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Certain predictors in the selection and design of the new media environment for learning and teaching

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Abstract

In Croatian classrooms it is possible to observe teaching scenarios that follow the features of constructivist and traditional teaching theories and many variants and combinations of teaching didactics that are student centered and those that are teacher centered. Teachers struggle to find their way in the selection and design of a media environment that fulfils the developmental needs and ways of learning of the net generation. In many classrooms, pupils still spend most of their time seated in twos at tables aligned in three columns listening to and watching what the teacher is saying and doing (in other words, teacher-centered instruction). Teaching equipment and furniture are mostly adjusted to the needs of the traditional theories of teaching and frontal instruction. The research was carried out on a total sample of 435 pupils in the upper secondary level of education in four counties in the continental part of the Republic of Croatia in order to examine the predictors of using the new media environment for learning. The authors employed the stepwise model to determine statistically significant predictors within the model. The predictors, such as the subject specialisation of the teacher, years of service, the traditional didactics paradigm and the constructivist position paradigm account for 12.7% of the variance of the criterion variable of using the new media environment for learning. Sex, type of school and the frequency of permanent professional development were not seen as statistically significant predictors, i.e., they were not included in the stepwise regression models. The question then arises about what the other, non-investigated predictors of the new media environment for learning would be, considering that the predictors determined do not provide an explanation for the high variability of the criterion variable. Years of service and the subject specialism of the teacher are seen as the most significant predictors of using the new media environment for learning.

Keywords: learning environment; teaching strategies; constructivism; secondary education; multimedia didactic;

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1. Introduction

The questions of how to teach young people and prepare them for life are as old as humanity. However, these questions have never been as complex and relevant as today. There are many underlying reasons for this, but it is particularly important to bear in mind that the planet Earth is home to seven billion members of the human species and is witness to the greatest ever communications-technological revolution that has been evolving over the past twenty years. The communications-information revolution has resulted in the arrival of numerous forms of digital media content that greatly affect all forms of human life and communications, including the segments of growing up, upbringing and school-based teaching.

Although there are many definitions and scientific explanations of the terms knowledge, instruction, teaching, learning and other related phenomena and expressions, members of the human family still find the following questions interesting: What is knowledge? How to teach effectively? How to complement growing up and upbringing with digital media? How to structure the process of acquiring knowledge? What is the relationship between knowledge and reality? (Tobias & Dufty, 2009).

In particular, many new questions follow from constructivism as an epistemological direction, as a didactic paradigm and as an attempt to explain more thoroughly the processes of awareness, learning and the place of science in the life of man. Examinations of the traditional theories of learning and explanations of the basic phenomena important for the preservation of the human species (learning, upbringing, science) intensified especially at the beginning of the past century (Dewey, Montessori, Vigotsky, Piaget, etc.). Discussions concerning the sustainability of the explanations offered in the past century by the advocates and interpreters of the constructivist theory have intensified over the past three decades. In terms of pedagogy and didactics, discussions and interpretations of the constructivist positions of Mezirow (1997 and 2000), Reich (2006) and Terhart (2003 and 2005) are particularly interesting and useful.

2. Between traditional and constructivist didactics

In the states that evolved from the disintegration of the former Yugoslavia in the second half of the 20th century, didactic and pedagogic literature was heavily influenced by the Soviet pedagogues Danilov (1899-1973), Yesipov (1894-1967), Goncharov (1902-1978) and Gruzdjev (1889-1953). All states that were under political and military control of the so-called former Eastern Bloc underwent the same influence. The didactic and pedagogic theories of Soviet pedagogues focused excessively on the work of teachers, and too little on the activities of pupils. Didactic theories of those times describe and explain in detail the whats and hows of teachers' work, where pupils should sit, listen, watch and respond to questions that the teachers ask. Didactic scenarios in the state schools of Central Europe did not differ much from those in East and South East Europe. Still, in the second half of the past century, school and pedagogic pluralism was made possible in all states of Central and Western Europe, so that the didactic and pedagogic ideas of Maria Montessori, Rudolf Steiner, Célestin Freinet and other reform pedagogues made their impact on pedagogy in state schools.

