

PROBLEMS OF TEACHERS RELATED TO TEACHING OPTIONAL SCIENCE SUBJECTS IN ELEMENTARY SCHOOLS IN SERBIA

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ABSTRACT

In the Republic of Serbia, first to fourth graders have to choose three optional subjects from the list comprising six of them. These also include science subjects, Hands in Dough and The Guardians of Nature. The present paper deals with teaching optional science subjects in the elementary school, as well as with problems teachers may have when they teach them. The research involved 182 elementary school teachers from Vojvodina. The analytical and descriptive method was used in the research, whereas the instrument referred to a questionnaire based on the crucial aim. The teachers mostly teach The Guardians of Nature, more than Hands in Dough, because of the contents they consider less complex in the former case. Besides, they think that they do not have enough professional and methodological knowledge to use the methods of science, which is taught within the latter subject, and that they lack the needed literature and technical resources, so they do not offer Hands in Dough to children. In addition, they need some further training considering the use of scientific method to be able to improve their competences for teaching such a subject and provide children with better knowledge from the field of natural sciences.

Key words: *early elementary school teaching, problems in teaching science, the Republic of Serbia, teachers.*

INTRODUCTION

All successful education reforms in the world have been principally based on raising the level of education in the area of science and mathematics (Ivanovic, 2000). Therefore, the contemporary education concepts particularly emphasize the importance of education in the field of science. Knowledge in this field becomes an important factor of the economic power, and its level of development influences the development of the entire society (Davies, 2004). Some developed countries, primarily the U.S.A., France and Great Britain, express some concern about losing their competitiveness in the economic world even more if they do not improve the quality of education in science and engineering (Lederman, 2008). An early introduction of science in teaching is justified due to its importance in performing the functional tasks of education, such as the development of scientific views of the world, critical thinking, flexibility and different cognitive styles of students. A national objective of education in the U.S.A. points out the requirement according to which the American pupils must be the most successful in science and mathematics. In 2001, the European Union members adopted the strategic objectives of education and training by 2010 and emphasized, as the first strategic objective, an increase in enrolment considering the studies of science and engineering.

The crisis of early education in the field of science and engineering is present in almost any educational system. In the European Union and the U.S.A. there are efforts on the popularization and facilitation of science-based learning from the earliest years of schooling. One of the most important projects of "scientific literacy" - *Hands on*, under Lederman's direction, involved 50,000 out of 400,000 students from the public schools in Chicago. The project also covered other areas in the U.S.A. and significantly stirred the entire American system of education. Even in 1991, Great Britain started the program (Curry, 1992) called SAE (Science across Europe). At the end of the long-lasting research, they set the educational objectives that can be considered as common to all the member states. The objectives are the following:

- o To present the contents of science to pupils in an appropriate way,
- o To point to the natural phenomena that are involved in our everyday life,
- o To establish, i.e. improve the inter-subject correlation,
- o To offer a global dimension of education, i.e. provide an access to information available to pupils from one country and also important for solving identical problems in another country, and
- o To develop communication skills in foreign languages.

In 1996, there was an initiative with the aim to raise the quality of elementary science education in France, supported by the French Academy of Sciences and helped by the Trey Foundation, as well. Prominent French physicists were concerned about the situation in the early science teaching, so they started its reform (Charpak, 1996). Being encouraged with *Hands on*, the program for improving science teaching in elementary schools in the U.S.A., French scientists proposed *La main a la suffer, Les sciences a l'ecole primaire*. Both American and French programs were based on the phenomenon well-known to all educators, i.e. a special interest in experiments among pre-schoolers and young schoolers. The early science learning, based on the experiment as the primary source of scientific knowledge, had remarkable results. An integrated approach to the initial learning of science enabled pupils to perceive the nature with all the phenomena and processes in it.

A few years later, the European Union launched a two-year project for similar reasons. Named GRID (Growing Interest in the Development of Teaching Science), the project was implemented as a part of the program known as Socrates 6 from 2004 to 2006, and it was coordinated by the French university - *Universitaire de Lorraine*. It primarily included British, Belgian, Finnish, Irish, Hungarian and Italian institutions. One of the current programs is the Lisbon Strategy 2010. The Council of Europe made a decision on this strategy at the meeting held in March, 2000 (http://ec.europa.eu/education/lifelong-learning-policy/doc1120_en.htm). It was then decided that the European Union, by 2010, should become the strongest and the most competent leader in the world education (Rodrigues, 2003).

Integrated science teaching

In the developed countries, the integrated science teaching has been carried out differently. Thus, in France, the integrated approach to teaching natural and some social sciences has been implemented for five years, with 4 hours per week, in Germany for two years (in the third and the fourth grade), with the same number of hours every week, in Italy for five years, and in Sweden for three years (the fourth, the fifth and the sixth grade) with 6 hours per week, in Greece for two years (the third and the fourth grade). The science teaching curriculum (NRSC) in the United States provides an integrated approach at eight levels (Science). The first six levels have been realized as *Science and Technology for Children*, while the seventh and the eighth level have been known as *Scientific and Technological Concepts for Secondary Schools*. Teaching has covered two integrated fields, such as *Science on the*

Earth and Life and Physical Sciences and Technology. In Japan, the integrated science teaching has been implemented for ten years, with 3 hours per week.

The countries of former Yugoslavia have also retained the concept of integrated science teaching in the early elementary education. In some of the newly independent states, the integrated science teaching has been reformed according to the European requirements. Elementary education lasts for eight years in the Republic of Serbia. The early elementary school teaching ranges from the first to the fourth grade, while the subject-based teaching ranges from the fifth to the eighth grade. Teaching science in the Serbian elementary schools has been realized as *integrated instruction about the nature and science (from the first to the fourth grade)* and *the subject-based instruction (from the fifth to the eighth grade)*. Science-related teaching has been performed by class teachers and subject teachers (teachers teaching one or two subjects). Based on the latest changes in the curriculum in the Republic of Serbia, the early elementary education includes the integrated teaching of natural and social sciences within the compulsory subjects, such as *The World around Us* with 2 hours per week in the first two grades, and *Nature and Science* with 2 hours per week in the third and the fourth grade. *The Guardians of Nature* and *Hands in Dough* are available as optional subjects in all grades with one hour per week. A similar concept of studying science in the early elementary education exists in Russia and Bulgaria.

The results of testing students' knowledge in science with the use of European instruments such as TIMS and PISA have indicated the upsetting lagging in science of Serbian students behind the ones from other European countries. In the Republic of Serbia, the curriculum tries to achieve a balance between the integration and the differentiation of teaching contents. The area of science and mathematics is gradually being differentiated towards relatively independent subjects in higher grades. Compulsory subjects in the elementary school can be classified in five different areas, as follows: language and art; science and mathematics; social area; health-related area, and technical area. In higher grades, the subjects from the first-mentioned field prevail in comparison with the subjects from the second-mentioned field. The introduction of subjects such as *Biology* and *Geography* in the fifth grade provides some continuous acquisition of their contents, when children cease to have the subject called *Sciences*. There is no similar continuity in the case of subjects such as *Physics* and *Chemistry*. *Physics* is introduced, as an independent subject, one year later, and *Chemistry* even two years later.

A particular problem in the realization of contemporary science teaching in the Serbian elementary schools refers to the lack of teachers. The subject-based teaching is burdened with the lack of qualified teachers to adequately teach science. The phenomenon of negative selection is generally

related to the selection of science teachers, when selecting teachers from the available personnel as well as when selecting candidates for this educational profile. The situation in the case of integrated science teaching is even more complex. There are a few undergraduate study programs for this profile. The job classification considering education in the Republic of Serbia does not include the category of *teachers for integrated science teaching*, or the category of *science teachers*. The education of teachers specialized in integrated science teaching is more demanding than the education of teachers specialized in teaching a particular science as it should be organized in such a way to enable a comprehensive overview of the contemporary situation in the wide area of science, technique and technology. It is certain that this sort of education should not be too comprehensive but it should enable future teachers to receive some continuous education in science to meet the needs of contemporary science teaching. Additionally, this education must be strongly supported by education in the field of history and philosophy of science in order to provide a comprehensive view of the nature with all the phenomena and processes in it.

