THE IMPACT OF ONLINE LEARNING ON STUDENT MOTIVATION IN SCIENCE AND BIOLOGY CLASSES

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Abstract/Povzetek. The research aimed to check for difference in learning motivation between students learning online and students participating in modern classroom instruction. The study participants included students attending grades 5 to 8, divided into experimental (online classes) and control groups based on pre-testing. The results show that there is no statistically significant difference in motivation between the tested sub-samples. Student motivation for learning natural sciences declines with their years of schooling, but this is not statistically significant. It can be concluded that online teaching of Science and Biology as a learning tool can be as motivating as modern teaching using active classroom methods.

Vpliv spletnega učenja na motivacijo učencev pri naravoslovju in biologiji

Cilj raziskave je preveriti razlike v učni motivaciji med učenci, ki se učijo z uporabo spleta, in učenci, ki so udeleženi v sodobnem poučevanju. Udeleženci v raziskavi so bili učenci od 5. do 8. razreda, na osnovi predhodnega testiranja razdeljeni v eksperimentalno skupino (pouk z uporabo komunikacijske tehnologije) in kontrolno skupino. Rezultati kažejo, da med testiranima podvzorcema ni statistično pomembnih razlik v motivaciji. Motivacija učencev za učenje naravoslovja upada z leti šolanja, vendar to ni statistično pomembno. Sklepamo lahko, da je učenje naravoslovja in biologije z uporabo komunikacijske tehnologije kot orodja za učenje lahko enako motivacijsko kot pouk z uporabo aktivnih metod poučevanja.

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Introduction

Digital society, in which today's students live, implies the use of Information and communication technology (ICT) for both social interactions and learning. In order for ICT to become a teaching tool, it is necessary, in addition to objective factors, infrastructure and material conditions, to have competent teachers who will apply e-learning and be able, if necessary, to conduct complete online instruction using e-learning systems (in this paper, the term e-learning refers to a complete online instruction). It is this kind of teaching, which applies e-learning and modern teaching strategies that can develop the potential of children and prepare them for the challenges of everyday life (Bulić et al., 2017). Since their implementation in the 1990s, learning management systems have slowly become part of the teaching and education of future teachers (Dahlstrom et al., 2014), but it is questionable how competent the teacher themselves are to use them in class. However, the increasing use of the Internet and educational technology in teaching requires student interactivity (Violante and Vezzetti, 2015), thus it is important to find guidelines and ways to develop student interaction, participation and work performance. Therefore, the focus of the learning and teaching process is on student activities in the learning management system and on active class participation, with the aim of achieving the necessary educational outcomes and retaining knowledge by making decisions based on the available data (Wei et al. 2015). The learning management system, the students and the teachers themselves, play important roles in the learning process. Student satisfaction alone is crucial in the learning process as it leads to greater motivation and better achievement of learning outcomes, whereupon Bolliger and Martindale (2004) cite three major factors of student satisfaction: teachers, technology and interactivity. Students like using computers in classroom, as well as the World Wide Web, interactive whiteboards, virtual learning environment, as they all present a more interesting path to gaining knowledge using visual and audio information (Bratina, 2012). While there are numerous benefits to using ICT in teaching, it should be noted that improper or excessive use of ICT can lead to dehumanization of teaching and adversely affect learning, especially in the first cycle of education. Therefore, the role of the teacher is extremely important as she/he should properly design teaching processes and weigh the amount of computer materials (Brumen et al., 2017). When planning classroom work, special attention should be paid to student motivation (Butler, 2014), as one of the most important components that influences the achievement of required educational outcomes. Social-cognitive theory (Bandura, 1986; Pajares and Schunk, 2001; Pintrich, 2003) explains that the processes of human learning and motivation are in an interaction that integrates the characteristics of the individual (intrinsic motivation, self-assessment, locus of internal control, environmental influence such as grammar school or vocational

