THE VIEWS AND OPINIONS OF BIOLOGY STUDENTS ON THE APPLICATION OF PROGRAMMED INSTRUCTION IN THE REALIZATION OF PHYSIOLOGICAL PROGRAM CONTENT

Dragan Djurić[1], Jelena Stanisavljević[2]
[1]High school "Branislav Petronijevic", Ub, Serbia
[2]Faculty of Biology, University of Belgrade, Serbia

ABSTRACT

This paper analyzes the effect of programmed biology teaching on the development of motivational processes in students in the field of physiological programming content of the subject Human anatomy and physiology. The study sample consisted of 60 graduate students grouped into one experimental and one control group. For the experimental group, the physiological courses (Teaching Area: Nervous System) were carried out using programmed instruction, which was performed using computer and programmed materials containing the concept maps. The control group at the same facility implemented the classical-lecturing teaching. After elaborating on the teaching material, a survey was conducted for students of the experimental group. The survey results show a great interest by students in the programmed model of teaching and reported high motivation for adopting physiological programming content using such a didactic model.

Key words: *concept maps, motivation of students, physiological teaching contents, programmed instruction*

INTRODUCTION

At Faculty of Biology, University of Belgrade, teaching contents of the theoretical part of subjects are being realized mainly by classical-lecturer

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(information-illustrative) teaching. This type of teaching is characterized by transmission of knowledge, organization such as "ex cathedra", in which students are to a greater extent objects, rather than subjects of educational work, the more passive listeners but active agents in the process of development. With this type of work students are not able to independently promote the implementation of the planned educational contents.

Given that this kind of teaching is non-motivating for students, they lose interest in the offered curricula.

Considering the physiological content that will be realized at the Faculty of Biology, University of Belgrade, we can see the need for implementing a programmed model of teaching, which would replace the traditional lecturing approach and facilitate the acquisition of complex content, those lacking adequate natural teaching resources.

The programmed teaching material is logically structured in a way which involves retaining the essential and eliminating non-essential content and the dismantling of content on the main elements. By reducing the material to what is important students are not burdened by memory and have more opportunities for reflection. Decomposition of the contents to the basic elements allows a student to gradually enter into the matter, going from simpler to more complex content. Independent work will encourage students to think actively, which in classical (frontal) teaching is not the case, and to ensure that each individual progresses at their own pace according to their intellectual capacity. In the process of programmed instruction, students were given continuous feedback on whether they mastered the planned parts of the program (Field, 2007). All this promotes their activation and motivation for acquiring the curriculum.

Today, with the development of educational technology, the realization of programmed instruction using computers or computer programs that are designed to support all phases of the implementation of this model of teaching is especially suitable.

There are several studies that proved the effectiveness of computer-teaching technology, especially in the implementation of general biology (Brewer, 2004), the environment (Lin & Lehman, 2002) and specific botany (Karal et al., 2010, Moreno et al., 2001) program content. In the course of these studies a positive impact of interactive computer simulations to a range of students' knowledge is demonstrated.

Today, there are applied computer simulations that integrate different types of feedback. The effect of this feedback on the realization of concept maps by students has been questioned. Concept maps constitute the terms connected to certain correlations in a hierarchical structure (Novak, 1991). This approach is often applied in science teaching, primarily with regard to creation

of program content (Edmondson, 1995) and checking of knowledge (Chu et al., 2010).

Research has proven the effectiveness of this concept in the form of programmed materials, with the help of computer teaching technology (Chiou, 2008). Specific research has been done concerning the effectiveness of such models in the implementation of environmental program content (Ifenthaler, 2010).

Without feedback which is based on the programmed teaching biology, there is no student motivation. Several recent studies have shown a positive effect on the implementation of innovative models of teaching (problem and exemplary-based biology teaching) to establish the basic motivational processes in students, which are mostly in correlation with emotional and volitional processes (Đurić, Stanisavljević, 2010a; Đurić, Stanisavljević, 2010b).