Integrated science teaching is usually planned for the early educational period, so that future teachers must acquire necessary knowledge in a wide and complex field of methodology, pedagogy and psychology. The problem of Serbian teachers specialized in integrated science teaching in the early elementary school is usually solved by engaging class teachers – teachers teaching from the first to the fourth grade. However, it should be kept in mind that the academic education of future elementary school teachers in the field of science is not at a required professional level. It practically covers two semesters of teaching science, where the contents are not always equally represented, so bipolarization is almost always recognized. Some contemporary concepts of integrated science teaching, for example in Hungary, try to overcome this problem by occasionally engaging subject teachers, as well.

In France, under the program known as *La Main a la pate*, there has been organized a considerable professional support to class teachers in order to help them teach science in an integrated way. Class teachers were actually helped by teaching assistants, mostly students of science (teaching stream), as well as by students studying at technical and engineering faculties. On-line support was also available, so class teachers could get the needed help and guidance for integrated science teaching from different e-mail addresses. These are just necessary interim solutions; this type of teaching is particularly demanding in terms of contents, methods, and forms of learning. One of the possible ideas for providing teachers capable of integrated science teaching refers to the advanced training of class teachers or subject teachers on particular science concepts through postgraduate studies. This model already

exists in the U.K. In many European countries, class teachers have been trained at seminars, previously accredited for this purpose by the authorities. Postgraduate studies and advanced training organized through appropriate seminars are reasonable ideas only in the educational systems in which there is a clear professional development for teachers as well as a defined licensing protocol.

The introduction of teachers competent for integrated science teaching in contemporary education must be prepared by educators. It is, thus, necessary to carry out an extensive research into the needs of additional advanced training of educators, starting from the previously defined educational standards in science (Lamanauskas & Vilkoniene, 2008; Huinker & Madison, 1997). This enormous work must be done by co-operating scientists, psychologists and educators, aimed at planning the curriculum based on a completely integrated approach (Blumenfeld Krajcik, Marx & Soloway 1994, Riquarts & Henning 1998). However, almost any model of integrated teaching represent isolated biological, physical, chemical and geographical views of natural phenomena and processes (Nezvalova, 2007). There are few completely integrated contents, apart from the fact that the American concept represents the science learning module with a fully integrated approach. In order to accept integrated science teaching and make science contents closer to the youngest learners, it is needed to make efforts (Watters & Ginns 2000) to convince others that the entire population needs science in the elementary education - the scientific literacy for all (Marbach-Ad & McGinnis, 2008) .

It is possible to successfully prepare teachers for integrated science teaching if there is an easily understandable set of standards related to the required professional and pedagogical knowledge. Expertise in the field of science should be based on the knowledge of concepts and principles that are common to all sciences (Lang, 2000). General scientific concepts and principles are generated from the concepts and relationships in specific scientific areas and disciplines, and they include the use of mathematics in scientific research (Marble, 2007). Pedagogical knowledge should be based on the ideas of constructivism and the construction of knowledge should be based on analysis and metaphors, abstraction and conceptual understanding of contents (Nezvalova, 2007). Planned pedagogical contents have been structured in the well-known model of researching the pedagogical contents at the faculties of education, and they include as follows: actions and strategies of learning, organization of school experiences with respect to individual needs, evaluation and use of previously acquired knowledge, and transformation of ideas into understandable segments. In the education of teachers specialized in integrated science teaching, a special attention must be paid to the relationship between science contents and pedagogical contents. Pedagogical contents

must be structured in such a way to enable solutions of complex problem situations in studying the natural phenomena and processes (Davis, 2004).

METHODS

Research problem

Children should enrich their knowledge about the nature through optional subjects in order to easily understand simple cause-and-effect relations in the nature, gradually form concepts, and learn about the phases of research focused on the nature. *The Guardians of Nature* develops proper environmental attitudes and behaviours in children. *Hands in Dough* enables children to learn about the scientific method and its application in the discovery of nature. It is necessary to determine the items presented in the list of optional subjects which are suggested to children. It is also vital to determine possible problems in their realization to be able to solve them. The obtained results should facilitate the improvement of integrated science teaching.

Research aim

The aim of the paper refers to the analysis of problems which teachers have in teaching the above stated optional subjects, *The Guardians of Nature* and *Hands in Dough*, as well as the analysis of their attitudes to further education in science and methods of integrated science teaching, all in order to improve such teaching.

Research hypothesis

The main hypothesis is that teachers have special professional knowledge, also motivation, for teaching *The Guardians of Nature* and *Hands in Dough*, which results in their high quality realization. They want to continuously expand knowledge to be able to improve their integrated science teaching.

Research methods and techniques, research instruments

This research included the analytical and descriptive method. Field research, action research and combined techniques were used. The research

was carried out in 14 elementary schools in Vojvodina. The action research was aimed at analyzing the teaching of optional subjects on the basis of school documentation, and their presentation to pupils and parents. The curriculum anticipates the optional subjects covering integrated science teaching because they exist in the contemporary society and their contents can be adjusted to younger pupils. However, practice shows that *Hands in Dough* is rarely taught, with a small number of pupils choosing this subject. The action research was added to determine the reasons for such a status. The action research began after all the participants had agreed upon this, and its aim referred to the improvement of integrated science teaching. The authors wanted to identify the opinions of teachers about possible ways in which the implementation problems could be eliminated. The usual model of action research was used (Suzic, 2007), including the phases as follows:

- o planning the research;
- o paying visits to schools and analysing school documentation to identify optional subjects in the teaching practice, with a special emphasis on the ones from the field of integrated sciences;
- o talking to teachers, informing them about the research aim, listening to their suggestions regarding the practices of integrated science teaching, in order to prepare the instrument (questionnaire);
- o designing the questionnaire;
- o paying visits to schools, conducting the research upon the agreement of all teachers;
- o analysing results obtained from the questionnaires;
- o drawing the conclusions and determining possible ways of overcoming the existing problems in the integrated science teaching.

In pedagogical terms, the action research was expected to show teachers' views of the optional subjects related to integrated science teaching, their needs and interests in some further education in science and methodology of integrated science teaching. In the conducted action research, the reflexive principle was applied, implying that all the participants could make critical comments on the optional subjects related to integrated science teaching and their implementation.

The questionnaire facilitated the analysis of problems in teaching the optional subjects related to integrated science teaching, as well as teachers' attitudes towards their continuous education in science and methods of integrated science teaching. The research instrument included a questionnaire based on the research tasks. The questionnaire consisted of 25 questions, open-ended and close-ended ones. The obtained results were statistically processed. The items in the questionnaire were classified in three groups. The first group was aimed at finding out how teachers create their lists of optional

subjects and present them to parents and pupils. The second group was required to determine teachers' attitudes towards the subjects such as *The Guardians of Nature* and *Hands in Dough*, as well as their importance for pupils. The third group was intended to examine teachers' attitudes towards their continuous education in science and methods of integrated science teaching to acquire new knowledge and thus raise the quality of integrated science teaching.

Sample

The sample was made up of 182 teachers from 14 schools in Vojvodina. The research was conducted in 2010/2011. It involved the teachers who had at least 5 years of teaching experience, since Serbian teachers could receive a license after five years spent in teaching. They averagely spent 18 years on doing the teaching job. Most of the teachers (91.93%) worked in city elementary schools. 98.92% of teachers were educated to teach children from the first to the fourth grade, acquiring the title of class teacher, while 1.08% of them finished education required for subject teachers. Accordingly, the majority of teachers were qualified to teach first to fourth graders. It does not mean that they were theoretically and practically trained to the same extent for teaching science in the lower grades of elementary school, taking into account the multidisciplinary and interdisciplinary nature of contents. The implementation of these subjects was affected by teachers' affinity for science, and their ability to transform science contents into proper teaching and to adjust them to the mental characteristics of first, second, third, and fourth graders. It is important to emphasize that all the surveyed teachers, during their schooling, had subjects in which they studied science concepts as well as science teaching methods.

RESULTS

The results were organized in three categories according to the defined research tasks:

The way in which the optional subjects are selected,

Attitudes of teachers towards the optional subjects related to integrated science teaching, and

Attitudes of teachers regarding their own professional training for teaching the subjects mentioned above and their opinions about some further professional development.

The results were processed by applying the SPSS statistical package. The list of optional subjects and their teaching is shown in Table 1. The knowledge of teachers about the ways of choosing and presenting optional subjects are shown in Table 2.

