

BIOLOGY TEACHERS' ATTITUDES TOWARD COMPUTER ASSISTED LEARNING

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Abstract – Based on the new technology initiative in Serbian education, we explored primary school teachers' attitudes toward Computer Assisted Learning (CAL) in biology teaching, as well as the relationships between the teachers' attitudes and four independent variables: age, teaching experience, teachers' competence to use modern teaching aids and their professional advanced training in the field of computer applied learning. Fifty-four elementary school biology teachers from Novi Sad participated in the study. The findings suggested that the teachers generally had positive attitudes toward CAL in biology teaching. Correlation analyses revealed significant relationships between age, teaching experience, teachers' competence to use modern teaching aids in the teaching process, professional advanced training in the field of computer applied learning, and the teachers' attitudes toward CAL. We offer suggestions for further research in this field.

Key words: Computer Assisted Learning; attitudes; biology teachers; elementary education

INTRODUCTION

The last two decades have witnessed a worldwide proliferation of information and communication technologies (ICT) in the field of education. ICT is not only a backbone of the Information Society, but also an important catalyst and a tool for inducing educational innovation that changes the learning style of pupils (Pelgrum, 2001). A factor that determines educational innovation in general is teachers, as they are the users of ICT resources for educational development. Since technology does not have an educational value in itself, it becomes important when teachers apply it in the learning-teaching process (Tezci, 2009).

In advanced countries around the world, various learning models that support ICT resources are widely used. One such learning model is Computer Assisted Learning (CAL). CAL is an educational method that uses computers as an environment in which learning occurs, strengthening the learning

period and the pupils' motivation, and it can be useful for pupils to improve their learning speeds. This educational method is formed by combining a computer technology and learning principles by oneself (Hancer and Tüzeman, 2008). The research results of many authors around the world have confirmed that the CAL method in biology teaching contributes to its greater effectiveness (Cepni et al., 2006; Efe and Efe, 2011; Katircioglu and Kazanci, 2003; Yusuf and Afolabi, 2010), and greater motivation of the pupils (Ferrer, 2002; Kubiato and Halakova, 2009; McKinnon et al., 2000; Yu, 1998) in comparison to traditional teaching.

In the Republic of Serbia, very little is known about the application of CAL in biology teaching. There are publications on the different types of software for elementary school biology classes, which are designed according to the CAL model (the publishers are Zavod za udžbenike, Multisoft, Kvarak Media, Klett, Bigz). However, research into their effectiveness has not been carried out yet. Since the

Table 1. Background characteristics of respondents

Variables		f (N)	%
Age of Respondents	from 25 to 30 years old	10	18.52
	from 31 to 35 years old	9	16.67
	from 36 to 40 years old	12	22.22
	from 41 to 45 years old	6	11.11
	from 46 to 50 years old	2	3.70
	from 51 to 55 years old	6	11.11
	from 56 to 60 years old	9	16.67
Teaching experience	Up to 5 years	12	22.22
	from 6 to 10 years	11	20.37
	from 11 to 15 years	11	20.37
	from 16 to 20 years	3	5.56
	from 21 to 25 years	7	12.96
	from 26 to 30 years	4	7.41
	31 years and more	6	11.11

CAL teaching method cannot be applied without a sufficient number of computers in the classroom, a possible reason for its minimal and inadequate representation in biology teaching and the teaching of other subjects is the poor technological equipping of our schools (Drakulić et al., 2011). Considering that the Ministry of Education, Science and Technology Development has invested immense efforts in equipping schools with sufficient numbers of computers for years now, it is to be expected that computers, and thereby the CAL teaching method, are going to get their proper place in the Serbian educational system.

Application of a CAL model, in teaching, depends on the general attitude of teachers towards a particular model (Huang and Liaw, 2005; Rovai and Childress, 2002), age and teaching experience (Handler, 1993; Massoud, 1991; Woodrow, 1992), application of computers in the classroom (Teo, 2008; Zhao et al., 2001), teachers' competence in its application (Yuen et al., 1999), and professional advanced training (Tsitouridou and Vryzas, 2003). Starting from these findings, the main aim of this study was to find out the general attitudes of Serbian primary school teachers toward CAL in biology teaching. Further-

more, the aim was to explore the relationship among the general teachers' attitudes toward CAL and other variables related to the teachers' personal background: age, teaching experience, teachers' competence to use modern teaching aids in the teaching process, as well as the professional advanced training in the field of computer applied learning.