Since the physiological teaching contents are hard to understand and the conventional expository teaching approach is not motivating for students, we wanted to examine whether there is a positive link between the implementation of the programmed model of teaching (as an innovative model of work) and students' motivation for acquiring physiological programming contents using this didactic model and for better understanding of that content.

Discussing in particular the physiological structure of program content, and taking into account the above mentioned characteristics and the results concerning the use of programmed materials, we are now implementing a programmed model of teaching (linear programmed material with concept maps) within the subject Human Anatomy and physiology (curriculum content: The nervous system), as well as testing the effect of its application.

This work is a result of extensive educational research conducted during the summer semester of 2010/2011 at the Faculty of Biology, University of Belgrade, where different effects of the application of programmed teaching biology (range, quality and durability of the acquired knowledge in students) were compared.

RESEARCH AIMS AND OBJECTIVES

The main task of this research is the analysis of programmed teaching biology at the development of student motivation. The basic, the null hypothesis states that there is a positive correlation between the implementation of programmed instruction of biology and exercise motivational processes in students. Students are expected to be active, and independently develop their own creative possibilities.

RESEARCH METHODOLOGY

The study included a total of 60 students (graduate academic program of study – major – biology teacher/professor), Faculty of Biology, University of Belgrade. In order to achieve the objectives of this paper, the model of pedagogical experiment with parallel groups was designed. Students were grouped into one experimental and one control group (Killerman, 1998).

Both groups were made uniform at the beginning of the experiment, prior to introducing the experimental factor, by using several pedagogical tools (number of students, sex ratio, pre-test of general physiology knowledge).

After balancing the experimental (E) and control (C) groups of students, the E group was presented with the physiology material (human nervous system) through programmed instruction (including concept mapping), while the C group through the traditional instruction method.

The realization of the programmed model of teaching in the experimental group took place in several stages. Students were introduced to the programmed material which presented physiological content (the Nervous system) using a computer program, in the three teaching terms. In the first teaching period the following topics were covered: Peripheral nervous system and spinal cord. The second teaching period focused on the brain, while the third topic was The autonomic nervous system and diseases of the nervous system. Students successively move through these themes, independently and at their own pace crossing proper sequences or their linearly arranged articles. As part of the programmed material, after each sequence of content, students answered the questions (in textbox). They also had the task (at the end of the programmed materials for each team) to compile a concept map (including, but offered a number of concepts and some relations) on the basis of completed work and answers to questions. After that, in a separate file students had a chance to check the accuracy of their responses and construction of concept maps.

The execution of the traditional, expository instruction method in the C group was accomplished by presenting the above-mentioned physiology material through the following methods: oral presentation, illustrations and demonstrations (also during the three instruction periods). The C group students did not have the opportunity to independently, or in groups to solve specific problems and make their own conclusions.

Upon completing the teaching process, a survey was conducted for the students in the experimental group who participated in this educational research (30 students) in order to assess their attitudes and opinions on the

implementation of the programmed model of teaching with respect to physiological curriculum.

Along with the programmed materials and survey, the following were also used as part of the experiment: university documentation, teacher presentations, and other materials such as textbooks and practicum manuals corresponding to the given area.

Data and result analysis were performed by using the standard statistical methods / table-descriptive statistics (sum, percentage frequency). All these analyses were conducted using the statistical software package Statistica 6.

RESULTS AND DISCUSSION

After the survey the results were obtained and presented in table 1.

Table 1. The results of the survey

Questions	Variants of student responses	Number of students	%
1. The way in which we have covered teaching area Nervous system was:	a) very interesting	24	80
	b) average	5	16.16
	c) tiring and boring	1	3.33
2. This approach to teaching physiology enabled me to learn:	a) much more	25	83.33
	b) average	5	16.67
	c) slightly	0	0
3. Did it facilitate the understanding of content in physiology:	a) yes	27	90
	b) no	3	10
4. Would you like to realize other content from biology this way:	a) yes	28	93.33
	b) no	2	6.67

Based on the questionnaire for students, with a specific, open-ended question number 5, the following conclusions can be presented:

For most students (80%) the way they deal with educational content Nervous system was very interesting;

83.33% of students reported that through processing of teaching areas using programmed instruction they have learned more, 16.67% stated that this approach allowed them to learn the average, while there were not students who said they learned a bit in this way;

90% of students believe that this way of teaching facilitates the understanding of physiological teaching content, while 10% of students found that this method of teaching and learning does not contribute to their

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understanding of content in physiology; the question: "Would you like to realize other content from biology this way?", 93.33% of the students expressed a positive attitude, and 6.67% had a negative attitude.