Nowadays, Croatian teachers can learn simply enough about didactic scenarios and teaching strategies from all around the world (e.g. from Germany, England, the USA, Canada; more in Reich, 2006; and in Reece and Walker, 2011), but Croatian classrooms are still equipped for traditional instruction. The didactic design of teaching scenarios and of the educational environment in which the scenarios are conducted follows the paradigm of teacher-centered instruction. All attempts at procuring the latest digital equipment for the classroom follow the principles of frontal instruction: in most cases the equipment procured supports lecture-style instruction (e.g. smart boards, PowerPoint presentations, etc.). Frequently, pupils can be seen seated in three columns (tables aligned based on the 19th century scenario), staring at their tablet computers.

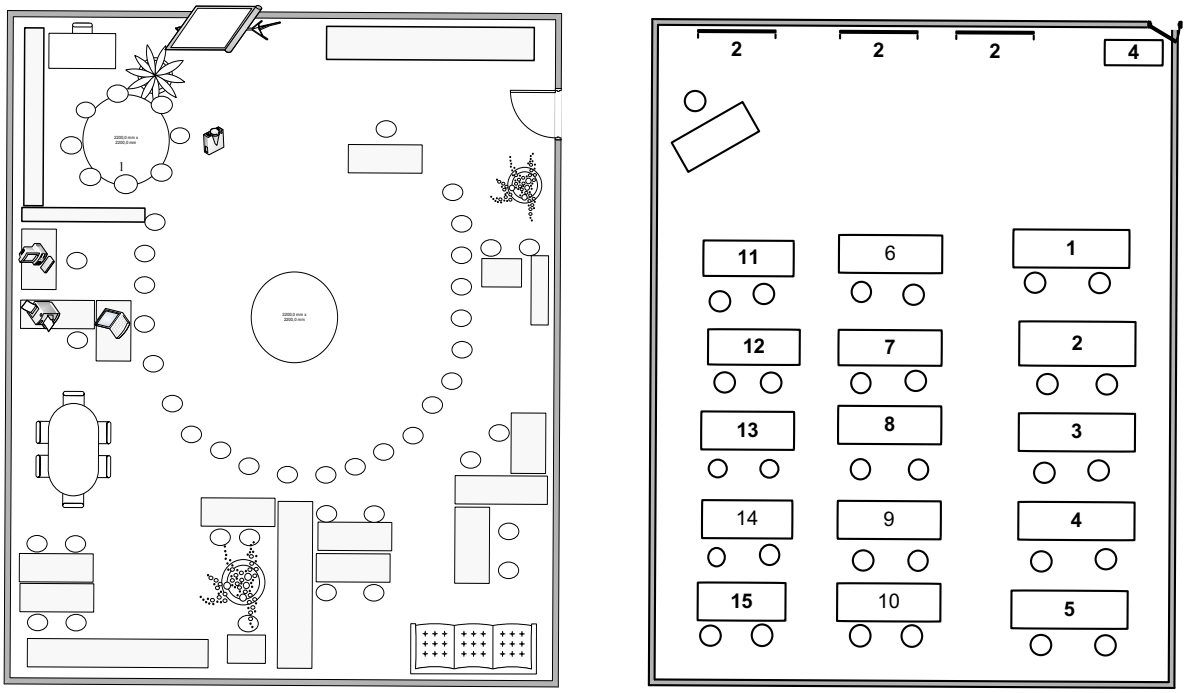

Figure 1 (a) constructivist instruction classroom, (b) frontal instruction classroom (Matijevic & Radovanovic, 2011)

Experts from around the world are seeking opportunities to adapt instruction methods to the modern generations of pupils. The constructivist paradigm and didactic strategies for active and experiential learning are interesting to many both as a starting point and a direction ahead. Australian experts are examining possibilities for improving the way mathematics are taught (Vale, Davies, Weaven and Hooley, 2010). The use of methodical scenarios that follow from pupil-based instruction in mathematics is something to be advocated, and was tested on a sample of pupils with poor pre-knowledge. Models, meaning and approaches that target the pupil have been verified, and the results enable such a constructivist approach to be recommended to others. The ways in which teachers and leaders prepare for such instruction have also been described.

Gina Mariano (2014) deals with the problem of learning as part of the cognitive theory of learning in a multimedia environment. The purpose of the research conducted was to establish the effects of segmentation on immediate and deferred testing of the results of learning in a multimedia learning environment. The independent variables of segmentation and non-segmentation, along with immediate and deferred testing of results, were manipulated for an assessment of the effects of segmentation on the ability of participants to recall and reproduce information from a multimedia textbook. The data were analysed based on the 2x2 factorial design. The results of the study revealed that the segmentation of multimedia textbooks did not result in any significant differences in memory. The results also revealed that the time period between using the multimedia and the time of control checks did not affect the forgetting curve.