school environment) and the behavior of the individual (the individual's desire to engage in Biology-themed activities). If observing student motivation in class in the context of social-cognitive theory, it can be said their behavior is geared toward achieving a goal. The feature of motivated students is the achievement of the necessary educational outcomes as they regularly learn, actively participate in the classroom, make notes, frequently ask questions, carefully make experiments and draw conclusions, and engage in a wide variety of project activities. Their activity is directed towards the set goal: to achieve a good mark in Science or Biology, to enroll in a certain high school or college, or to choose a profession in which Biology is significant. As knowledge in the field of natural sciences is essential for the development of each country, in the teaching process special attention should be paid to the issue of student motivation for learning Science (5th and 6th grade) and Biology (7th and 8th grade) and to looking for ways to constantly increase their motivation for learning such contents (Novoselić et al., 2014). The importance of student motivation is emphasized by Sanfeliz and Stalzer (2003). They argue that the role of teachers is to stimulate learning motivation because motivated students enjoy learning Science, believe in their abilities and responsibly complete the tasks assigned. The authors conclude that intrinsic motivation, self-assessment and locus of internal control are important motivational factors for learning natural sciences. They emphasize that intrinsic motivation is a response to the student intrinsic need for learning, coming from their curiosity, a need for knowledge of Biology, and a sense of competence, while assessing one's own performance comes from students' belief that they can influence their success in learning Biology and can achieve the desired goal through their actions. Vizek-Vidović et al. (2003) state that intrinsic motivation is a response to students' intrinsic needs such as the need for knowledge, curiosity, a sense of competence, and Rheinberg (2004) indicates intrinsically motivated behavior if it occurs because of oneself and one's own desire. In addition to being intrinsically motivated, behavior can be extrinsically motivated, when the driver of behavior is not in the person, but outside (Vizek-Vidović et al., 2003; Rheinberg, 2004) in the form of good grades on the test, teacher praise, obtaining a diploma or a reward. Elements of motivation have been explored by other authors as well (Glynn and Koballa, 2006). Exploring students' self-regulation during e-learning, Liaw and Huang (2013) conclude that after using e-learning, students are satisfied, perceiving it as something useful. Bulić and Kostović (2019) have shown that students self- responsibly do their homework by taking online classes in Science and Biology. The perceived satisfaction and responsibility in students' work may have been influenced by such interactive environment. Deci and Ryan (1985) present a theory according to which an individual's behavior is determined by internal and external motives. Intrinsic motivation brings reward, that is, experience and satisfaction. Lack of motivation causes an individual to give up from the activities.

The authors see internal motivation as the main motivator of the educational process. Extrinsic motivation is seen as the antagonist of intrinsic motivation.

Methodology

Research objective and hypotheses

Starting from the assumption that the application of online learning in Science and Biology class in the Republic of Croatia is only at its beginning and almost no content for online learning in primary school is available, the research objective was set. The objective was to examine the impact of online learning on student motivation in Science and Biology classes. For the purpose of operationalization and achievement of the established objective, the following hypotheses were made: H1 − there is no statistically significant difference in motivation for learning Science and Biology contents between the sub-samples of the control and experimental groups; H2 − student motivation to learn Science and Biology declines with their years of schooling.

Research Sample

A total of 162 students attending 5th to 8th grade of primary school participated in the survey, as shown in Table 1. The sample of respondents represents the whole population of the school and, by all its characteristics, makes a representative sample from the whole population of primary school students.

Table 1: Sample of respondents.

Grade	Experimental group	Control group	Total nr. of students
5.	20	18	38
6.	23	19	42
7.	21	23	44
8.	18	20	38
total	82	80	162

Data Collection Procedure

In order to carry out the research and get answers to the set tasks and hypotheses, the following measuring instruments were applied: *knowledge pre-testing and a questionnaire (Science Motivation Questionaire - SMQ)*. The *knowledge pre-testing* instrument was used to generate experimental and control groups for each class and the test was