In considering individual responses to question 5 (What did you like / not like when processing the contents of the teaching areas Nervous System?), we can point out a number of similar positions that best describe the general attitude of students on the application of programmed instruction of biology:

o   "I like that the class actually requires activity. The volume of material is sufficient and understandable. "
o   "I loved the way the material is prepared, its visibility."
o   "The positive side is that with this kind of work is better remembering of assigned material."
o   "I liked that the work is interesting and somehow I feel "free"."
o   "I think that this system is successful because students participate in the process, they have no option to just turn off, as in 80% of cases."
o   "I like this mode because they force us to rethink what we know, and it still encourages us to learn more and better."

There were also conflicting opinions:
o   "I prefer the classical method of teaching."
o   "I used to work as usual."

Based on the survey results and students' views on the application of programmed instruction of biology it can be concluded that most of the students accepted this manner of work. Students realized that such an approach in teaching facilitates understanding and mastering physiological program contents. They were motivated to acquire the contents in programmed manner, and thus they gained quantitatively and qualitatively better knowledge of the teaching areas, Nervous system.

Negative responses of students indicate a particular role of classical teaching at the university, and each new form of teaching is strange for students and they approach it with a certain amount of uncertainty and caution especially towards what is new and different in the classroom.

Compared with our results, the research on the effectiveness of programmed instruction with the help of concept maps in the implementation of the biological program contents, showed that the group that applied concept maps using computers (E group) was better than group that is using paper and pencil to develop concept maps (C group) (Chang et al., 2001).

The results related to the implementation of ecological program contents with the help of computer-assisted instruction and concept maps,

indicate that it is the most efficient method in comparison with other different types of automatically generated feedback (Ifenthaler, 2010).

Also, the results of investigation of programmed instruction in the form of a custom designed Web-based assessment for use between lectures (Bio-Bytes), reported that this technology helped to improve students overall understanding of biological principles and concepts (Brewer, 2004).

Taking into account only programmed instruction without concept maps, computer aided teaching material about the Reproduction of Plants has been found positive by the biology students at undergraduate and graduate levels (Karal et al., 2010).

CONCLUSIONS

Motivation is the foundation of every well-organized labor, especially the complex such as programmed learning.

The application of programmed instruction contributes significantly to students' motivation to acquire the physiological teaching content, encourages the development of thinking, initiative students, develop independence in the exercise of intellectual activity. It achieved a high level of efficiency in the realization of program content in the nervous system, as well as increased the quality and quantity of knowledge acquired by students.

The modern biology teaching process, especially the physiological implementation of program content, should integrate and model programmed instruction. Such instruction is necessary in practice, in carrying out graduate academic studies at the Faculty of Biology (University of Belgrade), in intensifying the implementation of programmed instruction, primarily in the implementation of various physiological subjects, or the physiological curriculum. For this purpose, continuous teachers training should be ensured. Teachers and assistants should be trained in the various applications of different models of programmed teaching. This will significantly change not only their role in teaching, but will stimulate students' participation in education. Students will become active and creative implementers of instruction.

Given that the students, future teachers of biology, participated in this research, they also gained experience in programmed teaching which can be applied in their future work and thus make biology teaching more efficient.