A research study by a group of American authors (Liu, Olmanson, Horton and Toprac, 2011) examines learning and the motivation of secondary school pupils exposed to multimedia-enriched problem-based learning (PBL) in the field of learning scientific content. The authors examined the effect of a multimedia environment on learning scientific content. The analysis revealed that pupils had significantly improved their knowledge of scientific content in a final exam in comparison to the

initial exam. The final exam followed multimedia-designed problem-based learning. Pupils were highly motivated and they enjoyed the experience in an encouraging multimedia environment. It was demonstrated that there was a significant positive relationship between the motivation of pupils and their final results in the exam.

Kurzel, Slay, Rath and Chau (2002) describe the development of an adaptive multimedia learning environment that utilizes multimedia presentation techniques in its interface while still providing internet connectivity for management and delivery purposes. The system supports the WWW as its addressing space but uses the local client areas to store media items that are costly in terms of delivery time. Learning objects that provide frameworks for tasks and other summative assessment activities are stored on a server and delivered when required. The system supports link annotations in its adaptivity and employs an overlay student model with stereotyping when accessing the course content. With such powerful and flexible software, it is possible to organise a number of creative activities for pupils.

Duygu, Halil, Uluuysal and Karakoyun (2011) showed the procedure and results of research with the aim of revealing students' opinions about the use of PDAs (Personal Digital Assistant) in a learning environment within the context of multimedia-based applications. The procedure was tested on a purposive sample of 17 undergraduate students attending an elective course in computer education and instructional technology. Although the students belonged to the net generation, they had quite a few critical remarks concerning the software offered and the way it helped them in the learning process.

Neo and Leow (2014), authors from Malaysia, also study the inclusion of digital multimedia projects in teaching and learning and the influence of digital media on the selection of classroom teaching strategies. In their research project, the authors provided students with relevant content in a conventional learning environment (classroom), and content related to an animation course and its impact on learning. The research follows from Gagnes' learning theory. The results of introducing multimedia in teaching and learning were positive and encouraging.

The purpose of the research study published by Savaşci Acikalin (2014) was to investigate the extent to which science teachers use digital teaching technologies in specialised classrooms (cabinets) designed for such instruction. The study included 63 teachers who had just completed the teacher licence training course at one of the major universities in Turkey. They were asked to propose a methodological scenario for any topic from their curriculum, presuming that they had an ideal teaching environment and equipment. Based on an analysis of all methodological scenarios offered, the participants were asked to explain their decision to use media and the design of the media environment. It was seen from the results that PowerPoint was the most used teaching medium in all scenarios proposed. Immediately next were textbooks and the conventional blackboard. None of the participants envisioned a more prominent position for the internet, interactive smartboards, tablet computers, computer simulations or any other educational programme, although they were instructed to imagine an ideal educational environment in terms of time and resources.

The research results above, as well as many others aimed at enriching teaching scenarios with multimedia, indicate that the future of teaching in terms of multimedia instruction lies in digital media and the internet. ICT experts refer to such a type of instruction as blended learning, but in the tradition of Europe's didactic theory and terminology the term multimedia learning is more prevalent and accepted.

3. Empirical research

On a total sample of 435 pupils in upper secondary education in four counties in the continental part of the Republic of Croatia, the authors investigated the predictors of using the new media environment for learning. The variables of the new media environment (12) can be found toward the

negative end of a 4-point Likert-type scale ranging from: 1 – completely disagree; 2 – partially do not agree; 3 – partially agree; 4 – completely agree.

In line with the aim of the paper, which was to investigate the significance of certain predictors of using the new media environment, the summative/composite, i.e. the criterion variable of using the new media environment was constructed (Mean = 2:48; Mode = 3; Std.dev = 0.429; Skewness = -.313; Kurtosis =.090), and in terms of the number of points on the scale, the level of using the new media environment for learning is obviously at a relatively satisfactory level (Mode=3). This would indicate that secondary school teachers in the sample are relatively well-aware of the new media environment for learning (based on the negatively skewed distribution of the composite criterion variable).