Table 1. List of optional subjects and their realization

No	Name of the subject	Presence of the subject in offer (%)	Pupils who choose the subject (%)	Implementation of the subject in relation to the total implementation of optional subjects (%)
1	<i>The Guardians of Nature</i>	29.0	41.0	52.0
2	The National Tradition	20.0	18.0	14.0
3	From Toys to Computers	19.0	19.0	15.0
4	The Mother Tongue with Elements of National Culture	14.0	9.0	9.0
5	Beautiful Writing	10.0	7.0	6.0
6	Hands in Dough	8.0	6.0	4.0

Table 2. Knowledge of teachers regarding the ways of choosing and presenting optional subjects

Questions	Answers			
	True		False	
	n	%	n	(%)
Number of optional subjects school has to offer to pupils	179	98.4	3	1.6
School should first conduct a survey among pupils, i.e. their parents when selecting the subjects	53	29.1	129	70.9
List of optional subjects	168	92.3	14	7.7
List of optional subjects your school offers to pupils	177	97.3	4	2.7

The opinions of teachers about why *Hand in Dough* is rarely taught are shown in Table 4, while the attitudes of teachers towards the contents of optional subjects related to integrated science teaching are shown in Table 4. It is necessary to mention that all the teachers did not report on their attitudes regarding the reasons of insufficient teaching in the case of these optional subjects.

Table 3. Opinions of teachers about the reasons of insufficient realization in case of *Hand in Dough*

Teachers	Answers				
	It cannot be realized due to the lack of equipment	Difficult program	Subject additionally burdens pupils	There is no interest of pupils in this subject	Feeling of insufficient professional training of teachers
n	28	9	102	37	6
(%)	15.4	4.9	56.0	20.3	3.4

32.4% of the total number of surveyed teachers presented their attitudes.

Table 4. Attitudes of teachers towards the contents of *Hand in Dough* and *The Guardians of Nature*

Attitudes of teachers	Answers					
	yes		no		no attitude	
	n	(%)	n	(%)	n	(%)
Not adjusted to pupils	154	84.1	28	15.9	0	0
Contents of <i>The Guardians of Nature</i> are more adjusted to pupils than the contents of <i>Hand in Dough</i>	159	87.4	10	5.5	13	7.1
Contents in a good correlation with the contents of other subjects and it is more easily learned through experience	11	6.0	165	90.7	6	3.3

Table 5. Attitudes of teachers and their knowledge about the use of experiment in integrated science teaching

Questions	Answers					
	yes		no		no attitude	
	n	(%)	n	(%)	n	(%)
Should pupils learn science contents by using experiments even in class teaching?	138	75.8	44	24.2	0	0
	yes		no		partially	
	n	(%)	n	(%)	n	(%)
Do you know how to write instructions for performing an experiment?	32	17.6	119	65.4	31	17.0
Are you familiar with the classification of experiments in integrated science teaching?	334	18.7	115	63.2	33	18.1
Are you familiar with the use of different types of pupils' experiments in teaching?	32	17.6	121	66.5	29	15.9

The attitudes of teachers towards the significance of experiment, as well as their knowledge about the use of experiment are shown in Table 5.

The attitudes of teachers towards the acquired science knowledge, as well as their needs for further education, are shown in Table 6.

Table 6. Attitudes of teachers towards their knowledge and further education in science, also methodology of integrated science teaching

Questions	Answers					
	yes		no		no attitude	
	n	(%)	n	(%)	n	(%)
Do you need continuous education in science?	153	84.1	29	15.9	0	0
Do you need continuous education in the methodology of integrated science teaching?	153	84.1	29	15.9		0
Do you have knowledge in physics you need for your teaching?	57	31.3	112	61.6	13	7.1
Do you have knowledge in biology you need for your teaching?	103	56,6	75	41,2	4	2,2
Do you have knowledge in chemistry you need for your teaching?	35	19.2	125	68.7	22	12.1
Are you trained to present science contents and to adjust them to individual potentials of pupils?	81	44.5	88	48.4	13	7.1

DISCUSSION

According to the analysis of school documentation, it was clear that *Hands in Dough* (Table 1) is the least frequently chosen by pupils (6.0%); in addition, it is the least frequently taught, in comparison to other optional subjects (4.0%). Pupils mostly choose *The Guardians of Nature* (41.0%). It covers 52.0% of all the optional subjects being taught. These results are in a correlation with the presence of suggested subjects. Teachers mostly suggest *The Guardians of Nature*, while *Hand in Dough* is the least suggested subject.

All the surveyed teachers knew that pupils had to choose one of the optional subjects. They were also aware of the total number of optional subjects that should be suggested to pupils in a particular grade. 1.6% of them did not know that every school was required to suggest at least three optional subjects - out of six. Although they were familiar with the number of optional subjects, 7.7% could not list them, i.e. 2.7% did not know which optional

subjects were suggested to pupils in the school in which they worked at that time. In fact, it means that a small number of teachers is not interested in optional subjects.

When selecting optional subjects, every school is first required to interview pupils (or their parents) about optional subject(s) they want to learn, and then school suggests the most interesting subjects according to the survey.

Surprisingly, a large percentage of teachers (70.9%) said that they surveyed neither pupils nor their parents (Table 2). It means that teachers themselves eliminate some optional subjects, favoring other ones at the same time. Teachers are supposed to circle the optional subjects they suggest to pupils. According to the obtained results, it can be concluded that teachers influence children's preferences when selecting the subject, i.e. their list of optional subjects is very similar to their pupils' list.

The attitudes of teachers towards teaching *The Guardians of Nature* and *Hands in Dough*

Teachers were asked to explain why it was difficult to teach *Hands in Dough*, as well as to make suggestions in order to improve this subject teaching, and to give their remarks. 67.6% of the surveyed did not answer to this question, indicating that they did not seriously consider the active engagement of pupils in acquiring the knowledge of science, or using the method of science research, although they believed that pupils should study such contents in the elementary school from the first to the fourth grade. 32.4% of the teachers who answered to this question mentioned why these subjects should not be taught in the elementary school, from the first to the fourth grade. Most of those who answered to the question (56.0%) believe that pupils will learn enough about the nature through compulsory subjects later, and therefore they should not be additionally burdened with such an optional subject. 20.3% of them believe that pupils are not seriously interested in this, which is partially true (Table 3).

The research shows that most pupils selected *The Guardians of Nature*, and the smallest number of them *Hands in Dough*. Their choice was influenced by an inadequate presentation of *Hands in Dough* by teachers who hardly ever suggested this subject to pupils because they lacked expertise. In this way, students were not properly informed about the subject contents. 15.4% of them think that *Hands in Dough* cannot be taught as the school is not adequately equipped. This argument is not valid because its teaching does not require any special materials, but the objects and materials for daily use in the immediate environment (Charpak, 1996, Church, 2003).

A small percentage of teachers who answered to this question (4.9%) believed that *Hands in Dough* had a very difficult and time-consuming program. They stated that they had no affinity for teaching the contents of science (3.4%) and that they did not feel competent enough. A part of the teachers who provided the answer to this question belonged to a large percentage of teachers who felt that they were not trained to teach science in the elementary school, from the first to the fourth grade.

The teachers mostly (84.1%) think that the contents of *The Guardians of Nature* and *Hands in Dough* are not interesting and adjusted to pupils (Table 4). They believe that the contents of *The Guardians of Nature* are closer to pupils in comparison to the contents of *Hands in Dough*. Such an attitude contradicts the experience of teachers in France and other EU countries, which successfully teach *Hands in Dough*. *The Guardians of Nature* is not aimed at acquiring the knowledge in ecology, but at developing a responsible attitude towards the nature and the environment. Pupils should reach these goals through games, ecological experiments, workshops, environmental actions and similar activities which require creativity, expertise and training in teaching. Only 15.9% of respondents believe that the above-mentioned subjects have very interesting programs, which encourages students' curiosity and desire to explore the nature. A very small number of teachers (6.0%) think that the contents of these subjects are in a good correlation with the contents of other subjects, and that it is easier to learn experientially.

