unexpected information for the students of this group. The data indicate that there was no active and passive forgetting, which was expected (Robbins at al., 2001), but on the contrary, the improvement of knowledge was noted. It should be noted that the contents between the post-test and the re-test are not repetitive, but are disturbed by other contents. Perhaps the content that the students of the E group learned about, the ways of application and presentation, have become interesting to students over time, and they have been additionally educating themselves independently through different sources of knowledge (encyclopedias, internet etc). The results of the re-test partially confirm the second hypothesis of this research. Obviously, the verbal method of the teacher, as well as the textual method, which dominated the C group, was not enough for students to understand complex contents. The E group teacher focused more on students' attention, increased student interest for the content and learning process itself. All of that was missing in the test group C. The reason for the better quality and durability of the students' knowledge in this group should be sought in the fact that the use of animated videos most likely facilitated the better understanding of the content (Han et al., 2013; Kaptan & Izgi, 2014). The content of the multimedia models applied in this research was created in accordance with the interests, of the E group students. In this way the contents became closer and more interesting to the students, and most likely influenced the increased interest in learning new content. The content in the MT was more dynamic, more beautifully designed than the contents in the textbooks, followed by audio-visual effects, which most likely influenced the student's desire to learn. Multimedia has activated more of the student senses, which also affected the E group to understand and remember the adopted knowledge better than the C group students.

Conclusion

The students who learn using the created multimedia teaching model have achieved better and more durable knowledge than the students who learn the same contents through traditional teaching (verbal and textual methods). The created multimedia models used in this research contributed to the adoption of more advanced knowledge at the highest cognitive level of creation. The variations in the knowledge of the students on the same cognitive level were observed on the post-test and the re-test. At some cognitive levels, the students who have learned through created multimedia models have gained better knowledge on the re-test than on the post- test at the higher cognitive levels. Further research should examine the reasons for this phenomenon. Regardless of these variations in knowledge on certain cognitive levels in the application of geographic contents in the fourth grade of elementary school, the advantage should be given to MT over TT. Teachers themselves should create multimedia models in the processing of initial natural science content, as well as other content from integrated natural sciences, in order to adjust the content and make it more understandable and make it more understandable.

The reasons for a larger contribution of the multimedia teaching compared to the traditional teaching are reflected in the manner the students are learning through these two types of teaching. Using multimedia teaching, the students learn in a more obvious manner and the contents are in line with their interests and pre-knowledge. The contents presented in such a manner are more familiar and interesting to the students, they are more dynamic and better designed than the contents in the textbooks and they are accompanied by audio-visual effects, which undoubtedly contributes to students desire to learn and results in better scores. Such teaching climate enables a more active students' participation, which is followed by their engagement, as well as their motivation for further learning. The increase in motivation will reflect on the learning process and students' interest in the content. The interdisciplinarity of the school subject

shows that the conclusions of this study cannot be applied to all teaching contents. However, they can certainly be a foundation for further similar studies with a more representative sample.

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