In their research of the significance and contribution of predictors in using the new media environment for learning, the authors used a multiple linear regression analysis based on the stepwise model.

The descriptive values of the predictors in the regression model are presented in Table 1.

Table 1. Descriptive Values of the Initial Predictors

	Minimum	Maximum	Mean	Std. Deviation	Mode	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Stat	Statistic	Std. Error	Statistic	Std. Error
gender	1.0	2.0	1.780	.4150	2	-1.354	.118	-.168	.235
school	1.0	7.0	2.660	1.1850	3	.716	.118	.383	.235
subject specialism	1.0	7.0	3.681	1.3565	5	-.376	.118	-.822	.235
years of service	1.0	4.0	2.012	1.0529	1	.598	.117	-.942	.234
frequency of professional training	1.0	4.0	3.531	.7806	4	-1.600	.118	1.694	.235
traditional didactics paradigm	1.0	4.0	2.899	.9228	3	-.558	.117	-.473	.234
constructivist position paradigm	1.0	4.0	2.929	1.0515	4	-.599	.117	-.867	.234

Key: *School* (1 – grammar school; 2 – vocational school; 3 – primary school; 4 – student accommodation facilities; 5 - combined: 6 – secondary school without categorisation; 7 - unemployed); *Subject specialism* (1 - first- through fourth-grade teacher; 2 - specialist subject teacher in primary school; 3 - general education subject teacher in secondary school; 4 - vocational education subject teacher in secondary school; 5 - expert assistant; 6 - headteacher; 7 - teachers in the residential facilities for students); *Years of service in school* (1- under10 years; 2 - from 11 to 20 years; 3 - from 21 to 30 years; 4 - over 30 years); *Frequency of professional training* (1- never; 2- once; 3- twice; 4 - three or more times); *Paradigms* (1 - completely disagree; 2- partially disagree; 3- partially agree; 4- completely agree).

The stepwise model of the regression equation uses those predictors (independent variables) with the highest Pearson's correlation coefficient with the criterion variable (Table 2).

Table 2. Model Summary[e] - Predictor Models (variables) in the Stepwise Model

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.239[a]	.057	.055	.41226	.057	23.307	1	385	.000	
2	.305[b]	.093	.088	.40487	.036	15.167	1	384	.000	
3	.336[c]	.113	.106	.40084	.020	8.761	1	383	.003	
4	.357[d]	.127	.118	.39815	.014	6.197	1	382	.013	1.882

a. Predictors: (Constant), subject specialism

b. Predictors: (Constant), subject specialism, years of service

c. Predictors: (Constant), subject specialism, years of service, constructivist position paradigm
d. Predictors: (Constant), subject specialism, years of service, constructivist position paradigm, traditional didactics paradigm
e. Dependent Variable: composite - using the new media environment for learning

As evident from Table 2, four out of seven predictor variables based on the stepwise model are included (in the models). As evident from Table 1, all four models account for only 12.7% of the variance of the criterion variable, i.e., 11.8% (Adjusted R^2; cross – validity of the regression model is good, i.e., if the regression model were derived from the population, and not from the sample, it would result in only 0.9% less variance). The authors state that the most significant predictor is the teacher's subject specialism; separately it accounts for 5.7% of changes/variability of the criterion variable, i.e., 5.7% of the changes in the perception of the new media environment can be foreseen based on the subject specialism of the teacher. In model 2, the predictor variables "subject specialism" and "years of service" account for a total of 9.3% of the variability of the criterion variable. In models 3 and 4, along with other predictors in models 1 and 2, there are the predictors of the "constructivist position paradigm" (model 3) and the "traditional didactics paradigm" (model 4). None of the four models explains a great deal of the variance of the criterion variable (12.75%). This means that the predictors have little impact on the criterion variable, that is, they do not alter it much.

It is interesting that the initially set predictors such as gender, type of school and permanent training were not shown as being statistically significant, i.e., they were not included in the regression models (4). The question now arises about what constitutes the other, non-investigated predictors of the new media environment for learning.

The results of ANOVA ($p \leq 0.05$) confirm the statistical significance of the predictor (models) variables. The results of the Durbin Watson test indicate that the residuals are not autocorrelated.

Insight into the contribution of the predictor variables (in the models) in the explanation of the variance of the new media environment for learning is presented in Table 3.