MATERIALS AND METHODS

Respondents

Respondents in this study were 54 biology teachers from 15 elementary schools in Novi Sad. The schools were randomly selected from the 33 elementary schools existing in Novi Sad. The background characteristics of respondents (age and teaching experience) are presented in Table 1.

The research instrument

The research instrument was a questionnaire developed by the author. It was pilot-tested on a group of biology teachers. After revision of the instrument based on the pilot-test results, 81 questionnaires were distributed to randomly selected teachers. Fif-

ty-four usable questionnaires were returned for a response rate of 67%. The research was carried out in the school year 2011/2012.

The questionnaire consisted of four parts. The first part included two questions related to age and teaching experience. The second part included a question examining the general attitude of teachers to CAL application in biology teaching. A 20-item Likert scale was designed for measuring the teachers' general attitudes toward CAL. Respondents answered by using a five-point scale with the following answers: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). Seven items were negatively worded and the rest were positively worded. The reliability for the whole scale was high ($\alpha = 0.87$).

The third part of the questionnaire included a question asking the teachers to assess their own competence in the practical application of modern teaching aids and devices in the teaching process. This question was designed according to the five-point Likert Scale, and the answers were scored from 5 (very competent) to 1 (very incompetent). The last part of the instrument included a question related to the professional advanced training in the field of computer application in biology teaching.

Data analysis

Both descriptive and correlation analyses were used for the data analysis in order to examine the research questions. Correlation analysis was used to determine relationships among the teachers' attitudes toward CAL and the selected variables. Significance was accepted when $p < 0.05$. All analyses were conducted in SPSS 14.0 software.

RESULTS AND DISCUSSION

Teachers' attitudes toward CAL in biology teaching

The main aim of this study was to examine teachers' attitudes toward CAL in biology teaching. Distribution of results for each individual statement on the

application and significance of CAL in biology teaching is shown in Table 2.

Analysis of the results (Table 2) showed that elementary school biology teachers have a positive attitude toward the application of CAL in biology teaching. This statement was confirmed by obtained mean values for each individual claim, being a base for drawing conclusions on the degree of their acceptance in the scale. The most accepted claim, item no. 1 – “*I would like to have more opportunities to apply CAL in my school*”, and the least accepted claim, item no. 2 – “*I would not apply CAL in biology teaching*” demonstrated a significant willingness of teachers to accept and apply CAL in biology teaching.

The total score of all items for every individual teacher was determined on this scale in order to complete the analysis of the teachers' attitude toward CAL. Negative statements were excluded from the calculation, as they related to the rejection of CAL, while the statements of teachers who preferred this model of work were awarded small values (1 or 2). The results of the teachers' attitude toward CAL are presented in Table 3.

By applying this division of attitude intensity (Table 3), it was found that every other teacher (62.96%) fell into the category of moderately positive attitude toward CAL in biology teaching; 24.07% of the teachers had a strong positive attitude, and 9.26% of them were in the category of wavering. Only 3.70% of teachers fell into the category of moderately negative attitude, while no teacher had an extremely negative attitude toward CAL in biology teaching. Such positive attitudes toward CAL application in education were confirmed by other similar studies conducted in the other countries (Albirini, 2006; Sadik, 2006; Yunus, 2007).

