STUDIA UNIVERSITATIS MOLDAVIAE, 2019, nr.5(125)
Seria "Științe ale educației" ISSN 1857-2103 ISSN online 2345-1025 p.79-86

CZU: 378.147.333:57

THE EFFECTS OF ICT INTEGRATED LEARNING ON MOTIVATION AND SELF-EFFICACY TO LEARN BIOLOGY

Ghalib BADARNE

Kaye College Israel,
Tiraspol State University

The following article focuses on the effects of ICT integrated learning on motivation and self-efficacy to learn biology. Implementation of ICT in biology classes offers a lot of opportunities for teaching-learning process, and through pedagogical experiment was researched the opinion of students regarding the influence of ICT lessons in biology on their motivation, self-efficacy, meaningful learning and the opinion about the implementation of ICT in biology learning.

***Keywords**: ICT, Teaching and learning biology, pedagogical experiment, motivation, self- efficacy, meaningful learning.*

EFECTELE ÎNVĂȚĂRII PRIN INTEGRAREA MIJLOACELOR TIC ASUPRA MOTIVAȚIEI ȘI AUTOEFICACITĂȚII DE A ÎNVĂȚA BIOLOGIA

În articol sunt abordate efectele învățării integrate TIC asupra motivației și autoeficacității de a învăța biologia. Implementarea TIC în clasele de biologie oferă numeroase oportunități pentru procesul de predare-învățare. Prin experimentul pedagogic a fost studiată opinia elevilor cu privire la influența lecțiilor TIC în biologie asupra motivației, eficacității lor, învățării semnificative, precum și opinia despre necesitatea implementarii TIC pentru studierea biologiei.

***Cuvinte-cheie**: TIC, predarea și învățarea biologiei, experiment pedagogic, motivație, autoeficacitate, învățare semnificativă.*

Introduction

The integration of digital tools into the teaching process represents, in the informational age, one of the priorities of education policies worldwide. This essentially contributes to the opening of new horizons for educational practice in facilitating information processing, presentation processes and building knowledge.

Research on the implementation of Information and Communication Technologies (ICT) in the teaching process of pre-university education has been increasing over the last decades. These are partly motivated by educational reforms, including the Education - 2020 strategy, geared to the formation and development of skills specific to the 21st century.

Every student has opportunities to become more active and to have greater motivation by using of ICT in learning process [1].

The use of IT in secondary biology teaching offers an enormous potential, although it is a huge challenge for newcomers. Learning software and the web can offer a variety of opportunities for learning, ranging from non-interactive content provision to highly interactive student-centred learning experiences [2]. ICT integration and implementation in biology facilitates learning process by bringing educational content closer to students, and contributes to the revision, acquisition and usage of knowledge. In this way the educational process is integrated into technological-informational age. The advantages of ICT use in teaching-learning process are:

1. The multispectral development of students personality, at all levels, including those with special learning needs;
2. The realization of greater number of tasks that contribute to the achieving of goals of the lesson;
3. Merging and expanding of multiple types of knowledge;
4. The encourage of creativity and enhance of research skills;
5. The development of communicative and collaborative skills, due to the turning of student's individual work into collective work etc. [3].

Material and methods

This work is aimed to researches who study the effects of ICT integrated learning on motivation and self-capability to learn biology, through a pedagogical experiment which took place in 9th grades classes of a junior high school, in the northern district of Israel. The distribution of pupils on samples is presented in table 1.

Table 1

The research samples according to classes and gender

	Control group			Experimental group			
Class	**9A**	**9B**	**Sum**	**9C**	**9D**	**9E**	**Sum**
Boys	17 (56,7%)	17 (58,6%)	**34 (57,6%)**	16 (53,3%)	13 (46,4%)	13 (46,4%)	**42 (48,8%)**
Girls	13 (43,3%)	12 (41,4%)	**25 (42,4%)**	14 (46,7%)	15 (53,6%)	15 (53,6%)	**44 (51,2%)**
Number of students	30	29	**59**	30	28	28	**86**
Number of participants in total: 145							

The main scientific problem of research is *determining the theoretical and methodological fundamentals of improving the teaching-learning-evaluation process in biology through the using of Informational and Communicational Technologies*.

1. One of the research questions is *to what extent does the ICT integrated learning affect the motivation and self- efficacy to learn biology among the learners*?