Table 3. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Colinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.217	.062		35.910	.000					
	Subject specialism	**.076**	.016	**.239**	4.828	.000	.239	.239	.239	1.000	1.000
2	(Constant)	2.075	.071		29.310	.000					
	Subject specialism	**.074**	.015	**.232**	4.774	.000	.239	.237	.232	.999	1.001
	Years of service	**.077**	.020	**.189**	3.894	.000	.198	.195	.189	.999	1.001
3	(Constant)	1.925	.086		22.287	.000					
	Subject specialism	**.070**	.015	**.221**	4.567	.000	.239	.227	.220	.992	1.008
	Years of service	**.073**	.020	**.180**	3.730	.000	.198	.187	.179	.994	1.006
	Constructivist position paradigm	**.058**	.020	**.143**	2.960	.003	.174	.150	.142	.989	1.011
4	(Constant)	1.798	.100		17.973	.000					
	Subject specialism	**.064**	.015	**.202**	4.171	.000	.239	.209	.199	.970	1.031
	Years of service	**.071**	.019	**.176**	3.675	.000	.198	.185	.176	.993	1.007
	Constructivist position paradigm	**.053**	.020	**.130**	2.692	.007	.174	.136	.129	.977	1.023
	Traditional didactics paradigm	**.057**	.023	**.121**	2.489	.013	.177	.126	.119	.962	1.040

a. Dependent Variable: composite - using the new media environment for learning

The values of non-standardised coefficients (betas) demonstrate a connection between the criterion variable and each predictor. All beta values are positive, which indicates that the values of the criterion variable increase along with the growth of the value of the predictors. In line with the stepwise regression model, beta values show the level of influence of each predictor separately and the controlling influence of the other predictors on the criterion variable, i.e., constancy of the other predictors.

Thus, the results are the following:

- In model 1, the effect is shown of the predictor variable SUBJECT SPECIALISM, and beta 0.076, which in terms of the measuring unit means that if the value of the predictor variable SUBJECT SPECIALISM is increased by 1 unit on the scale, the value of the criterion variable is increased by 0.076 units on the scale, i.e., in terms of the standardised regression coefficient/beta), for every 1 standard deviation of the predictors, the criterion variable is increased by 0.24 Sd.
- In model 2, the value of beta for the predictor variable *subject specialism* is 0.074, and by controlling the predictor variable YEARS OF SERVICE. The logic of the stepwise model reveals the "pure" effect of each predictor. Years of service in the models are a highly significant predictor. A graphical presentation of the arithmetic means of the predictors is shown in graphs 2 and 3.

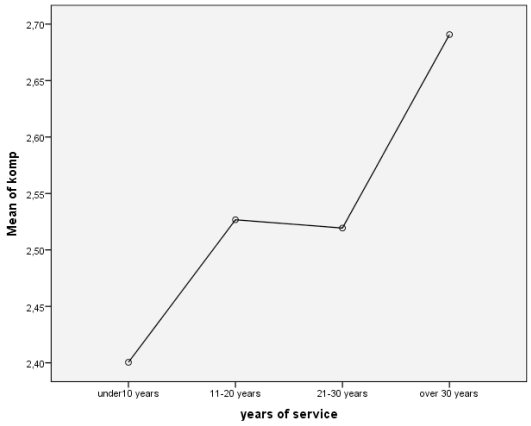

Figure 2. AS; predictor – years of service

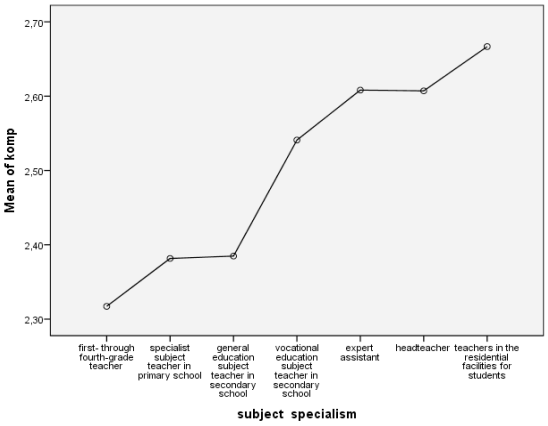

Figure 3. AS; predictor - subject specialism

Considering that the given two predictors proved to be most important in explaining the variability of the changes in the criterion variable, it is interesting to see their AS. In line with the positive beta regression coefficients (and partial correlations), there is a visible trend of distribution of the predictor variables. It is interesting that primary education teachers have the lowest assessment of the new media environment for learning, while the highest assessment comes from teachers in the residential facilities for students. Accordingly, the years of service have an effect on the relative growth in the assessment of the importance of the new media environment for learning.