Why is *The Guardians of Nature* in the first place on the list of optional subjects teachers suggest to their students, i.e. why is their teaching level the highest (up to three times higher in comparison to the second-ranked subject *From Toys to Computers*), if the majority of teachers believe that the contents are difficult and unadjusted to pupils? The answer may imply that these contents are closer to teachers, because they are about the environmental protection and improvement, than the contents of other subjects where teachers are expected to be familiar with the culture and tradition of different nations, such as *The National Tradition* and *Mother Tongue with the Elements of National Culture*. It should be emphasized that there are 27 ethnic groups in multinational and multireligious Vojvodina; the elementary school teaching is done in 6 languages; and there are students sitting in the same classes and belonging to different ethnic communities. In order to teach *From Toys to Computer*, teacher must have good computer knowledge.

Unlike *The Guardians of Nature*, which primarily includes the environmental contents, *Hands in Dough* requires teachers to have good science knowledge, ability to teach the multidisciplinary contents, and ability to use different types of experiments. In order to achieve the goal by organizing experimental classes, it is necessary to prepare experiment for the teaching

purposes. The methods for using experiments are reflected in the selection of experiments and its relation with the teaching unit which is going to be taught. The teacher must know in which part of his class to use experiment (Cvjetičanin, 2009). Experimental teaching must always represent a well-balanced unity, in which word and experiment are closely related. The teacher must know how to choose a *good, correct and necessary (from teaching viewpoints) experiment*.

The teacher must know how to choose and properly write the instructions depending on the purpose and the type of experiment (Gelman, 2004). In the case of instructions for *Hands in Dough*, the teacher needs to be much familiar with different types of experiments, such as: heuristic experiments, surprise experiments, preliminary experiments for confirmation; induction experiments, verification experiments, experiments for using the existent knowledge, experiments for revising the previously learnt contents, research experiments, quantitative experiments, etc. (Kramer, 1987). The range of requirements regarding *Hands in Dough* is definitely one of the reasons why the majority of teachers rarely suggest this subject to pupils, so it is rarely taught.

Although 75.8% of the surveyed believe that pupils should learn about science through using experiments in teaching from the first to the fourth grade in order to comprehend contents more easily, it has been noticed that most of them are not competent to use experimental teaching (Table 5). They point out that they do not clearly distinguish different types of experiments, their use in the class, and the ways of writing instructions for performing students' experiments in relation to the class objectives and tasks. This is the reason why they avoid *Hands in Dough* in their lists of suggestions. Only 17.6% of them did consider themselves qualified for good teaching with the use of laboratory experimental methods. Although all the surveyed teachers had the subjects focused on the natural sciences during their studies, obviously it was not enough for them to teach science from the first to the fourth grade.

The attitudes of teachers towards continuous education in science and methods of integrated science teaching

A high percentage of teachers (84.1%) has pointed out that they want to permanently receive education in science, aware that the rapid development of science continuously requires innovations in integrated science teaching. They think that they have a lower level of knowledge about physics and chemistry (Table 6), compared with biology, because contents in the field of biology are more frequently included in the curriculum of elementary school

teacher education. Teachers emphasize that they are not sufficiently trained to teach science and to adjust such contents to the individual needs of pupils. It is not an insignificant percentage of teachers who do not want permanent education in the natural sciences (15.9%). They claim that, during their institutionalized education, they acquired enough science knowledge, which is necessary to teach about the nature from the first to the fourth grade, i.e. the knowledge which meets the needs of pupils in learning. Curiosity and desire to learn more about the world is typical for children from the first to the fourth grade. Such an attitude, shown by a small number of teachers, can inhibit children's motivation to study the nature and do the independent research. They are not motivated to work, they have a traditional approach to education, i.e. they do not understand the importance of continuous innovations in teaching about the nature, and bring them closer to the interests and needs of pupils.

Starting from the obtained results, it is necessary to create a continuous education model for elementary school teachers specialized in the natural sciences, as well as to incorporate appropriate changes in the education of elementary school teachers. These changes should enable students to acquire better knowledge from various fields of science, engineering and technology, history and philosophy of science, as well as from integrated science teaching methods. It is important that the educational system of the Republic of Serbia supports changes in this segment of teacher education, i.e. supports the education of teachers who will teach integrated science contents in the early elementary school. In this way, there will be teachers able to improve the knowledge of elementary school pupils about the nature, and to help them easily get involved in independent (different subjects) science teaching in the later period.

CONCLUSION

The majority of teachers independently create a list of optional subjects for their pupils. Most of them include *The Guardians of nature*, so this ecological subject is mostly selected by pupils. It is taught three times more than *From Toys to Computers*, which is the second-ranked in the list of their favorite subjects. *Hands in Dough* is the least frequently suggested to pupils; they are hardly interested in it, and it is taught to the smallest extent, compared with other optional subjects. Attitudes of teachers towards the optional subjects focused on science affect the interests of pupils. A small number of teachers think that they are qualified for good science teaching in the elementary school. A few teachers, therefore, suggested *Hands in Dough* to

their pupils. This subject requires teachers to be better educated about science, methods of experimental teaching, able to present contents in an appropriate teaching way, and adjust them to pupils' mental and physical characteristics. The surveyed teachers need continuous education in science as well as the help of their associates. The curriculum for advanced education of elementary school teachers should increase the amount of science contents, laboratory exercises, and methods of integrated science teaching. The Republic of Serbia should introduce the concept of early integrated science teaching into the education of elementary school teachers.

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PROBLEMI UČITELJA U REALIZACIJI IZBORNIH PREDMETA PRIRODNIH ZNANOSTI U RAZREDNOJ NASTAVI U SRBIJI

SAŽETAK

U Republici Srbiji djeca u razrednoj nastavi trebaju odabrati tri izborna predmeta od ponuđenih šest. Među izbornim predmetima su i predmeti prirodnih znanosti, Čuvari prirode i Ruka u tijestu. Cilj rada je analiza zastupljenosti i realizacije tih predmeta u nastavi, kao i analiza problema s kojima se učitelji susreću tokom njihove realizacije. U istraživanju su sudjelovala 182 učitelja iz Vojvodine. Primijenjena je analitičko-deskriptivna metoda. Instrument istraživanja je anketa, konstruirana na temelju postavljenoga cilja. Većina anketiranih učitelja više realizira predmet Čuvari prirode, jer su im sadržaji lakši, nego predmet Ruka u tijestu. Oni navode da nemaju dovoljno stručnog i metodičkog znanja za primjenu znanstvene metode, što se uči u predmetu Ruka u tijestu, kao i potrebnu literaturu i tehničke mogućnosti, zbog čega ovaj predmet djeci ne nude kao izborni. Nužno je daljnje stručno i metodičko usavršavanje učitelja u primjeni znanstvene metode da bi povećali kompetencije za poučavanje u sklopu predmeta Ruka u tijestu i djeci omogućili bolje znanje iz područja prirodnih znanosti.

Ključne riječi: izborni predmeti, problem u realizaciji prirodnih znanosti, razredna nastava, Srbija, učitelji.

UVOD

Sve se uspješne obrazovne reforme u svijetu načelno zasnivaju na podizanju razine obrazovanja u domeni prirodno-matematičkih znanosti (Ivanović, 2000). Suvremeni obrazovni koncepti stoga ističu važnost obrazovanja u području znanosti. Navedeno znanje postaje važnim čimbenikom ekonomske moći, a njegov razvojni stupanj utječe na razvoj cjelokupnoga društva (Davies, 2004). Neke razvijene zemlje, ponajprije Sjedinjene Američke Države, Francuska i Velika Britanija, zabrinuto smatraju da će gubiti svoju konkurentnost u ekonomskom svijetu čak i više ako ne nastave poboljšavati kvalitetu obrazovanja u znanstveno-tehničkom području (Lederman, 2008). Pravodobno i rano uvođenje znanosti u nastavu opravdava se obavljanjem funkcionalnih zadataka te razvojem znanstvenoga pogleda na svijet, kritičkoga

mišljenja, fleksibilnosti i različitih kognitivnih stilova učenja. Nacionalni obrazovni cilj u Sjedinjenim Američkim Državama naglašava zahtjev prema kojemu američki učenici moraju biti najuspješniji u prirodno-matematičkim znanostima. Zemlje članice Europske Unije usvojile su 2001. godine strategijske ciljeve obrazovanja i stručnog usavršavanja do 2010. godine, među kojima se osobito ukazuje na povećanu stopu upisa na studentske programe iz toga područja.