The research hypothesis was established: *the motivation and self-efficacy in learning among students who learned biology by the ICT method are significantly higher in comparison to motivation and self-capability dimensions among students learning by the traditional method*.

In order to examine this research hypothesis, a variance ANOVA test was conducted, as it is shown on table 2 below:

Table 2

ANOVA-type test to examine differences in levels of motivation and self-efficacy in learning in a comparison between the control groups and the experimental groups

Class	Mean (scale 1-4)	Standard deviation	$F_{(4, 139)}$
9th grade 1	3.37	0.55	2.10
9th grade 2	3.41	0.41	
9th grade 3	3.57	0.39	
9th grade 4	3.22	0.51	
9th grade 5	3.28	0.54	

The data in Table 1 show that there is no significant difference ($F(4,139) = 2.10$, $p > 0.05$) between motivation and self-efficacy in comparison between the control groups (classes 1, 2) and the experimental groups (classes 3, 4, 5). That is to say, the first hypothesis is that motivation and self-efficacy in learning among students who learned biology by the ICT method are significantly higher in comparison to the dimensions of motivation and self-efficacy in learning among students studying in the traditional method was refuted.

In order to examine this research question, the average and standard deviation were calculated for attitudes toward motivation and ability among the study population.

In the questionnaire, nine statements were presented to the subjects who presented positions on motivation and self-efficacy, the subjects were asked to scale their level of consent regarding the statement on a scale increases from 1 to 4, (4 – Definitely agree, 1 – Definitely disagree).

Table 3

Mean and Standard Deviation of the Motivation and Self-efficacy Scale among the Study Population

No.	Statement (N=145)	Average	Standard deviation
1	I am happy that I learn biology with ICT	3.61	0.66
2	I think I'll receive a high score in biology with ICT	3.43	0.74
3	The integration of ICT will help me to understand the material	3.59	0.68

4	I will be more concentrated in the biology class when it is integrated with ICT	3.39	0.77
5	With ICT, I can succeed in biology even without the help of the teacher	2.85	0.89
6	I'm sure I can do a really good job in papers and tests in ICT integrated biology	3.39	0.75
7	ICT integration makes biology more interesting	3.62	0.61
8	Learning ICT integrated biology is hard for me	3.26	0.87
9	Learning in an ICT environment cause difficulties and stress during the lesson	3.26	0.92
	Weighted Score	**3.77**	**0.24**

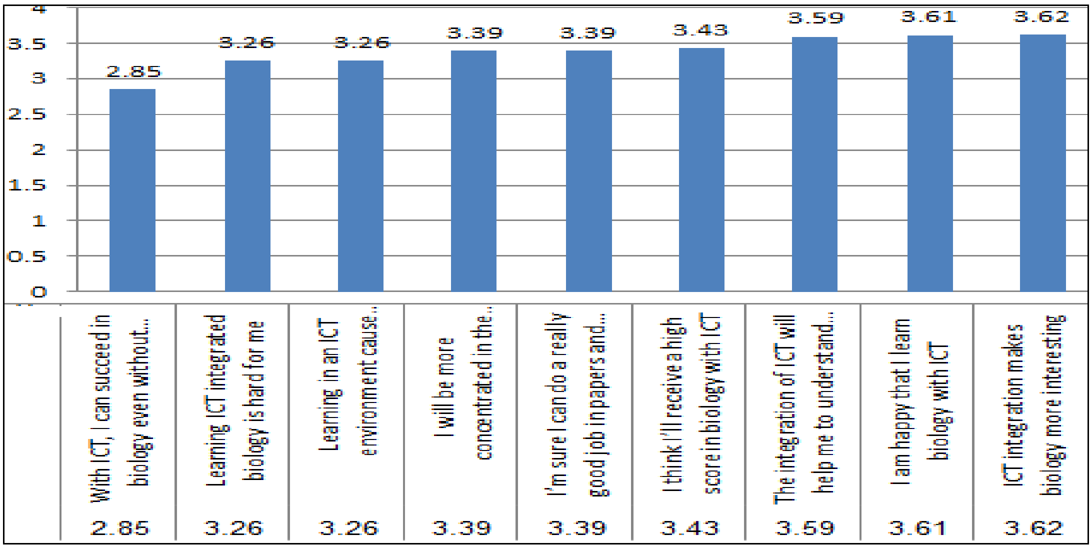

Fig.1. Mean of motivation and self-efficacy scale.