written by all students one month before they started to use Moodle. Equivalent pairs were determined with as similar initial results as possible, the groups being balanced also in terms of gender. The questionnaire completed by students represents the *Science Motivation Questionaire* founded by Glynn and Koballa (2006). SMQ provides insight into students' motivation to learn natural sciences. The first part of the questionnaire (SMQ) explores sociodemographic, independent variables: grade (age), gender, and student achievement. The second part refers to motivation survey, containing 30 closed-type particles (dependent variables) grouped in ways to test six different dimensions of motivation, to which students responded using a five-point Likert scale (1 – never, 2 – rarely, 3 – sometimes, 4 – often, 5 – always). The researched dimensions of motivation were: intrinsic motivation, extrinsic motivation, personal assessment of the importance of learning Biology, locus of internal control, assessment of one's own performance, and anxiety when testing knowledge of Biology. Intrinsic motivation for learning Biology is tested by particles: 1 (I enjoy learning Biology), 16 (the knowledge of Biology I have is more important to me than the grade I will get), 22 (I find the subject of Biology interesting), 27 (learning Biology is a challenge for me), and 30 (I feel successful when I understand Biology). Extrinsic motivation for learning Biology is tested by particles: 3 (I want to have better results on Biology tests than other students in the class), 7 (it is important for me to have a good grade in Biology), 10 (the knowledge in Biology will help me in the future for getting a good job), 15 (I think about the impact of a Biology grade on my overall success at the end of the school year), and 17 (the knowledge of Biology will help me one day at work). The personal assessment of the importance of learning Biology is tested by particles: 2 (the knowledge of Biology is important to achieve my goals), 11 (I think knowing Biology will help me in life), 19 (I think about how I will apply Biology knowledge to daily life), 23 (Biology knowledge is essential to my life) and 25 (Biology knowledge has practical application in my life). The locus of internal control is examined by particles: 5 (if I have problems in learning Biology, I will try to find out the cause of the problem), 8 (I put effort into learning Biology), 9 (I use different ways of learning to master the contents of Biology), 20 (I blame myself if I don't understand Biology), and 26 (I prepare thoroughly for a Biology test). The fifth dimension of motivation, which relates to assessing one's own performance, is tested by particles: 12 (I expect to achieve an equally good or better result than other students in the class), 21 (I will certainly successfully do practical work in Biology), 24 (by mastering the content in Biology, I will develop the necessary skills), 28 (I am convinced that I will successfully complete the Biology test), and 29 (I believe I can get an excellent grade in Biology). Whether students feel anxiety when testing their Biology knowledge is tested by particles: 4 (I feel uneasy when I do the Biology test because I don't know Biology), 6 (as the time of writing the Biology test approaches, I feel uneasy), 13 (I

worry that my grade in Biology will be insufficient), 14 (I worry that other students in my class are more successful in Biology than me), 18 (I don't like Biology tests).

In this survey, 30 SMQ questions were divided into six dimensions, making 5 questions per dimension. The scale was five degrees, and the maximum for each dimension tested was 25. The total sum of all particles used in the SMQ was 150. Students who achieved a total score of 30 to 59 are never or rarely motivated to study natural sciences; those with a score 60 to 89 are rarely or sometimes motivated; 90 to 119 sometimes or often motivated, while students who scored 120 to 150 points are often or always motivated to learn natural sciences (Glynn, Taasoobshirazi, and Brickman, 2009), or in this case, to learn Science and Biology.

Prior to the research, the required teaching contents for each class were designed by using the ADDIE model (Molenda, 2003), they were created and uploaded on Moodle. Lesson plans for the experimental and control groups were the same in terms of planned objectives and educational outcomes as well as class activities for all students, regardless of whether they were included in online teaching using e-learning system or in modern teaching with active classroom methods. Although the experimental and control group preparations were compatible, the lessons differed in working methods. In order to test the measuring instruments, a pilot study was conducted in two grades, which showed that the measuring instruments are reliable and valid and that the main research could be started. Passwords have been created for all students to access the online content. During the teaching, the control group students were in the Biology classroom and participated in modern teaching under guidance of a teacher using modern methods, while the experimental group students were in the Informatics classroom and did not have a face-to-face (f2f) contact with the teacher throughout the survey. Students from the experimental group could access the teaching content posted on Moodle not only in school but also from home, when and for how long they wanted. The students of the experimental group were instructed on the basics of using Moodle during one school lesson (in the Informatics classroom), which took eight school lessons as there were many grades included. An arrangement was made for the use of the Informatics classroom and for the supervision of the student work by the Informatics teacher, who could help if the students encountered technical difficulties.

Data Processing Procedures

The obtained research results were verified by the Kolmogorov-Smirnov test to determine the normality of the data. As the normal distribution of the data was reported, the data were processed by parametric methods (t-test). When presenting the data, the parameters of the descriptive statistics were first presented so that the measures of central tendency and measures of data variability could be observed, followed by the presentation of the results of the inferential statistics parametric technique. Data were considered significant if $p < 0.05$. All results were calculated using Statistica 12.0 software (StatSoft, Tulsa, Oklahoma, USA).