Kriza ranog obrazovanja u znanstveno-tehničkoj domeni postoji u svim obrazovnim sustavima. U zemljama članicama Europske Unije i Sjedinjenim Američkim Državama poučavanje znanstvenih sadržaja nastoji se popularizirati tako da se učenicima od najranije školske dobi omogući lakši pristup njihovu usvajanju. Jedan je od najvažnijih projekata „znanstvene pismenosti“, naslovljen *Ruke gore* i pod Ledermanovim vodstvom, obuhvaćao 50 000 od ukupno 400 000 učenika iz škola u Chicagu. Projekt se proširio na ostala područja Sjedinjenih Američkih Država te znatno uzburkao cjelokupni američki obrazovni sustav. Velika Britanija je još 1991. godine pokrenula program (Curry, 1992) pod nazivom SAE (*Science Across Europe*, Znanost u cijeloj Europi). Na kraju dugogodišnjeg istraživanja uspjeli su definirati obrazovne ciljeve koji će biti zajednički za sve zemlje članice, a to su:

- o približiti učenicima znanstvene sadržaje,
- o istaknuti prirodne pojave koje su sastavni dio našega svakodnevnoga života,
- o uspostaviti, odnosno unaprijediti interdisciplinarnost,
- o ponuditi globalnu dimenziju obrazovanja, to jest omogućiti pristup informacijama koje su dostupne učenicima u jednoj zemlji, a važne su pri rješavanju identičnih problema u nekoj drugoj zemlji, i
- o razviti komunikacijske vještine na stranim jezicima.

Pod patronatom Francuske akademije znanosti i uz potporu Zaklade Trey u Francuskoj je 1996. godine pokrenuta inicijativa usmjerena na podizanje kvalitete osnovnog obrazovanja s obzirom na poučavanje znanstvenih sadržaja. Ugledni su francuski fizičari bili zabrinuti za situaciju u ranom poučavanju prirodnih znanosti te su započeli proces njegove reforme (Charpak, 1996). Potaknuti programom *Hands on* (*Ruke gore*), čiji je cilj bio unaprijediti poučavanje znanosti u američkim osnovnim školama, francuski su znanstvenici predložili program pod nazivom *La main a la suffer* (*Znanost u osnovne škole*). Oba su programa, američki i francuski, nastala na temelju fenomena dobro poznatoga svim pedagozima u svijetu, a to je posebno zanimanje što ga predškolska i djeca u ranoj školskoj dobi pokazuju za eksperimente. Rano je poučavanje znanstvenih sadržaja, zasnovano na eksperimentu kao primarnom

izvoru samoga znanstvenoga znanja, polučilo znatne učinke. Integrirani je pristup znanstvenim sadržajima u početnim fazama poučavanja učenicima omogućio uvid u prirodu sa svim njezinim pojavnostima i procesima.

Nekoliko je godina poslije Europska Unija pokrenula sličan dvogodišnji projekt. Naslovljen je GRID (*Growing Interest in the Development of Teaching Science*, Povećano zanimanje za kvalitetniju nastavu iz predmeta znanstvenog usmjerenja) i provodio se kao dio programa Socrates 6 u razdoblju od 2004. do 2006. godine. Njegov je koordinator bilo francusko Sveučilište u Lorraineu. Obuhvaćao je uglavnom britanske, belgijske, finske, irske, mađarske i talijanske institucije. Jedan od aktualnih programa je Lisabonska strategija 2010. Vijeće Europe donijelo je odluku o navedenoj strategiji u ožujku 2000. godine (http://ec.europa.eu/education/lifelong-learning-policy/doc1120_en.htm). Na sastanku je tada odlučeno da glavni cilj Europske Unije do 2010. godine bude postati najjačom, najkonkurentnijom, vodećom obrazovnom silom u zapadnom dijelu svijeta (Rodrigues, 2003).

Integrirana nastava u području znanosti

U razvijenim se zemljama integrirana nastava u području znanosti provodi tijekom različitih vremenskih razdoblja. U Francuskoj se tako integrirano pristupa poučavanju prirodnih i nekih društvenih znanosti već pet godina, s tjednim fondom od 4 sata, u Njemačkoj dvije godine (u trećem i četvrtom razredu), s istim tjednim fondom sati (4), u Italiji pet, a u Švedskoj tri godine (četvrti, peti i šesti razred) s tjednim fondom od 6 sati, te u Grčkoj dvije godine (treći i četvrti razred). Nastavni plan i program (NRSC) u Sjedinjenim Američkim Državama omogućuje integrirani pristup poučavanju znanstvenih sadržaja na osam razina. Prvih se šest razina realizira kao Znanost i tehnologija za djecu, dok su sedma i osma razina pod nazivom Znanstveni i tehnološki koncepti za srednje škole. Nastava se provodi u dva integrirana područja, Znanost na Zemlji i život te Fizičke znanosti i tehnologija. Integrirana se nastava o prirodi i znanosti u Japanu provodi već deset godina, a tjedni joj je fond 3 sata.

Zemlje nastale raspadom Jugoslavije također su zadržale koncept integrirane nastave u nižim razredima osnovne škole. U nekim novoosnovanim državama integrirano je poučavanje znanstvenih sadržaja reformirano i usklađeno s europskim zahtjevima. U Republici Srbiji osnovnoškolsko obrazovanje traje osam godina, prva su četiri razreda niži razredi, a predmetna se nastava provodi od petoga do osmoga razreda. Poučavanje se znanstvenih sadržaja u osnovnoj školi u Srbiji provodi kao *integrirana nastava o prirodnim i znanstvenim fenomenima (od prvoga do četvrtoga razreda)* i kao *predmetna*

nastava (od petoga do osmoga razreda). Nastavu izvode učitelji i predmetni nastavnici (nastavnici koji poučavaju samo jedan ili dva predmeta). S obzirom na najnovije promjene u nastavnom planu i programu za osnovne škole u Republici Srbiji, niži razredi imaju integriranu nastavu iz područja prirodnih i društvenih znanosti u formi obaveznih predmeta *Svijet oko nas* (2 sata tjedno u prva dva razreda) i *Priroda i znanost* (samo 2 sata tjedno u trećem i četvrtom razredu). *Čuvari prirode* i *Ruke u tijestu* ponuđeni su kao izborni predmeti u svim razredima s jednim satom nastave tjedno. Sličan koncept poučavanja znanstvenih sadržaja u nižim razredima osnovne škole postoji u Rusiji i Bugarskoj.

Rezultati testiranja znanja iz područja znanosti uz primjenu nekih europskih instrumenata kao što su TIMS and PISA ukazuju na zabrinjavajuće zaostajanje učenika iz Srbije u odnosu na učenike iz drugih europskih zemalja. U Republici Srbiji nastavnim se planom i programom nastoji uspostaviti ravnoteža između integracije i diferencijacije nastavnih sadržaja. Obrazovno se područje s prirodno-matematičkim sadržajima postupno diferencira prema relativno neovisnim predmetima u višim razredima. Obvezni se predmeti u osnovnoj školi mogu klasificirati u pet različitih obrazovnih područja: jezik i umjetnost; prirodno-matematičko; društveno; zdravstveno; i radno-tehničko područje. U višim razredima prevladavaju predmeti iz prirodno-matematičkoga područja u odnosu na predmete iz društvenoga područja. Uvođenje predmeta kao što su *Biologija* i *Zemljopis* u peti razred omogućuje nastavak usvajanja njihovih sadržaja poslije realizacije predmeta *Priroda i društvo*. Takav je nastavak onemogućen kada je riječ o predmetima kao što su *Fizika* i *Kemija*. U prvom slučaju prekid iznosi jednu godinu, a u drugom slučaju čak dvije godine.