Table 3 and Fig.1 present averages and deviations of the statements. The findings indicate that the students expressed positive attitudes at a high level toward ICT in terms of its abilities to raise their motivation and self-efficacy in learning biology. The range of answers ranges from "I can succeed in biology without the help of the teacher" (M = 2.85, SD = 0.89); to "The integration of ICT makes the biology subject more interesting" (M = 3.62, SD = 0.61). The weighted grade of the students' positions in the 9 items about motivation is 3.77 (scale 1-4) (SD = 0.24). The Cronbach alpha coefficient, which indicates the internal consistency (reliability) between the items, is α = 0.849, indicating high reliability. In addition, the rates of motivation and self-efficacy were examined for the online lessons reported by the students from all five classes. These lessons appear in ascending order, broken down by grade, in Fig.2 below:

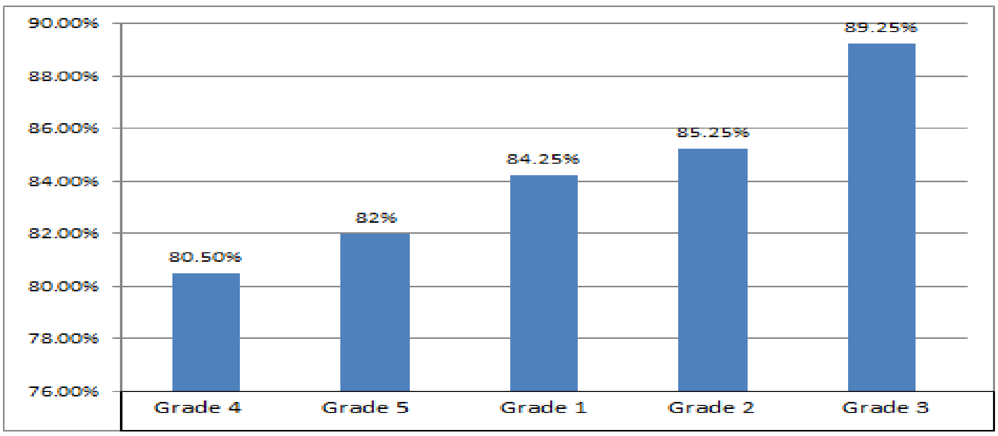

Fig.2. Students' motivation and ability rates in ICT biology lessons.

Fig.2 shows that all students from all five classes, regardless of the experimental groups and control groups, reported very high rates of motivation and self-efficacy because of the online lessons. The reports of the participants in the control groups were based on their ongoing experiences in ICT learning, outside the intervention framework of this study. Students of class number 3 reported the highest rate 89.25% of motivation and self-efficacy, after them are classes: number 2 (85.25%), number 1 (84.25%), number 5 (82%), and finally number 4 (80.50%). In conclusion, the significance of these findings in the research question is that <u>all students think that the ICT lessons in biology significantly improve their motivation and self-efficacy.</u>

2. Another research question is *what is the attitude of students towards integrating ICT in biology lessons?*

Regarding to this question was established the research hypothesis: *Students who studied biology by the ICT method will show more positive attitudes toward ICT in comparison to students who studied by the traditional method*.

To examine this hypothesis, a variance ANOVA test was conducted as shown in Table 4 below.

Table 4

ANOVA-type variance test to examine differences in attitudes toward ICT in comparison between control groups and experimental groups

Class	Mean (scale 1-4)	Standard deviation	$F_{(4, 139)}$
9th grade 1	3.26	0.42	1.69
9th grade 2	3.19	0.40	
9th grade 3	3.41	0.36	
9th grade 4	3.19	0.49	
9th grade 5	3.11	0.58	

The data in Table 4 indicate that there is no significant difference ($F(4,139) = 1.69$, $p > 0.05$) in attitudes towards ICT in comparison between the control groups (classes 1, 2) and the experimental groups (classes 3, 4, 5). In other words, the second hypothesis is that students who have studied biology by the ICT method will show more positive attitudes toward ICT compared to students who studied by the traditional method, was refuted.