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Dragan Djurić
High school "Branislav Petronijevic" Ub,
 Vuka Karadžića 15, 14210 Ub,
draganbiolog@gmail.com

Jelena Stanisavljević
University of Belgrade, Faculty of Biology,
Studentski trg 16, 11 000 Beograd,
jelena.stanisavljevic@bio.bg.ac.rs

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STAVOVI I MIŠLJENJA STUDENATA BIOLOGIJE O PRIMJENI PROGRAMIRANE NASTAVE U REALIZACIJI FIZIOLOŠKIH PROGRAMSKIH SADRŽAJA

SAŽETAK

U ovom radu analizira se primjena programirane nastave biologije na razvoj motivacijskih procesa kod studenata u području fizioloških programskih sadržaja nastavnog predmeta Anatomija i fiziologija čovjeka. Uzorak istraživanja činilo je 60 studenata diplomskih akademskih studija, koji su bili grupirani u jednu eksperimentalnu i jednu kontrolnu skupinu. Eksperimentalna skupina je realizirala fiziološke nastavne sadržaje (Nastavno oblaspodručje: Živčani sustav) primjenom programirane nastave, koja je izvođena uz pomoć kompjutora i programiranih materijala, koji su sadržavali i izradu mapa pojmova. Kontrolna skupina je iste sadržaje realizirala klasičnom predavačkom nastavom. Nakon ovakve obrade nastavnog gradiva provedena je anketa za studente eksperimentalne skupine. Rezultati ankete pokazuju veliku zainteresiranost studenata za programirani model nastave i ističu iznimnu motiviranost za usvajanje fizioloških programskih sadržaja primjenom ovog didaktičkog modela.

Ključne riječi: fiziološki programski sadržaji, mape pojmova, motivacija učenika, programirana nastava

UVOD

Na Biološkom Fakultetu Sveučilišta u Beogradu teorijski sadržaji predmeta izvode se uglavnom tradicionalnom metodom predavanja (informativno-ilustracijski). Ovakav način poučavanja podrazumijeva prijenos znanja "ex-catedra" gdje su studenti, u većoj mjeri, objekti a ne subjekti u obrazovnom procesu, tj. oni su pasivni slušači ali i aktivni agenti u razvojnom procesu. Ovaj način rada studentima ne omogućuje samostalno primjenjivanje planiranog obrazovnog sadržaja.

S obzirom na to da je ovakav način poučavanja nemotivirajući za studente, oni često gube interes za ponuđeni kurikul. Uzevši u obzir fiziološki programski sadržaj koji se realizira na Biološkom fakultetu Sveučilišta u

Beogradu, može se uočiti potreba za primjenom programiranog modela poučavanja koji bi zamijenio tradicionalni „predavački" pristup te potpomogao usvajanje teško razumljivog sadržaja, odnosno sadržaja za koji ne postoje odgovarajući prirodni izvori za poučavanje.

Programirani nastavni materijali logički su strukturirani na način koji uključuje zadržavanje bitnog i eliminaciju nebitnog sadržaja te razgradnju sadržaja na bitne sastavnice. Smanjujući opseg materijala na ono što je bitno studenti se ne opterećuju memoriranjem te im se otvaraju mogućnosti za promišljanje. Rastavljanje sadržaja na osnovne sastavnice omogućuje studentima postupno zbližavanje sa sadržajem od jednostavnijeg k složenijem. Samostalni rad potiče studente na aktivno promišljanje, što kod tradicionalne, tj. frontalne nastave nije slučaj i omogućuje svakom pojedincu napredak koji se zbiva njima odgovarajućim tempom te je primjeren njihovim intelektualnim sposobnostima. Za vrijeme programirane nastave studenti su kontinuirano dobivali povratnu informaciju o svladavanju planiranih dijelova programa (Field, 2007). Sve to potiče njihovo aktiviranje i motivaciju za usvajanje kurikula.

Danas, u vrijeme obrazovnih tehnologija, posebice je primjereno provođenje programirane nastave koristeći računala ili računalne programe koji su razvijeni kako bi potpomogli sve faze u primijeni ovog modela poučavanja.

Postoji nekoliko studija koje su dokazale učinkovitost poučavanja putem računala, posebice u sadržaju opće biologije (Brewer, 2004), okoliša (Lin & Lehman, 2002) i specifičnog botaničkog sadržaja (Karal et al., 2010, Moreno et al., 2001). Kod tih je programa istraživanje pokazalo da interaktivne računalne simulacije imaju pozitivan učinak na znanje studenata.