Models 3 and 4 show the contribution of the separate predictor variables in the models. In view of the *lege artis* implementation of the regression analysis and potential generalisations, it is necessary to point out certain conditions for its implementation. The *t Values* are all statistically significant, which confirms that all the values of the regression coefficients in the models are statistically

significantly different from 0. Multicolinearity (VIF; statistic tolerance) is not confirmed. Also, the regression analysis is under the influence of outliers flagged in the casewise diagnostics. The residual above +3 SD was confirmed only in the case of one N, which in terms of the total N indicates that the regression model is correct.

Furthermore, the precondition of homoscedasticity and linearity is relatively fulfilled. Graph 5 shows normal probability – probability P-P. The graph indicates that the residuals detected are relatively normally distributed, since they are located along a straight line.

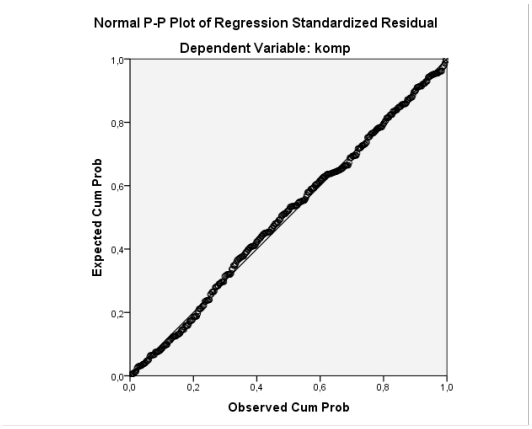

Figure 4. Normal P-P plot regression standardized residuals

4. Conclusion

Although teachers are aware that there are no limits to learning, that anyone can and should learn, that learning needs can be fulfilled in many different ways (Botkin, Elmandjra, & Malitza, 1998; March, 2006) by using many differently designed media environments and didactic strategies, teachers find it hard to embrace change in their place of work. The traditional didactics of frontal instruction is strongly embedded in professional literature and classrooms. Therefore, it is necessary to examine the willingness of teachers to change, and the ways in which teachers prepare for new didactic paradigms and didactic classrooms scenarios.

Statistically significant predictors were determined within the model as part of the multiple regression analysis (stepwise model). The predictors, i.e. the teacher's subject specialism, years of service, the traditional didactics paradigm and the constructivist position paradigm, account for 12.7% of the variance of the criterion variable of using the new media environment for learning. The predictors of gender, type of school, frequency of permanent training are not seen as statistically significant predictors, i.e. they are not included in the regression models (4). The question therefore arises about what the other, non-investigated, predictors of the new media environment for learning would be, since the predictors determined do not account for a high variability of the criterion variable. The most significant predictors for using the new media environment for learning are years of service and the subject specialism of the teacher.

In view of the conditions tested for the *lege artis* implementation of the said regression analysis outside the experiment, it is possible to indicate a certain role, the influence of predictors on using the new media environment. Obviously, the specific nature of the pedagogic activity of expert assistants (teachers in residential facilities for students) and headteachers has more influence on the use of the new media environment as opposed to teacher colleagues in primary school. Also, teachers with more years of service are more likely to use the new digital media, i.e., there is a growing assessment of the

importance of the new media environment for learning. This is actually unexpected, since one would assume that young teachers are more involved in the digital media and pay more attention to such media in terms of didactics. However, the results indicate otherwise.

In view of the significance/importance of predictors, we expected that the constructivist paradigm would have a fundamental role/significance for using the new media environment. However, it is indicative that there is almost equal significance of the constructivist and the traditional paradigm for using the new media environment. Obviously, the type of work and years of service were crucial for using and changing the said media environment.

The results of this paper indicate how important it is to examine the role of using the new media environment. The media environment is no longer an auxiliary (secondary) didactic activity; it has assumed a primary role in the process of upbringing and education. Naturally, it follows that it is necessary to examine its use in upbringing and education as a whole, so that it does not become an end in itself. Voluntarism, without a well-designed didactic-methodological scenario, prevents the media environment from fulfilling its purpose, the purpose of the new age, the new net generation.

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