In order to examine this research question, the average and standard deviation were calculated for the components of the variable, student attitudes. In the research questionnaire, the respondents were presented with nine statements that represent students' attitudes toward the integration of ICT in biology classes, the subjects were asked to rate their agreement on a scale from 1 to 4 (4 – definitely, 1 – strongly disagree). Table 5 presents averages and standard deviations of the statements.

Table 5

Averages and Standard Deviation of the Scale of Student Attitudes toward the Integration of ICT in Biology classes

No.	Statement (N=145)	Average	Standard deviation
1	I would want every lessons at school will be ICT integrated	3.4	0.84
2	Studying ICT integrated biology bore me	3.35	0.85
3	I think learning biology with ICT is more interesting than the regular method	3.5	0.71
4	I believe than learning in an ICT environment will help me in the future as well	3.48	0.7
5	In your opinion, the learning with ICT was/will be different from learning as you've learned this far?	3.23	0.71
6	I am pleased that I studied / will study biology this year in with ICT.	3.36	0.78
7	Do you prefer to study and test in ICT integrated biology rather than the usual frontal method?	3.34	0.8
8	If you could choose, would you choose to study online units in other subjects as well?	3.44	0.79

9	The theoretical exam is more appropriate to check that the student is good in biology than the ICT exam	2.14	1.03
Weighted Score		**3.24**	**0.42**

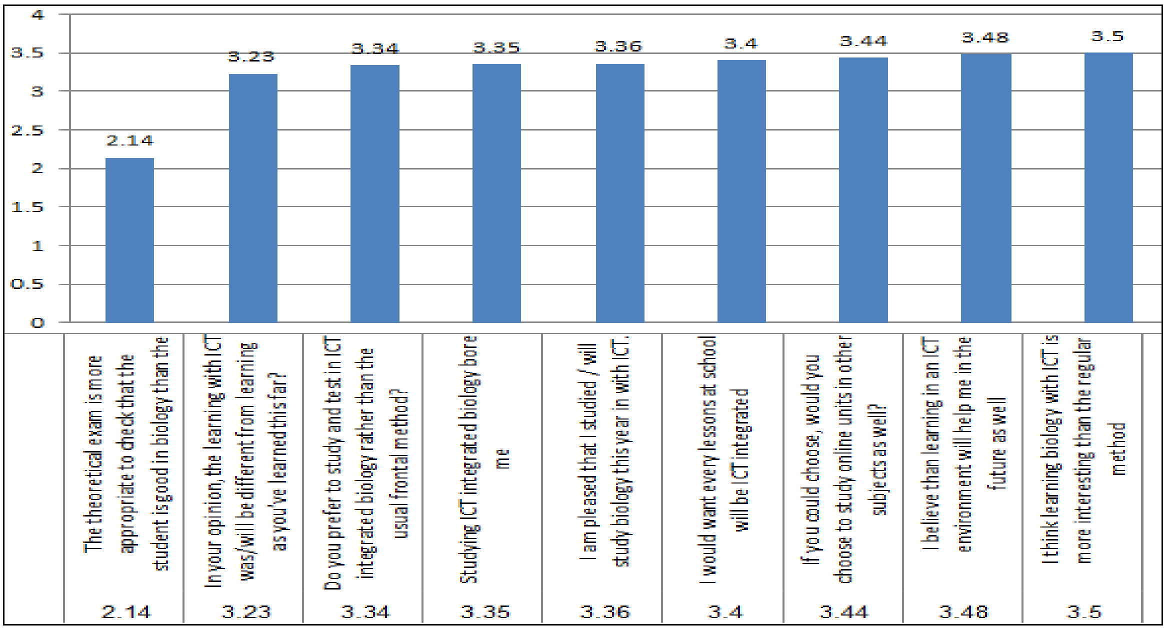

Fig.3. Average of students' attitudes toward the assimilation of ICT in the biology class.

Table 4 and Fig.3, which display the statements in ascending order according to the average value, show that the students expressed very positive attitudes towards the assimilation of ICT in biology classes. The average positions ranged from "The theoretical exam more appropriate to check that the student is good in biology from the ICT aspect?" (M = 2.14, SD = 1.03) to "I think it is more interesting to study biology using ICT than the usual method" (M = 3.5, SD = 0.71). The weighted score of the students' positions in the 9 items regarding attitudes toward ICT integration is 3.24 (scale 1-4) (SD = 0.42). The Cronbach alpha coefficient, which indicates the internal consistency (reliability) between the items, is α = 0.721, which indicates high reliability.