As the SMQ examined 6 relatively independent dimensions of motivation using the t-test for independent samples, the significance of differences among the respondents across all 6 dimensions was examined. Before the application, the results in each dimension were condensed using sums. The analysis was made separately for grades 5, 6, 7 and 8.

Results and Interpretation

The results of the SMQ descriptive statistics for all students attending grade 5 to grade 8, by groups and grades, are shown in Table 2. A review of the table shows that both groups show relatively uniform values in the assessment of individual dimensions of motivation, whereupon only the dimensions of *anxiety* and *locus of internal control* show slightly lower values of arithmetic mean and a relatively high variability in responses. From this it can be concluded that the respondents of both groups are uniform in their estimations of motivation dimensions and that both groups are more uncertain in personal assessment of anxiety while determining the success in and mastery of the teaching contents of Science and Biology, and they are significantly more uncertain in assessing the variables indicating the locus of internal control. Comparing the results of the analysis by grades shows that younger students are more confident in assessing the dimensions of motivation, while older students show greater uncertainty regarding their assessment. Analyzing the data by dimensions of motivation, it can be seen that the students of both groups are uniform in their assessment, but that they differ in terms of grades they attend. The data show that the lowest values are achieved by students attending grades 7 and 8, them showing considerable variability in assessment. This is particularly pronounced for students in grade 8 of both groups, for almost all dimensions of motivation, except anxiety, which is described in this way by the grade 7 sub-sample. The results show that students are generally motivated to learn during Science and Biology classes, but apart from intrinsic motivation, external reward in the form of good

grades is still important to them. It is certainly a good result of research that students do not feel anxious about testing their knowledge. The question is whether the teacher methodology affects the reduced anxiety. It is likely that students are well prepared for the written tests through the repetition of the necessary teaching content, thus anxiety itself is not very pronounced. As grade 8 students do not consider learning Biology so important, it is necessary to find ways in pedagogical practice that will lead to their greater interest in STEM subjects.

Table 2: SMQ descriptive statistics results by groups and grades

samples		experimental group					control group				
	raz	AS	± SD	min	max	α_3	AS	± SD	min	max	α_3
DIM 1	5.	21,70	2,43	15,00	25,00	-1,17	22,06	2,31	18,00	25,00	-0,62
	6.	20,74	3,15	15,00	25,00	-0,41	21,16	1,89	16,00	24,00	-0,92
	7.	20,71	2,90	14,00	25,00	-0,85	20,74	2,36	16,00	24,00	-0,80
	8.	19,28	3,32	13,00	25,00	-0,09	19,80	4,24	8,00	25,00	-1,63
DIM 2	5.	20,40	2,98	15,00	25,00	-0,13	21,06	2,69	16,00	25,00	0,08
	6.	21,78	2,81	15,00	25,00	-0,64	21,05	2,76	15,00	25,00	-0,93
	7.	20,14	3,23	13,00	24,00	-0,70	18,78	3,36	13,00	25,00	0,01
	8.	18,00	4,13	12,00	24,00	-0,02	19,75	4,82	5,00	25,00	-1,93
DIM 3	5.	20,5	2,74	15,00	24,00	-0,20	20,78	3,44	14,00	25,00	-0,26
	6.	19,96	4,13	9,00	25,00	-0,89	20,00	3,80	10,00	25,00	-1,16
	7.	19,48	3,49	13,00	25,00	-0,45	18,35	3,23	12,00	23,00	-0,03
	8.	17,67	4,63	12,00	25,00	0,21	19,90	4,83	6,00	25,00	-1,42
DIM 4	5.	19,65	2,35	15,00	23,00	-0,64	19,61	2,83	15,00	24,00	-0,20
	6.	19,52	2,48	15,00	25,00	0,33	19,16	2,59	15,00	24,00	-0,12
	7.	19,00	3,13	13,00	23,00	-0,56	18,87	2,29	10,00	24,00	-0,96
	8.	18,06	3,40	12,00	23,00	-0,57	18,60	3,66	11,00	24,00	-0,76
DIM 5	5.	20,40	2,39	15,00	24,00	-0,53	20,22	2,76	15,00	24,00	-0,53
	6.	20,39	3,06	15,00	25,00	-0,20	20,16	3,48	13,00	25,00	0,01
	7.	20,00	3,10	14,00	25,00	-0,11	20,13	2,46	16,00	25,00	0,22
	8.	18,33	4,00	9,00	25,00	-0,73	17,85	3,67	8,00	23,00	-0,01
DIM 6	5.	13,15	3,59	7,00	19,00	0,22	13,67	3,91	6,00	21,00	0,22
	6.	13,74	3,85	5,00	21,00	-0,22	14,37	4,52	6,00	22,00	-0,01
	7.	11,48	4,04	5,00	20,00	0,60	12,61	3,06	8,00	19,00	0,67
	8.	13,11	3,89	6,00	19,00	-0,58	13,85	4,59	6,00	23,00	0,13