Danas postoje primijenjene računalne simulacije koje integriraju različite vrste povratne informacije. Učinkovitost povratnih informacija upitna je kada je riječ o primijeni pojmovnih mapa u radu sa studentima. Pojmovne mape sadrže pojmove koji su vezani uz određene korelacije u hijerarhijskoj strukturi (Novak, 1991). Ovaj se način primjenjuje često u poučavanju prirodnih znanosti, posebice kod stvaranja programiranog sadržaja (Edmondson, 1995) i kod provjeravanja znanja (Chu et al., 2010).

Istraživanje je dokazalo učinkovitost ovog koncepta u obliku programiranih materijala uz pomoć računalne tehnologije (Chiou, 2008). Posebno je istaknuto proučavanje učinkovitosti takvih modela kod primjene nastavnog sadržaja vezanog uz okoliš (Ifenthaler, 2010).

Bez povratne informacije, koja je osnova za programirano poučavanje biologije, studenti ne bi bili motivirani. Nekoliko novijih studija ukazalo je na pozitivan učinak kod primijene inovativnih modela poučavanja (problemsko poučavanje i poučavanje zasnovano na primjerima) na osnovne motivacijske procese kod studenata koji gotovo u cijelosti koreliraju s emocionalnim procesima i željama (Đurić, Stanisavljević, 2010a; Đurić, Stanisavljević, 2010b).

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S obzirom na to da je sadržaj fiziologije teško razumljiv i da tradicionalno izlaganje kao nastavni pristup nije motivirajuće za studente, htjeli smo istražiti postoji li pozitivan odnos kod primijene programiranog modela poučavanja (kao inovativnog modela rada) i motivacije studenata za usvajanje fiziološkog programskog sadržaja kroz ovaj didaktički model i za bolje razumijevanje ovih sadržaja.

Kako je riječ o fiziološkom programskom sadržaju, i uzimajući u obzir gore navedene karakteristike te rezultate vezane uz korištenje programiranih materijala, u ovome trenutku primjenjujemo programirani model poučavanja (linearni programirani materijal s konceptualnim mapama) kolegija Ljudska anatomija i fiziologija (kurikulski sadržaj: živčani sustav), kao i testiranje učinka ove primjene.

Ovaj rad rezultat je opsežnog obrazovnog istraživanja koje je provedeno u ljetnom semestru akademske godine 2010/2011. na Biološkom Fakultetu Sveučilišta u Beogradu gdje su se uspoređivali različiti učinci primjene programiranog poučavanja biologije (opseg, kvaliteta i postojanost usvojenog znanja).

CILJEVI I SVRHA ISTRAŽIVANJA

Glavni zadatak ovoga istraživanja je analiza programiranog poučavanja biologije u stvaranju motivacijskih procesa kod studenata. Nulta hipoteza je pozitivna korelacija između primijenjenog programskog poučavanja biologije i razvijanja motivacijskih procesa kod studenata. Očekuje se da studenti postaju aktivniji te da samostalno razvijaju svoje kreativne potencijale.

METODE

Istraživanje je provedeno na ukupno 60 studenata (diplomski studij – profesor biologije) Biološkog Fakulteta Sveučilišta u Beogradu. Da bi se pokazala svrha ovog istraživanja, izrađen je model pedagoškog testiranja korištenjem dvije paralelne skupine. Studenti su grupirani u eksperimentalnu i kontrolnu skupinu (Killerman, 1998).

Obje su skupine homogenizirane prije samog početka eksperimenta, odnosno prije uvođenja eksperimentalnog faktora koristeći nekoliko pedagoških alata (broj studenata, odnos spolova, predtest znanja opće fiziologije).

Nakon što su se eksperimentalna (E) i kontrolna (C) skupina uravnotežile, skupini E predstavljen je fiziološki materijal (živčani sustav

čovjeka) kroz programiranu nastavu (uključujući pojmovne mape), dok je C skupini isto bilo prikazano korištenjem tradicionalnih metoda poučavanja.