Additionally, the rates of attitudes of all students, experimental and control groups, were examined with regard to the online lessons. These rates appear in ascending order, broken down by grade, in Fig.4. below.

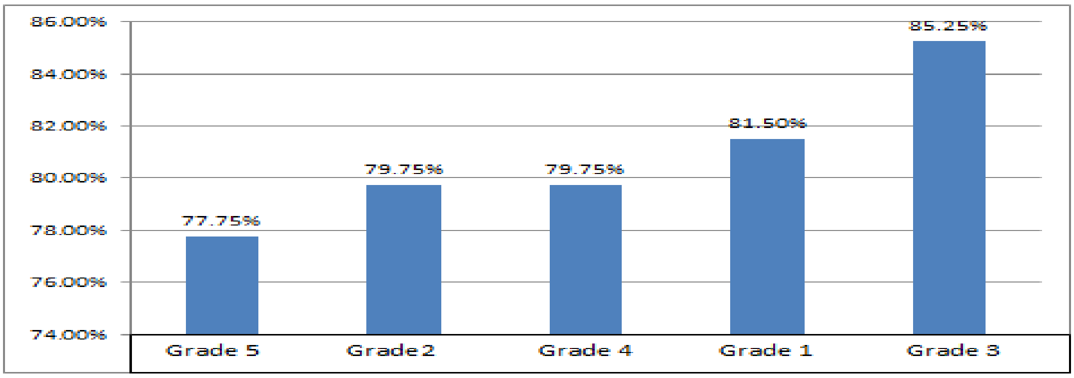

Fig.4. Attitudes of all students, experimental and control groups toward the rates of ICT biology lessons.

Fig.4 shows that students from five 9th grades, from the experimental and control groups, expressed very positive attitudes towards the online learning of biology. Students of class 3 showed the most positive attitudes among all participants at the rate of 85.25%, followed by class 1 students (81.5%), followed by class 2 and 4 who showed positive attitudes at a high and similar rate of 79.75%, and finally, class 5 which also showed positive attitudes at a high rate of 77.75%. To conclude, the significance of these findings is that the students, whether in the experimental group or in the control group who experienced the biology subject during regular school sessions, not necessarily in the current research, have shown positive and significant attitudes towards ICT learning of the biology subject.

3. Next research question is *does the integration of ICT in biology lessons improve students' meaningful learning*?

Regarding to this question was established the research hypothesis: *Students who studied biology by the ICT method will report that learning is more meaningful for them than for students who studied by the traditional way*.

In order to examine this hypothesis, a different ANOVA test was conducted as shown in Table 6 below.

Table 6

ANOVA-type variance test to examine differences in meaningful learning concepts by comparison between control groups and experimental groups

Class	Mean (scale 1-4)	Standard deviation	$F_{(4, 139)}$
9th grade 1	3.37	0.44	1.54
9th grade 2	3.40	0.42	
9th grade 3	3.52	0.42	
9th grade 4	3.28	0.50	
9th grade 5	3.23	0.59	

The data in Table 6 indicate that there is no significant difference ($F (4, 139) = 1.54$, $p> 0.05$) in the significant learning concepts compared to the control groups (classes 1,2) and the experimental groups (classes 3,4,5). In other words, the third hypothesis that students who studied biology by the ICT method will report that learning is more significant for them than for students who studied by the traditional method was disproved.

For this question the average and standard deviation were calculated for attitudes towards significant learning in ICT integration among the study population.

In the questionnaire, the respondents were presented with nine statements that presented attitudes toward meaningful learning. The interviewees were asked to rate their agreement to a scale of 1 to 4 (4 – definitely agree, 1 - strongly disagree).