N VARIABLES INDEX: DIM1 (dimension 1) intrinsic motivation; DIM2 (dimension 2) extrinsic motivation; DIM3 (dimension 3) personal assessment of the importance of Biology learning; DIM4 (dimension 4) locus of internal control; DIM5 (dimension 5) personal success assessment; DIM6 (dimension 6) anxiety during testing Biology knowledge.

Normality for the experimental group was also tested for all SMQ dimensions (Table 3). The results show a normal distribution of the data.

Table 3: Results of normality testing for students in the experimental group attending grades 5 to 8 (max D-test value; p-level of significance, K-S-Kolmogorn-Smirnov test for normality testing)

	GRADE 5		GRADE 6		GRADE 7		GRADE 8	
	max D	K-S p	max D	K-S p	max D	K-S p	max D	K-S p
DIM1	0,19	p > 0,20	0,15	p > 0,20	0,21	p > 0,20	0,13	p > 0,20
DIM2	0,16	p > 0,20	0,15	p > 0,20	0,19	p > 0,20	0,10	p > 0,20
DIM3	0,19	p > 0,20	0,16	p > 0,20	0,15	p > 0,20	0,17	p > 0,20
DIM4	0,22	p > 0,20	0,15	p > 0,20	0,15	p > 0,20	0,16	p > 0,20
DIM5	0,15	p > 0,20	0,14	p > 0,20	0,17	p > 0,20	0,15	p > 0,20
DIM6	0,13	p > 0,20	0,11	p > 0,20	0,17	p > 0,20	0,19	p > 0,20

Normality was also tested for all SMQ dimensions and for the experimental group (Table 4). The results of normality testing show that all the variables in all grades show normal distribution (p> 0.05), therefore parametric statistical methods were used in further data processing.

Table 4: Results of normality testing for students in the control group attending grades 5 to 8 (max D-test value; p-level of significance, K-S-Kolmogorn-Smirnov test for normality testing)

	GRADE 5		GRADE 6		GRADE 7		GRADE 8	
	max D	K-S p	max D	K-S p	max D	K-S p	max D	K-S p
DIM1	0,21	p > 0,20	0,20	p > 0,20	0,20	p > 0,20	0,26	p < 0,15
DIM2	0,17	p > 0,20	0,23	p > 0,20	0,10	p > 0,20	0,22	p > 0,20
DIM3	0,21	p > 0,20	0,17	p > 0,20	0,16	p > 0,20	0,19	p > 0,20
DIM4	0,16	p > 0,20	0,18	p > 0,20	0,14	p > 0,20	0,15	p > 0,20
DIM5	0,22	p > 0,20	0,16	p > 0,20	0,11	p > 0,20	0,16	p > 0,20
DIM6	0,12	p > 0,20	0,09	p > 0,20	0,19	p > 0,20	0,11	p > 0,20

To determine the statistically significant difference of the respondent sub-samples by groups and grades, in the motivation variable, a t-test (Table 5) was carried out for the mentioned independent variables.

Table 5: T-test results of SMQ among groups of respondents by grades.