Realizacija programiranog modela poučavanja u eksperimentalnoj skupini provedena je u nekoliko faza. Studenti su u računalno programiranim materijalima dobili fiziološki sadržaj (živčani sustav) u tri semestra. U prvome semestru prezentiran im je sadržaj sa sljedećim temama: Periferalni živčani sustav i kralježnica. U drugom semestru obrađena je tema Mozak a treća tema bila je Autonomni živčani sustav i bolesti živčanog sustava. Teme se obrađuju sukcesivno, individualno i prema osobnom tempu, popraćeno linearno postavljenim člancima. Kao dio programiranog materijala, nakon svakog nastavka, studenti su odgovarali na pitanja (u knjizi) (Prilog 1). Također su imali zadatak (nakon programiranih materijala za svaki semestar) da na osnovi prijeđenog sadržaja i odgovora na pitanje, naprave pojmovne mape (uključujući ponuđeni broj pojmova i nekih odnosa) (Prilog 2). Nakon toga, studenti su u zasebnoj mapi mogli provjeriti točnost svojih odgovora i rezultate rada na svojim pojmovnim mapama.

Tradicionalna, predavačka nastava u skupini C gore navedeni fiziološko materijal prezentirala koristeći sljedeće metode: usmene prezentacije, ilustracije i demonstracije (u tri nastavna semestra). Studenti u skupini C nisu imali priliku samostalno ili zajednički u grupnom radu riješiti određene probleme i doći do zaključaka.

Nakon prikupljenih podataka iz ankete koja je uključivala studente u eksperimentalnoj skupini (30 studenata), podaci su obrađeni kako bi se procijenili njihovi stavovi i mišljenja o uvođenju programiranog modela poučavanja u izvedbi fiziološkog kurikula (Prilog 3).

Uz programirane materijale i anketu sljedeće stavke također su korištene u istraživanju: fakultetska dokumentacija, prezentacije učitelja, ostali materijali kao što su udžbenici i materijali za vježbe koje prate određeno područje.

Podaci te analiza rezultata obrađeni su koristeći standardne statističke metode / deskriptivnu statistiku (zbroj, postotak frekvenciju). Sve su analize rađene korištenjem statističkog programa Statistica 6.

REZULTATI I RASPRAVA

Nakon istraživanja rezultati su objedinjeni te prikazani u tablici 1.

Tablica 1.

Na osnovi upitnika za studente koji je sadržavalo i pitanje otvorenog tipa (broj 5) mogu se donijeti sljedeći zaključci:

Za većinu studenata (80%) način na koji je obrađen sadržaj Živčani sustav bio je vrlo interesantan.

83.33% studenata izjavilo je da je pomoću programirane nastave naučilo više, 16.67% izjavilo je da im je ovaj pristup omogućio osrednje učenje, a ni jedan student nije izjavio da nije naučio ni najmanje na ovaj način.

90% studenata vjeruje da ovaj način poučavanja potiče razumijevanje fiziološkog sadržaja dok 10% studenata smatra da ova metoda poučavanja i učenja ne pridonosi njihovom boljem razumijevanju sadržaja o fiziologiji.

Na pitanje "Biste li željeli učiti i ostale sadržaje iz biologije na ovaj način?", 93.33% studenata odgovorilo je pozitivno, a 6.67% imalo je negativan stav.

Uzimajući u obzir odgovore na pitanje broj 5 (Što vam se svidjelo/nije svidjelo kod učenja sadržaja Živčani sustav?) možemo izdvojiti slične odgovore koji najbolje opisuju opće stavove studenata kod primjene programiranog poučavanja biologije:

o "Sviđa mi se što se u nastavi traži aktivnost. Količina materijala je dostatna i razumljiva."
o "Sviđao mi se način na koji je materijal pripremljen te njegova vidljivost."
o "Pozitivna strana je da se ovim načinom bolje pamti priječeni materijal."
o "Sviđa mi se jer je posao interesantan i nekako se osjećam „slobodno"."
o "Mislim da je ovaj sustav uspješan jer studenti sudjeluju u samom procesu i nemaju mogućnost isključiti se kao u 80% slučajeva."
o "Sviđa mi se ovaj model jer nas potiče da promislimo o onome što znamo i potiče nas da naučimo više i bolje."