Osobit problem pri realizaciji suvremenih koncepata osnovnoškolskoga poučavanja znanstvenih sadržaja u Republici Srbiji predstavlja nedostatak nastavnog osoblja. Nastava je iz tih predmeta opterećena nedostatnim brojem odgovarajuće osposobljenih predavača. Pojava je negativne selekcije najčešće na djelu pri odabiru stručnjaka obrazovnoga profila. Situacija je čak složenija kada je riječ o integriranom pristupu poučavanju znanosti. Vrlo je malo preddiplomskih studijskih programa za taj obrazovni profil. Nomenklatura zanimanja u području obrazovanja u Srbiji ne propisuje obrazovni profil za *učitelje specijalizirane za integrirano poučavanje prirodnih znanosti* ili *profesore prirodnih znanosti*. Obrazovanje učitelja za provedbu integrirane nastave znanstvenog usmjerenja predstavlja zahtjevniji zadatak u odnosu na obrazovanje predmetnih nastavnika istoga usmjerenja jer bi trebalo biti organizirano tako da omogući sveobuhvatan pregled suvremene situacije u širokom području znanosti, tehnike i tehnologije. Dakako, njihov sadržaj ne bi trebao biti previše opsežan, ali bi trebao omogućiti budućim učiteljima kontinuirano znanstveno obrazovanje da bi odgovorili zahtjevima suvremene

nastave iz područja znanosti. Osim toga, takvo obrazovanje mora imati čvrstu potporu obrazovanja iz područja povijesti i filozofije znanosti da bi omogućilo cjelovit uvid u prirodu sa svim njezinim fenomenima i procesima.

Takva se nastava obično planira provesti u ranoj fazi obrazovnoga razdoblja, a budući učitelji, osposobljeni za integriranu nastavu o prirodi, moraju steći nužno obrazovanje u jednom vrlo širokom i složenom metodičkom, pedagoškom te psihološkom području. Problem učitelja specijaliziranih za rano integrirano poučavanje prirodno-znanstvenih sadržaja u Republici Srbiji obično se rješava angažmanom osnovnoškolskih učitelja – učitelja od prvoga do četvrtoga razreda. Potrebno je, međutim, imati u vidu da akademsko obrazovanje budućih učitelja koji će poučavati takve sadržaje u osnovnim školama nije na zadovoljavajućoj profesionalnoj razini. Ono se odvija praktično tijekom dva semestra nastave posvećene znanstvenim sadržajima, pri čemu oni nisu uvijek ravnomjerno raspoređeni, te je bipolarnost skoro uvijek primjetna. Neki suvremeni koncepti integrirane nastave u domeni prirodnih znanosti, primjerice u Mađarskoj, nastoje prevladati ovaj problem povremenim uključivanjem predmetnih nastavnika u integriranu nastavu.

U Francuskoj je, u sklopu programa *La Main a la pate (Ruka u tijest)*, učiteljima organizirana široka stručna potpora pri realizaciji integrirane nastave zasnovane na znanstvenim sadržajima. To u biti znači da su učitelji dobili pomoćne učitelje, uglavnom studente znanstvenih područja (nastavnički smjer), te studente tehničkih i inženjerskih usmjerenja. Organizirana im je također pomoć elektronskim putem – učiteljima su bile dostupne brojne elektronske adrese odakle su dobili potrebne upute za provedbu integrirane nastave. Sve su to samo privremena rješenja jer je integrirana nastava o znanstvenim sadržajima osobito zahtjevna u smislu odabira sadržaja, metoda i oblika učenja. Jedan od mogućih koncepata pružanja odgovarajućega kadra za integriranu nastavu jest napredno usavršavanje učitelja ili predmetnih nastavnika za pojedine znanstvene predmete putem poslijediplomskih studija. Takav koncept postoji u Velikoj Britaniji. U mnogim se europskim zemljama učitelji osposobljavaju na seminarima specijaliziranim za integriranu nastavu na znanstvene teme, koje odobravaju obrazovne vlasti. Poslijediplomski studij i napredno usavršavanje na odgovarajućim seminarima imaju smisla jedino u obrazovnim sustavima u kojima postoji razvojna linija stručnog usavršavanja učitelja s jasno određenim protokolom licenciranja.

Uvođenje učitelja za integriranu nastavu zasnovanu na znanstvenim sadržajima u suvremeno obrazovanje mora biti povezano s odabirom i pripremom obrazovnih stručnjaka. Potrebno je stoga provesti opsežno istraživanje o potrebama za dodatnim stručnim usavršavanjem obrazovnih stručnjaka na temelju prethodno utvrđenih obrazovnih standarda u znanosti (Lamanauskas i Vilkoniene, 2008; Huinker i Madison 1997). Ovaj ogroman

posao trebaju zajednički i dogovorno obaviti znanstvenici, psiholozi i pedagozi da bi pripremili nastavni plan i program temeljen na istinski integriranom pristupu (Blumenfeld Krajcik, Marx i Soloway 1994, Riquarts i Henning 1998). Međutim, skoro svi modeli integrirane nastave predstavljaju izolirana biološka, fizička, kemijska i zemljopisna stajališta o prirodnim fenomenima i procesima (Nezvalova, 2007). Postoji neznatno mali broj pravih integriranih sadržaja, s iznimkom američkoga koncepta koji naglašava modul usvajanja znanstvenih sadržaja uz pomoć potpunoga integriranoga pristupa. Da bi se prihvatilo integrirano poučavanje znanstvenih sadržaja, a znanstveni sadržaji približili najmlađim dobnim skupinama, nužno je nastojati (Watters i Ginns 2000) prihvatiti stajališta o potrebi pružanja takvih sadržaja svima bez obzira na razinu osnovnoškolskog obrazovanja - znanstvena pismenost za svakoga (Marbach-Ad i McGinnis, 2008).

Priprema učitelja za integriranu nastavu zasnovanu na znanstvenim sadržajima može biti uspješna ako postoje lako razumljivi standardi potrebnoga stručnoga i pedagoškoga znanja. Stručnost bi se u području znanosti trebala temeljiti na znanju o konceptima i načelima koja su zajednička svim znanstvenim disciplinama (Lang, 2000). Opći znanstveni koncepti i načela potječu od konceptata i odnosa u pojedinim znanstvenim područjima i disciplinama, a obuhvaćaju primjenu matematike u znanstvenom istraživanju (Marble, 2007). Pedagoško se znanje treba zasnivati na konstruktivističkim idejama, a konstrukcija znanja treba počivati na analizi i metaforama, apstraktnome i konceptualnome shvaćanju sadržaja (Nezvalova, 2007). Planirani su pedagoški sadržaji organizirani u dobro planiranome modelu istraživanja pedagoškoga sadržaja na učiteljskim fakultetima, a obuhvaćaju sljedeće: aktivnosti i strategije učenja, organizaciju školskog iskustva uz poštovanje individualnih potreba, vrednovanje i primjenu prethodno usvojenoga znanja i prenošenje ideja u razumljive segmente. Pri obrazovanju učitelja za integriranu nastavu o znanosti posebna se pozornost mora posvetiti odnosu između znanstvenoga i metodičkoga sadržaja. Metodički sadržaj mora biti tako strukturiran da omogući rješenja za složene problemske situacije pri usvajanju prirodnih fenomena i procesa (Davis, 2004).

METODE

Problem i predmet istraživanja

Djeca trebaju obogatiti svoje znanje o prirodi putem izbornih predmeta da bi lakše shvatila jednostavne uzročno-posljedične odnose u prirodi, postupno formirala koncepte i učila o fazama znanstvenog istraživanja prirode.

Izborni predmet Čuvari prirode razvija pravilna ekološka stajališta i ponašanje. U sklopu izbornoga predmeta Ruke u tijestu djeca uče o znanstvenoj metodi i njenoj primjeni u istraživanju prirode. Potrebno je odrediti koji se izborni predmeti nude djeci. Itekako je bitno također utvrditi moguće probleme pri njihovoj provedbi da bi se oni mogli riješiti. Dobiveni bi rezultati trebali omogućiti provedbu kvalitetne integrirane nastave u domeni prirodnih znanosti.

Cilj istraživanja

Cilj je rada analiza problema s kojima se učitelji suočavaju pri realizaciji izbornih predmeta Čuvari prirode i Ruke u tijestu te analiza njihovih stajališta o daljnjem usavršavanju u području prirodnih znanosti i metodike integrirane nastave prirodnih znanosti da bi se poboljšala njezina kvaliteta.

Istraživačke hipoteze

Glavna je sljedeća hipoteza: Učitelji imaju specijalno stručno, metodičko znanje i motivaciju kada je riječ o izbornim predmetima *Čuvari prirode* i *Ruke u tijestu*, što dovodi do visoke kvalitete u samoj njihovoj realizaciji. Učitelji žele kontinuirano unaprjeđivati svoje znanje da bi poboljšali integriranu nastavu iz područja prirodnih znanosti.