Table 7

Averages and standard deviation of the ICT integration scale in the study of biology and significant learning

No.	Statement (N=145)	Average	Standard deviation
1	In the integrated biology class, I am more active than in a regular lesson	3.36	0.75
2	In ICT integrated biology lesson I also learn from classmates (not just from the teacher)	3.26	0.74
3	In ICT integrated biology lessons, we waste time in class	3.41	0.88
4	I can help others in ICT integrated biology lessons	3.26	0.75
5	In e-biology classes I can express my own ideas	3.16	0.76
6	The ICT biology lessons have caused me pleasure and a learning experience	3.51	0.68
7	Learning biology in a leading ICT environment can lead to a sense of involvement in learning	3.42	0.76
8	Learning biology in ICT environment contributes to the development of knowledge	3.53	0.62
9	Teaching biology in an ICT environment encourages learning related to everyday life	3.34	0.76
Weighted Score		**3.36**	**0.12**

Table 7 and Fig.5 show that the students reported a very high level of meaningful learning because of learning through the assimilation of ICT in teaching biology (grades 3 + 4). The average range of student responses was between "I can express my own ideas" (M = 3.16, SD = 0.76) to "Learning biology in the ICT environment contributes to the development of knowledge" (M = 3.53, SD = 0.62). The weighted score of the students' attitudes in the 9 items about the significant learning is (M= 3.36, SD= 0.12) All of this on the Likert scale of (1-4), the Cronbach alpha coefficient, which indicates the internal consistency (reliability) between the items, is α = 0.858, which indicates high reliability.

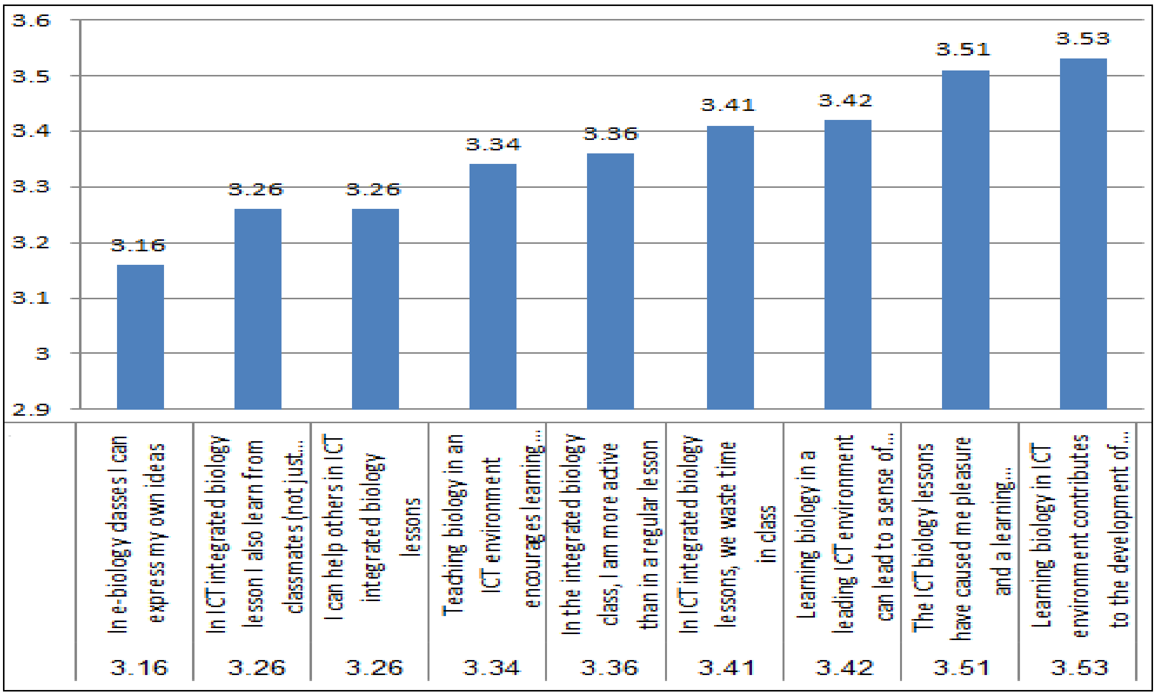

Fig.5. Means of the significant learning scale in ascending order.

In addition, the meaningful learning rates of all students, control and experimental, in ICT lessons were examined. These rates appear in ascending order, broken down by class, in Fig.6 below.