Teachers' perceptions in terms of factors related to attributes toward CAL

Age and teaching experience

Examining the influence of these two independent

Table 2. Distribution of results for each individual statement on the application and significance of CAL in biology teaching

No.	Items	Percent (%)					Mean
		SD	D	N	A	SA	
1	I would like to have more opportunities to apply CAL in my school.	0.00	0.00	3.70	27.78	68.52	4.65
3	CAL allows easier and faster understanding and adoption of knowledge of biology than traditional teaching	1.85	1.85	11.11	44.44	40.74	4.20
5	CAL provides better quality and quantity of knowledge of biology.	0.00	0.00	20.37	59.26	20.37	4.00
6	CAL more contributes to a greater durability and application of acquired knowledge than the conventional way of teaching	0.00	0.00	22.22	59.26	18.52	3.96
8	CAL allows more autonomy in the pupils' work and higher cognitive activity in the classroom than the traditional way of teaching.	0.00	3.70	14.81	40.74	40.74	4.19
9	CAL may be more interesting way of learning than the classical approach in teaching.	0.00	0.00	7.41	50.00	42.59	4.35
11	CAL provides greater attention and discipline of pupils in the learning process than the traditional way of teaching.	0.00	3.70	18.52	48.15	29.63	4.00
12	CAL provides more dynamic in the biology teaching than the conventional way of teaching.	3.70	1.85	12.96	57.41	24.07	3.96
13	CAL allows higher level of teaching individualization than the traditional teaching.	0.00	0.00	9.26	53.70	37.04	4.28
15	CAL provides a more relaxed atmosphere in the classroom, since pupils are more motivated to learn.	3.70	1.85	20.37	50.00	24.07	3.89
16	CAL enables more efficient monitoring and objective evaluation of the pupils' work.	3.70	9.26	44.44	22.22	20.37	3.46
17	Unlike traditional teaching, CAL allows better control of pupils over their own progress.	3.70	3.70	14.81	50.00	27.78	3.94
18	CAL requires greater responsibility of pupils for the results of their work and progress in learning.	5.56	5.56	14.81	50.00	24.07	3.81
2*	I would not apply CAL in biology teaching.	72.22	14.81	9.26	3.70	0.00	1.44
4*	It seems to me that the application of CAL is more harm than good.	59.26	18.52	18.52	0.00	3.70	1.70
7*	It is more useful for pupils to attend traditional lectures than to waste time dealing with the preparation of CAL software for the biology lessons.	40.74	35.19	9.26	11.11	3.70	2.02
10*	CAL application inhibits teachers' creativity.	46.30	31.48	14.81	7.41	0.00	1.83
14*	CAL may cause the 'impoverishment' of the teacher-pupil relationship, because it reduces the frequency of contacts between teachers and pupils.	20.37	38.89	18.52	18.52	3.70	2.46
19*	Our teaching is good enough even without use of computers.	27.78	42.59	12.96	14.81	1.85	2.20
20*	There is no valid reason why the teachers should be convinced to apply computers in the classroom.	59.26	31.48	7.41	1.85	0.00	1.52

SD, strongly disagree (1); D, disagree (2); N, neutral (3); A, agree (4); SA, strongly agree (5)

* Represent negative items

Table 3. General teachers' attitude toward CAL in biology teaching

Intensity of an attitude:	Scale value	f (N)	%
strongly negative	up to 1.50	0	0.00
moderately negative	from 1.51 to 2.50	2	3.70
wavering	from 2.51 to 3.50	5	9.26
moderately positive	from 3.51 to 4.50	34	62.96
Strongly positive	from 4.51 to 5.00	13	24.07

Table 4. Teachers' competence to use teaching aids and devices

How much are you competent to use teaching aids and devices?	Percent (%)					Mean
	VI	SI	NC	SC	VC	
Overhead Projector	0.00	1.85	0.00	14.81	83.33	4.80
TV Set	0.00	0.00	0.00	16.67	83.33	4.83
Video Recorder	1.85	0.00	7.41	16.67	74.07	4.61
Computer	3.70	5.56	11.11	38.89	40.74	4.07
Video Beam Projector	22.22	7.41	7.41	20.37	42.59	3.54
Multimedia programs (Power Point, Flash, Photoshop, Paint)	9.26	24.07	16.67	48.15	1.85	3.09
Educational Software	38.89	42.59	11.11	7.41	0.00	1.87

VI, very incompetent (1); SI, somewhat incompetent (2); NC, neither competent (3); SC, somewhat competent (4); VC, very competent (5)