Istraživačke metode i tehnike, istraživački instrumenti

U ovome je istraživanju primijenjena deskriptivno-analitička metoda. Korištene su sljedeće tehnike: terensko istraživanje, akcijsko istraživanje i kombinirane tehnike. Istraživanje je provedeno u 14 osnovnih škola na području Vojvodine. Akcijsko je istraživanje odabrano s ciljem analize realizacije izbornih predmeta na temelju školske dokumentacije i načina predstavljanja predmeta *Čuvari prirode* i *Ruke u tijestu*. Nastavni plan i program predviđa izborne predmete koji integriraju znanstvena područja jer postoje u suvremenom društvu, a njihovi su sadržaji prilagodljivi mlađim učenicima. Praksa, pak, pokazuje da je realizacija predmeta *Ruke u tijestu* na niskoj razini, kao i to da mali broj učenika bira navedeni predmet. Primijenjeno je stoga akcijsko istraživanje da bi se utvrdili razlozi za takvu situaciju. Akcijsko je istraživanje započelo nakon suglasnosti svih sudionika, a cilj mu je unaprijediti kvalitetu integrirane nastave u navedenoj domeni. Autori su nastojali steći uvid u mišljenje nastavnika o mogućim načinima otklanjanja problema pri realizaciji

gore spomenutoga nastavnoga predmeta. Korišten je uobičajeni model akcijskog istraživanja (Suzic, 2007) sa sljedećim fazama:

- o planiranje istraživanja
- o posjet školama i analiza školske dokumentacije da bi se utvrdila zastupljenost izbornih predmeta u nastavnoj praksi, s posebnim osvrtom na izborne predmete iz područja integriranih znanosti,
- o razgovor s nastavnicima, njihovo upoznavanje s ciljem istraživanja, stjecanje uvida u njihove prijedloge na temu realizacije nastave iz tih područja, a sve s ciljem pripreme instrumenta (upitnik);
- o pripremanje upitnika,
- o posjet školama, provođenje ankete uz pristanak nastavnika;
- o analiza rezultata prikupljenih uz pomoć ankete;
- o zaključci istraživanja i određivanje mogućih smjernica za prevladavanje postojećih problema u provedbi integrirane nastave na znanstvene teme.

Pedagoški rečeno, od akcijskoga se istraživanja u ovome radu očekivalo da pokaže stajališta učitelja prema izbornim predmetima u području integriranih znanstvenih disciplina, njihove potrebe i zanimanje za daljnje znanstveno obrazovanje te metodologiju integriranoga poučavanja znanosti. U provedenom je akcijskom istraživanju primijenjeno načelo refleksivne kritike, što pretpostavlja da su se svi sudionici slobodno mogli kritički osvrnuti na izborne prirodno-znanstvene predmete i njihovu realizaciju.

Upitnik je olakšao analizu problema u provedbi navedenih izbornih predmeta, kao i stajališta učitelja o kontinuiranom znanstvenome obrazovanju i nastavnim metodama u slučaju integriranoga pristupa. Instrument se odnosio na upitnik, konstruiran na temelju niza istraživačkih zadataka. Obuhvaćao je 25 pitanja. Elementi su upitnika u obliku pitanja otvorenog i zatvorenog tipa. Dobiveni su rezultati statistički obrađeni. Elementi su upitnika podijeljeni u tri skupine. Cilj prve skupine bio je utvrditi kako učitelji pripremaju i prezentiraju učenicima/roditeljima popise izbornih predmeta. Druga je skupina ispitivala stajališta učitelja o predmetima *Čuvari prirode* i *Ruke u tijestu*, te njihovu važnost za učenike. Treća je skupina bila namijenjena ispitivanju stajališta učitelja o budućem znanstvenom obrazovanju i nastavnim metodama u integriranom poučavanju znanosti s ciljem stjecanja novoga znanja i podizanja kvalitete nastave u toj domeni.

Uzorak

Uzorak su činila 182 nastavnika iz 14 škola u Vojvodini. Anketa je provedena 2010./2011. godine. Ovo je istraživanje obuhvaćalo učitelje koji su imali najmanje 5 godina radnog iskustva u nastavi jer oni u Srbiji mogu dobiti licencu tek nakon pet godina provedenih u nastavi. Prosječna dužina radnog odnosa anketiranih učitelja iznosila je 18 godina. Većina je anketiranih (91.93%) bila zaposlena u gradskim osnovnim školama. 98.92% njih imalo je obrazovanje potrebno za poučavanje od prvoga do četvrtoga razreda, stekavši naziv učitelja, dok je preostalih 1.08% steklo obrazovanje potrebno za predmetnoga nastavnika. Zaključeno je, dakle, da je većina sudionika istraživanja kvalificirana poučavati od prvoga do četvrtoga razreda. To ne znači da su anketirani teorijski i metodički osposobljeni na istoj razini da bi realizirali integriranu nastavu u nižim razredima osnovne škole, zbog multidisciplinarnosti i interdisciplinarnosti sadržaja. Njihova je realizacija pod utjecajem osobnih sklonosti prema znanosti i sposobnosti da metodički preoblikuju znanstveni sadržaj te ga prilagode mentalnim osobinama učenika osnovne škole od prvoga do četvrtoga razreda. Važno je naglasiti da su svi anketirani, tijekom svojega školovanja, imali predmete u sklopu kojih su usvajali znanstvene sadržaje i metode njihova poučavanja.

REZULTATI

Anketni su rezultati organizirani u tri kategorije, prema utvrđenim istraživačkim zadacima:

- o način na koji se biraju izborni predmeti,
- o stajališta učitelja o izbornim predmetima integriranih znanstvenih disciplina, i
- o stajališta učitelja o njihovu vlastitu stručnom usavršavanju s ciljem poučavanja gore navedenih predmeta te njihova stajališta o potrebama daljnega stručnog usavršavanja.

Anketni su rezultati obrađeni uz primjenu odgovarajućega statističkoga postupka, SPSS statističkoga paketa. Popis izbornih predmeta i njihova realizacija prikazani su u Tablici 1. Upućenost nastavnika u načine odabira i predstavljanja izbornih predmeta prikazana je u Tablici 2.

Tablica 1.

Tablica 2.

Mišljenje nastavnika o razlozima slabe realizacije izbornoga predmeta *Ruke u tijestu* prikazano je u Tablici 3, dok su stajališta nastavnika o sadržaju izbornih predmeta u području znanosti prikazana u Tablici 4. Potrebno je spomenuti da nisu svi nastavnici iznijeli svoja stajališta o razlozima nedovoljne realizacije izbornih predmeta u području integriranih znanosti.

Tablica 3. Mišljenje nastavnika o razlozima nedovoljne realizacije izbornoga predmeta *Ruke u tijestu*

Tablica 4.

Stajališta učitelja o važnosti eksperimenta, kao i njihova znanja o primjeni eksperimenta prikazana su u Tablici 5.

Tablica 5.

Stajališta učitelja o usvojenom znanju iz područja znanosti te potrebi daljnjeg obrazovanja prikazana su u Tablici 6.

Tablica 6.

DISKUSIJA

Na temelju analize školske dokumentacije očito je da učenici najmanje (6.0%) biraju izborni predmet *Ruke u tijestu* (Tablica 1), kao i to da je njegova realizacija na najnižoj razini (4.0%) u odnosu na ostale izborne predmete. Učenici uglavnom biraju predmet *Čuvari prirode* (41.0%). Na njega otpada 52.0% od ukupne realizacije svih izbornih predmeta. Ovi rezultati koreliraju sa zastupljenošću predmeta u ponudi. Učitelji zaduženi za izborne predmete uglavnom učenicima predlažu predmet *Čuvari prirode*, dok im najmanje predlažu predmet *Ruke u tijestu*.

Svi su anketirani znali da učenici moraju odabrati jedan od izbornih predmeta u ponudi. Bili su također svjesni ukupnoga broja izbornih predmeta koji bi trebali biti ponuđeni učenicima u određenome razredu. 1.6% učitelja nije znao da svaka škola ima obavezu učenicima ponuditi najmanje tri izborna predmeta od ukupno šest. Iako im je broj izbornih predmeta bio poznat, 7.7%

učitelja nije ih znao nabrojati, odnosno 2.7% njih nije znalo koji se izborni predmeti nude učenicima u školi u kojoj su tada bili zaposleni. To zapravo znači da mali broj učitelja ne pokazuje zanimanje za izborne predmete.