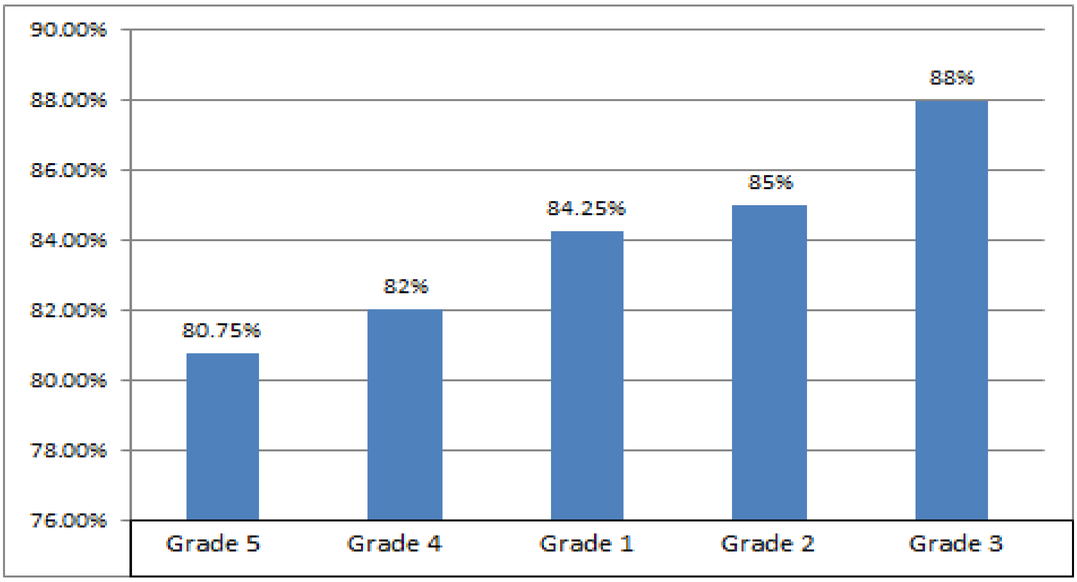

Fig.6. Perceptions of all students, experimental and control groups,
toward the significant learning rates of the biology subject, using the ICT lessons.

According to Fig.6, all students in the experimental and control groups reported very high rates of significant biology learning in online lessons. Students of class number 3 reported on the highest level of meaningful learning of all the other students from the other classes, in a rate of 88%, after which students of class 2 (85%), 1 (84.25%), 4 (82%), and finally students of class number 5 who reported meaningful learning at a high rate of 80.75%. In conclusion, the significance of these findings is that all students, whether they are students of the experimental group who have experimented with the ICT learning of biology as part of the intervention in the present study or whether they are students of the control groups who have experimented with online learning of biology lessons in the course of regular school-based learning rather than in the intervention of the current study, who responded to this research question, reported that ICT biology classes are best for improving their meaningful learning.

In summary, table data (3, 5, 7) and figures (1, 3, 5) indicate that the responses of the participants ranged on the average between "ICT integration makes biology subject more interesting" (M = 3.62, SD = 0.61); to "the theoretical examination is more appropriate to check that the student is good in biology from the online aspect" (M = 2.14, SD = 1.03). Meaning, the participants found positive attitudes at a very high level towards the assimilation of ICT in biology classes, in all ways and aspects.

Conclusions

Use of ICT in biology classes offers a lot of opportunities for teaching-learning process, and this is confirmed by the opinion of all students that the ICT lessons in biology significantly improve their motivation and self-efficacy. Another finding of experiment is that students have shown positive and significant attitudes towards ICT learning of the biology subject. Also, all students, who responded to research questions, reported that ICT biology classes are best for improving their meaningful learning. So, ICT means have a positive influence on motivation, self-efficacy, meaningful learning of students and they welcome the implementation of ICT in biology learning.

References:

1. DELIĆ-ZIMIĆ, A., GADŽO, N. Implementation of ICT in Education. In*: Proceedings of the International Symposium on Innovative and Interdisciplinary Applications of Advanced Technologies. IAT 2017: Advanced Technologies, Systems, and Applications II*. p.215-222.
2. PEAT, M., FERNANDEZ, A. The role of information technology in biology education: an Australian perspective. In: *Journal of Biological Education*, vol.34, 2000, Issue 2, 2010, p.69-73.
3. STAVREVA-VESELINOVSKA, S., KIROVA, S. Application of ICT in teaching biology (Example of a lesson). In: *Proceedings TIO 2016: The 6th International Conference Techniques and Informatics in Education*. ČAČAK, 28-29th May 2016. p.290-300.

Date despre autor:
Ghalib BADARNE, Kaye College Israel, PhD student, Tiraspol State University.

Prezentat la 04.04.2019