Našlo se nešto oprečnih mišljenja:
o "Preferiram tradicionalnu metodu poučavanja."
o "Radio sam kao i obično."

Na osnovi rezultata i odgovora studenata o primjeni programirane nastave biologije možemo zaključiti da je većina studenata prihvatila ovakav način rada. Studenti su shvatili da ovakav način rada potiče razumijevanje i usvajanje programa fiziološkog sadržaja. Studenti su bili motivirani za usvajanje sadržaja na programirani način te su kvalitativno i kvantitativno bolje usvojili materijal iz područja Živčani sustav.

Negativni odgovori studenata upućuju na određene uloge koje tradicionalno poučavanje na fakultetima ima, a svaki novi oblik poučavanja smatraju čudnim te za njih postoji određena količina neizvjesnosti i opreza prema novome i drukčijem u nastavi.

Usporedno s našim rezultatima, istraživanje učinkovitosti programirane nastave pomoću pojmovnih mapa za sadržaj iz nastave biologije pokazalo je da je skupina koja se koristila pojmovnim mapama pomoću računala (skupina E) bolja od skupine koja je koristila metodu „papir i olovka" u popunjavanju pojmovnih mapa (skupina C) (Chang et al., 2001).

Rezultati koji se odnose na primjenu računalno potpomognute nastave i pojmovnih mapa za područje ekologije ukazuju da je to najučinkovitija metoda u usporedbi s ostalim načinima odnosno automatski generiranim povratnim informacijama (Ifenthaler, 2010).

Rezultati istraživanja programirane nastave u obliku prilagođenog mrežnog praćenja, koje se koristi između predavanja (Bio-Bytes), također su pokazali da je ova tehnologija pomogla studentima u razumijevanju principa i pojmova iz biologije (Brewer, 2004).

Uzimajući u obzir samo programiranu nastavu bez pojmovnih mapa, računalno potpomognuti materijali na temu Reprodukcija biljaka imala je pozitivan odjek među studentima biologije na dodiplomskoj i diplomskoj razini (Karal et al., 2010).

ZAKLJUČCI

Motivacija je temelj svakog dobro organiziranog rada, posebice složenog kao što je programirana nastava.

Primjena programiranog poučavanja značajno pridonosi motivaciji studenata da se suoče s fiziološkim sadržajima predmeta, potiče kognitivni razvoj i inicijativu te samostalnost u izvođenju kognitivnih aktivnosti.

Postiže se visoka učinkovitost posebice u realizaciji sadržaja vezanog uz živčani sustav te povećava kvaliteta i kvantiteta znanja koje studenti stječu.

Moderno poučavanje biologije, posebice fiziološki sadržaj, zahtjeva integraciju programiranog poučavanja. To je potrebno i u praksi, u realizaciji diplomskih studijskih programa na Biološkom fakultetu (Sveučilište u Beogradu)

D. Djurić, J. Stanisavljević:
The views and opinions of biology students on the application of programmed instruction in the
realization of physiological program content

kako bi se pojačala primjena programiranog poučavanja, prije svega u predmetima iz fiziologije ili fiziološkog kurikula. Upravo zbog toga mora se osigurati stalno obrazovanje nastavnika. Nastavnici i asistenti morali bi se obrazovati o načinima primjene različitih modela programiranog poučavanja. To bi značajno promijenilo ne samo njihovu ulogu u poučavanju, već bi potaknulo sudjelovanje studenata u nastavi. Naime, studenti bi postali aktivniji i kreativniji u ostvarivanju nastavnog programa.

Osim što su studenti, budući nastavnici biologije, sudjelovali u ovome istraživanju, također su stekli iskustvo u programiranom poučavanju i načinu na koji se ono može primijeniti u njihovom budućem radu i time pridonijeti da poučavanje biologije bude još učinkovitije.