Table 5. Teachers' responses on professional advanced training in order to apply computers in biology teaching

Have you received some form of advanced training in order to introduce and use computers in biology teaching?	f (N)	%
No	26	48.15
Seminars	26	48.15
Lectures	1	1.85
Other	1	1.85

Table 6. Correlation of teachers' advanced training in the field of computer application in biology teaching, and their general attitudes on CAL in biology teaching

	Attending seminars	N	M	SD	SE	Significance of differences
Teachers' general attitude on CAL in biology teaching	Attended	27	4.37	0.629	0.121	t (52) = 3.42 p<0.01, η= 0.429
	Not attended	27	3.77	0.640	0.123	

variables on the teachers' attitude toward CAL, correlation analysis showed that both age ($r = -0.408$, $p < 0.01$) and teaching experience ($r = -0.370$, $p < 0.01$) influenced the teachers' attitude toward CAL. The obtained results indicated that as the age and teaching experience increased, the teachers' attitude toward CAL application was more negative.

In the research literature, there were different findings from various studies in terms of teachers' attitudes and age. For example, while some studies found that there was no significant relationship between teachers' age and attitudes (Handler, 1993; Massoud, 1991; Woodrow, 1992), other studies found that age had critical effects on the teachers' attitudes

(Blankenship, 1998; Cavas et al., 2009). As quoted in Cavas et al. (2009), Deniz (2005) found that the age of 36 was the breaking point for positive attitudes of elementary school teachers. A positive attitude of most teachers toward CAL in this research was confirmed by Deniz's research, since most teachers from the sample were younger than 36.

Korte and Hüsing (2006) also emphasized that experience was a significant factor for introducing ICT resources in teaching. These authors found that the most negative attitudes toward computer applied learning were in Spain (52%), Sweden (48%) and Iceland (47%), although they were the leading countries in regard to number of computers in schools and internet access. The main reason for that was the age of the teachers.

However, according to the results obtained in this research, it cannot be claimed with certainty that the age and teaching experience of teachers represent significant predictors of their attitudes toward CAL. The sample size in this study was small, thus limiting the extent to which the findings may be generalized. In order to investigate the real impact of age and experience of teachers in their attitudes toward CAL, it is necessary to include a significantly larger population of teachers in future research.

Teachers' competence in using modern teaching aids in biology teaching

An appropriate application of CAL is a result of good information about the possibilities offered by the computer, certain computer applications (Microsoft PowerPoint, Flash, Photoshop, Paint...), and the teachers' competence to use modern teaching aids. A descriptive method was used to obtain data on the teachers' competence to use various teaching aids and devices (Table 4).

Results showed (Table 4) that all the biology teachers were competent to use TV sets in biology teaching (100%), and that most of them were competent to use an overhead projector (98.14%) and video recorder (90.74%). The competence to use a video

beam projector was less (62.96%), the same as for their use of multimedia programs (50%). Concerning competence to use educational software in biology teaching, most of the teachers (81.48%) stated that they were not competent at all or that they were generally not competent to use them in teaching. Based on these results, it can be concluded that biology teachers are more competent to use older generation teaching aids than teaching aids of the new generation that are based on modern ICT. The competence of teachers to use TV set is probably the result of its massive use at home. Accordingly, it could be expected that a greater use of computers at home will result in more teachers competent to use them in education.

Correlation analysis established a significant impact of the teachers' competence to use modern teaching aids and devices on their attitude toward CAL. Accordingly, the attitude toward CAL application was much more positive in the teachers who were more competent to use and apply computers ($r = 0.578$, $p < 0.01$), video beam projectors ($r = 0.420$, $p < 0.01$), multimedia programs ($r = 0.618$, $p < 0.01$) and educational software in biology teaching ($r = 0.434$, $p < 0.01$). Many previous studies confirmed that the teachers' competence to use computers was an important factor that influences the teachers' use of computers in teaching (Asan, 2002; Braak, 2001; Gaudron and Vignoli, 2002; Jenson et al., 2002; Zhao and Cziko, 2001; Sahin and Thompson, 2006; Cavas et al., 2009). Subsequently, Pelgrum (2001) emphasized the teachers' lack of computer competence as the main barrier to their acceptance and adoption of ICT in the education process. Therefore, as CAL is one of many options for computer application in education, the teachers' competence to work on computer and apply its tools is especially important for its effective application in the classroom.