	GRADE 5			GRADE 6			GRADE 7			GRADE 8		
	t	p	p-var	t	p	p-var	t	p	p-var	t	p	p-var
DIM 1	0,46	0,65	0,84	0,51	0,61	0,03	0,00	0,97	0,35	0,42	0,68	0,30
DIM 2	0,71	0,48	0,67	-0,84	0,40	0,95	-1,4	0,18	0,87	1,19	0,24	0,53
DIM 3	0,72	0,47	0,34	0,04	0,97	0,73	-1,1	0,27	0,72	1,45	0,15	0,86
DIM 4	-0,05	0,96	0,43	-0,46	0,65	0,85	0,10	0,89	0,83	0,47	0,64	0,77
DIM 5	-0,21	0,83	0,55	-0,23	0,82	0,55	0,20	0,88	0,29	-0,4	0,70	0,72
DIM 6	0,42	0,67	0,71	0,49	0,63	0,47	1,1	0,30	0,20	0,53	0,60	0,50

The results of the t-test show that there is no difference between the experimental and control groups in the sum of the arithmetic mean of each dimension and it can be seen that p> 0.05, while *p-var* implies that the variances are homogeneous and there is no difference between the variances between the observed groups. All students, of both control and experimental groups, were highly motivated to work.

From the descriptive statistics results it can be seen that the arithmetic mean of the first dimension examining intrinsic motivation is above 20 in all grades (except for the grade 8 students, who show a decrease in motivation), which indicates that there is a great intrinsic motivation for learning Science and Biology. Since using Moodle is a new way of working for all students, with a particular challenge for online learning, this probably contributed to their greater motivation to work. The second dimension, which examines extrinsic motivation, also has a large arithmetic mean, which shows how important for students is a good grade on exams, as well as teacher praise, or external reward. In the third dimension examined, by which students evaluate the importance of learning Science and Biology, the arithmetic mean of grade 8 is lower than that of the other grades, as they do not rate learning Biology much important. Younger students find learning Biology and Science important. The fourth dimension, which refers to the locus of internal control, has an arithmetic mean between 18 and 20 in the experimental and control groups. The fifth dimension, which examines how students evaluate their performance, has an arithmetic mean above 20 for all grades except grade 8, where it is lower, which tells us that grade 8 students have worse performance estimates. Lower grade students are rated as more successful. The sixth dimension, which determined the existence of anxiety during Science and Biology knowledge testing, has low arithmetic mean in both the experimental group and the control group (about 13), indicating that students do not experience anxiety in Science and Biology knowledge testing. The anxiety score is good because obviously students did not show high levels of stress when writing tests, which may indicate that they are well prepared for the exams. From the students' answers it can be concluded that sometimes the teaching contents of Science and Biology are interesting to the students because of their subject matter, therefore they learn them out of curiosity without expecting a reward or a grade. It can be said that such students are intrinsically motivated, that is, they have an internal motivation for learning. Gardner (1985) showed that female students are more likely to have an intrinsic interest than male students, which is in contrast to the results of this study, because no statistically significant difference in interest was found with regard to the gender of the students. In teaching practice, it would be good to have a greater number of intrinsically motivated students, who would actively learn and successfully achieve the required educational outcomes. However, we are aware that the major motivational tool for learning is outside the

students themselves in the form of a reward or a grade. Accordingly, the results of the particle analysis examining the second dimension (extrinsic motivation) show that it is important for students to get a good grade in Science and Biology, which correlates with the research conducted by Carlone (2004), Osborne, and Collins (2001), which also showed that part of students show extrinsic interest in natural sciences, such as passing exams or gaining school success. The reward system, which is present in Croatian schools, reduces the occurrence of intrinsic motivation because it rarely encourages creativity, and requires the achievement of certain behaviors that the teacher rewards with an appropriate grade, due to which students are reluctant to do tasks that are not graded (Novoselić et al., 2014). This research also shows a great extrinsic motivation for all students, emphasizing that it is somewhat lower at grade 8 students. It can be said that grade 8 students show a declining motivation to learn Science and Biology and are not influenced either by external rewards. In personal assessment of the importance of learning Science and Biology, the arithmetic means of the experimental and control groups of all grades are also high (around 20.00), the lowest AM of the grade 8 experimental group being 17.67, indicating that students are nevertheless aware of the importance of knowledge of Science and Biology and their impact on their later life, which is in accordance with similar researches (Jenkins, 2005; Osborne and Collins, 2001). The locus of internal control (fourth dimension) is the highest at the youngest students who state that they are preparing thoroughly for the knowledge exam, put effort into learning and, if they encounter a problem, look for a cause. According to Vizek Vidović et al. (2003), students most often mention the following causes of success or failure, which can be classified into three categories: ability / personality traits, motivation / activities, and external factors. Successful students often attribute their success to their own abilities, not to external factors over which they have no control. In contrast, students who experience repeated failure attribute it to bad luck, and if they again experience failure, they attribute it to external factors (teacher attitudes toward the student, difficult tasks in the test, difficult subject). A study by Ames (1992) found that learning-oriented students were more likely to ask themselves how they would better understand certain content, leading them to continuous and quality learning. Therefore, in today's schools it is important to develop the competence of students related to *learn how to learn* and to help them understand the purpose of schooling, which is to acquire knowledge and competencies, and not just to get good grades. The fifth dimension of motivation examines the student's assessment of their own performance, and according to Black and Deci (2000), this group of particles refers to the control of student emotions so that they can be successful in mastering content in Science and Biology. This research has shown that students attending grades 5 and 6 have higher arithmetic means in the fifth dimension and assess themselves as more successful than their older schoolmates