Professional training in the field of computer applied learning

Computer literacy, i.e. knowledge and ability to use basic IT tools in practice, has become part of the general literacy of every individual. In the teaching proc-

ess, this literacy involves attending seminars, where teachers are trained to work on the computer and use it in the classroom. The results (Table 4) show how teachers are involved in their own IT advanced training.

The teachers' responses (Table 4) showed that almost half of them (48.15%) attended advanced training, while every other teacher (48.15%) was not engaged in advanced training in the field of CAL. Accordingly, insufficient attention was paid to monitoring and attending seminars on the use of ICT in the teaching process, thus significantly reducing the possibility of the teachers' professional development and improvement of their pedagogical practice. At the same time, the following question was asked: Are the teachers who attend seminars on computer application more competent to use them in the classroom? Comparing the mean differences (t test) between the two variables, it was established that there was a statistically significant difference between professional advanced training and every individual variable: competence to use computers ($t = 3.34, p < 0.01$), video beam projectors ($t = 2.75, p < 0.01$), multimedia programs ($t = 5.44, p < 0.01$) and educational software ($t = 2.39, p < 0.01$). This points to a need for the advanced training of teachers to use IT and other technologies, application of computers in didactic and methodical planning of classes, development of both information and critical literacy of teachers to access and use information from the internet, as well as the necessity to inform teachers about the availability of relevant educational content on websites dedicated to education (Lazarević, 2005).

“Is the general teachers' attitude toward CAL changed depending on their advanced training?” Results from Table 6 showed that advanced IT training was a significant predictor of the teachers' attitudes toward CAL ($t = 3.42, p < 0.01$). Therefore, the teachers who attended seminars had a more positive opinion of CAL application in biology teaching. Albirini, 2006 also confirmed that IT training was a significant factor that influenced the attitudes of teachers toward computers.

Computer application in biology classes opens the possibility to connect contents from different teaching subjects, and have more intensive cooperation among the teachers of different subjects and their pupils. In order not to face an inappropriate use of computers in teaching (playing computer games, uncontrolled internet search), it is essential for computer use to be systematic and controlled by the teachers themselves (Mirkov and Studen, 2005).

CONCLUSIONS

The study has examined a general attitude of Serbian teachers toward CAL in biology teaching, and relationships among teachers' attitudes and selected variables such as age, teaching experience, competence to use modern teaching aids, as well as professional advanced training in the field of computer application in teaching.

Although traditionalism in elementary school biology teaching still prevails in our country (Drakulić et al., 2011), teachers are aware of the significance of and need for the application of computers and other contemporary teaching aids and devices in biology teaching. This is confirmed by the exceptionally positive attitude to CAL application in biology teaching expressed by the majority of surveyed teachers. Analysis of the questionnaire results indicates that greater age and teaching experience increases the number of teachers who are distrustful of the effects of CAL in the education process. About 50% of the teachers who are trained to work on the computer and with computer programs have received advanced training in this field, which is not the case with the remaining 50% of the surveyed teachers. The teachers' competence to use computers and other contemporary aids and devices, as well as their advanced training, significantly positively correlate with the general teachers' attitude toward CAL.

Since the global analysis of the questionnaire results has shown that biology teachers have confidence in the application and contribution of computers and CAL in order to improve biology teach-

ing, it is necessary to take advantage of their trust and provide the required conditions in future, in which it could be possible to apply various models of work supported by ICT, thus increasing pupil motivation and achievement. In the meantime, it is necessary for biology teachers to receive constant advanced training through attending information and didactic-methodological seminars in order to obtain the competence to create and use multimedia presentations and educational software according to the model of programmed teaching and other models of interactive computer assisted learning.

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