believing they can achieve excellent success in Science and Biology. It is good for younger students to believe in themselves and their abilities, but the question is how to maintain that belief in themselves in the later years of schooling, since student belief in their own abilities and high appreciation of school success is an important factor in their future school achievement. The last, sixth dimension of motivation, which relates to feelings of anxiety during the assessment of knowledge in Science and Biology, shows that the students who participated in the research do not feel great anxiety during the assessment of knowledge in these subjects, but still they do show some anxiety. We describe anxiety itself as a state of fear, tension, or insecurity that is caused by a particular situation. Active, continuous learning and a thorough preparation of the students, both for the classes and for the knowledge assessment, will certainly reduce and overcome the feeling of anxiety. Vizek Vidović et al. (2003) state that ambitious students care about achieving great success, make great efforts, but at the same time they are overwhelmed by the fear of failure, and may therefore experience anxiety. The results of the research show that students are motivated to learn Science and Biology, but it is significant that the lowest motivation is present at the oldest students attending grade 8, when they should soon choose their future school, vocational or grammar school. The question arises about their motivation in other teaching subjects and their guiding principle in choosing the future school, which correlates with the research of Güvercin, Tekkaya, and Sungur (2010), which also showed that student motivation declines with the years of schooling. The traditional paradigm of teaching with the prevailing frontal teaching has dominated the Croatian schools, and only recently has there been a trend towards a more modern teaching with an active student and the application of modern learning resources at the center. As traditional teaching is not a motivational learning environment, teaching that is dominated by active teaching methods, research-based learning that arouses curiosity, linking curriculum content to everyday life, e-learning, complete online learning can have a motivating effect and motivate the student to learn. Students who are motivated to learn will acquire competencies that will enable them to be active and aware citizens who are responsible for themselves, society and the environment. In future research, it would be interesting to analyze the motivation to learn Biology in students attending grades 7 and 8 of many primary schools as well as high school students, and compare the results.

Conclusions and Practical Implications

The research examined the impact of online learning on student motivation for learning Science and Biology, and found no statistically significant difference between subgroups of respondents (control and experimental groups) regarding their motivation to learn Science and Biology. Such a conclusion suggests that

teaching in an online environment also strongly motivates students to learn, as does modern teaching that uses active methods of teaching and class work. All students, both of experimental and control groups, were highly motivated to learn, and no statistically significant difference was observed in any of the tested dimensions of motivation. The results of the t-test showed that in all examined dimensions (intrinsic motivation, extrinsic motivation, personal assessment of the importance of learning Biology, locus of internal control, personal assessment of one's own performance, anxiety during testing the knowledge of Biology) a high student motivation is present and it can be concluded that for all grades, for all dimensions examined, there is no difference among the variances or between the observed subgroups. In the context of global social changes in the education system, it is essential to change the approach to acquiring students' basic competences. As a good teacher competency profile is a prerequisite for acquiring student competences during the formal education of future teachers and their professional development, special attention should be paid to the development of digital competence of future and current teachers, since only a digitally competent teacher will be able to develop digital competence in students for the purpose of better understanding and application of knowledge in the field of natural sciences. Certainly one of the ways is using e-learning systems that can be a tool to promote better understanding.

Research Limitations and Suggestions for Further Research

The efforts of the teacher to design and upload Science and Biology teaching contents on the e-learning system need to be mentioned, since there were no ready-made, designed contents for these elementary school subjects. Therefore, it would be a good idea to share already designed contents so that other teachers could use them as well. The challenge was to communicate with the students of the experimental group, which took place exclusively via e-messages.

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