Pri odabiru izbornoga predmeta, od svake se škole prvo traži razgovor s učenicima (ili njihovim roditeljima) o tome koji izborni predmet žele učiti, a zatim im škola predlaže predmete koji su najzanimljiviji učenicima i njihovim roditeljima, prema anketi.

Iznenadujuće je veliki postotak učitelja (70.9%) naveo da ne intervjuiraju ni učenike niti njihove roditelje (Tablica 2). To znači da samoinicijativno eliminiraju neke izborne predmete u korist nekih drugih. Pretpostavlja se da zaokruže nazive izbornih predmeta koje predlažu učenicima. U skladu s dobivenim rezultatima, zaključak je da učitelji utječu na želje učenika pri odabiru predmeta, odnosno da je njihov popis izbornih predmeta vrlo sličan popisu učenika.

Stajališta učitelja o realizaciji izbornih predmeta *Čuvari prirode* i *Ruke u tijestu*

Učitelji su trebali navesti razloge zbog kojih je teško realizirati izborni predmet *Ruke u tijestu* te dati konkretne prijedloge i zapažanja o tome kako bi se njegova realizacija mogla učiniti uspješnijom. 67.6% anketiranih nije uopće odgovorilo na pitanje, što ukazuje na to da nisu ozbiljno pristupili aktivnom sudjelovanju učenika u stjecanju znanja iz područja znanosti ili prihvaćanju znanstvene istraživačke metode. Ipak, vjeruju da učenici trebaju usvajati takve sadržaje od prvoga do četvrtoga razreda osnovne škole. 32.4% učitelja, koji su odgovorili na pitanje, navelo je razloge zbog kojih taj predmet ne bi trebalo realizirati od prvoga do četvrtoga razreda osnovne škole. Većina onih koji su dali odgovor (56.0%) smatra da će djeca učiti o prirodi u sklopu obaveznih predmeta u višim razredima te ih ne treba dodatno opterećivati izbornim predmetom. 20.3% učitelja vjeruje da učenici ne pokazuju veliko zanimanje za taj predmet, što je djelomično točno (Tablica 3).

Anketa pokazuje da većina učenika, među ponuđenim izbornim predmetima, bira predmet *Čuvari prirode*, dok je najmanji broj onih koji se opredjeljuju za predmet *Ruke u tijestu*. Na takav odabir utječe njegovo predstavljanje od strane učitelja, koji ga najmanje predlažu učenicima zbog nedostatne stručnosti. Djeca tako nisu dobro informirana o njegovu sadržaju. 15.4% učitelja misli da se predmet *Ruke u tijestu* ne može realizirati jer škola ne raspolaže odgovarajućom opremom. Taj argument nije važeći jer njegova realizacija ne zahtijeva nikakav poseban nastavni materijal već predmete i

materijale za svakodnevnu uporabu iz najbližeg okruženja (Charpak, 1996, Church, 2003).

Mali postotak učitelja koji su na ovo pitanje odgovorili (4.9%) vjeruje da predmet *Ruke u tijestu* ima vrlo težak i vremenski zahtjevan program. Tvrdi da nemaju sklonosti za nastavu o znanstvenim temama (3.4%) i da se ne osjećaju dovoljno kompetentnima. Dio učitelja koji nisu odgovorili na ovo pitanje pripada velikom postotku onih koji se ne osjećaju dovoljno stručno i metodički osposobljenima da bi poučavali o znanosti u osnovnoj školi, od prvoga do četvrtoga razreda.

Većina nastavnika (84.1%) misli da su predmeti *Čuvari prirode* i *Ruke u tijestu* nezanimljivi i neprilagođeni učenicima (Tablica 4). Uvjereni su da je prvi predmet sadržajno bliži učenicima. Takva su stajališta u suprotnosti s onima koje imaju učitelji u Francuskoj i ostalim zemljama članicama EU, gdje se nastava iz predmeta *Ruke u tijestu* uspješno provodi. Cilj predmeta *Čuvari prirode* nije steći znanje iz ekologije već razviti pravilan odnos prema prirodi i postojećem okolišu. Djeca trebaju prihvatiti ove ciljeve kroz igru, eksperimente, radionice, ekološke i slične aktivnosti koje zahtijevaju kreativnost, stručnost i metodičko obrazovanje učitelja. Samo 15.9% anketiranih vjeruje da navedeni predmeti imaju vrlo zanimljiv program koji potiče znatiželju učenika za istraživanjem prirode. Zanimljivo je da broj učitelja (6.0%) misli da sadržaj tih predmeta nije u dobroj korelaciji sa sadržajem ostalih predmeta te da je lakše učiti kroz iskustvo.

Sljedeće pitanje glasi: zašto je predmet *Čuvari prirode* prvi na popisu izbornih predmeta koje učitelji nude učenicima, odnosno zašto je njegova realizacija na najvišoj razini (tri puta veća u odnosu na predmet *Od igračaka do računala* na drugom mjestu), ako većina učitelja vjeruje da je sadržajno težak i neprilagođen učenicima. Odgovor možda leži u činjenici da je sadržajno bliži učiteljima jer govori o zaštiti i očuvanju prirode u usporedbi s drugim predmetima gdje se od učitelja očekuje znanje o kulturi i tradiciji različitih naroda, kao što je *Narodna tradicija* ili *Materinski jezik s elementima nacionalne kulture*. Nužno je istaknuti da u multinacionalnoj i multikonfesionalnoj Vojvodini postoji 27 etničkih skupina; da se nastava u osnovnoj školi realizira na 6 jezika; te da učenici u istim razredima pripadaju različitim etničkim zajednicama. Za realizaciju predmeta *Od igračaka do računala* učiteljima je potrebno solidno informatičko znanje.

Za razliku od predmeta *Čuvari prirode*, koji se uglavnom bavi ekološkim temama, *Ruke u tijestu* zahtijeva od učitelja dobro znanje iz područja znanosti, sposobnost metodičkoga preoblikovanja multidisciplinarnoga sadržaja te sposobnost provedbe različitih eksperimenata. Da bi se postigli zacrtani ciljevi uz primjenu eksperimentalne nastave, nužno je metodički pripremiti eksperiment. Nastavne se metode očituju u odabiru eksperimenata i organskoj

povezanosti s nastavnom jedinicom koja je u pitanju. Učitelj mora znati u kojem dijelu sata primijeniti eksperiment (Cvjetićanin, 2009). Eksperimentalna nastava mora uvijek predstavljati harmoničnu cjelinu u kojoj su riječ i eksperiment čvrsto povezani. Učitelj mora znati odabrati *metodički dobar, pravilan i potreban eksperiment*.

Učitelj mora znati kako odabrati i pravilno metodički pripremiti upute ovisno o cilju i tipu eksperimenta (Gelman, 2004). U slučaju predmeta *Ruke u tijestu* to znači da učitelj mora biti dobro upoznat s različitim tipovima eksperimenata kao što su: heuristički, iznenadni, preliminarni, indukcijski, verifikacijski, eksperimenti s ciljem primjene znanja, ponavljanja, istraživanja, kvantitativni i drugi (Kramer, 1987). Upravo veliki zahtjevi u slučaju predmeta *Ruke u tijestu* predstavljaju jedan od razloga zbog kojih ga većina učitelja nema u svojoj ponudi, pa je njegova realizacija na niskoj razini.

Iako 75.8% anketiranih vjeruje da bi učenici trebali učiti o znanosti uz primjenu eksperimenata već od prvoga do četvrtoga razreda da bi lakše usvajala nastavno gradivo, primijećeno je da većina njih nije kompetentna za provedbu eksperimentalne nastave (Tablica 5). Ističu da jasno ne razlikuju vrste eksperimenata, njihovu primjenu na satu, načine na koje se pišu upute za provedbu učeničkih eksperimenata s obzirom na zacrtane ciljeve i zadatke. To je razlog zašto izbjegavaju učenicima predlagati predmet *Ruke u tijestu*. Samo 17.6% njih tvrdi da su stručno i metodički osposobljeni za kvalitetnu provedbu laboratorijskih eksperimenata u nastavi. Iako su svi anketirani učitelji imali predmete iz područja prirodnih znanosti tijekom studija, očito je da to nije bilo dovoljno za njihovu stručnu kvalifikaciju kada je riječ o provedbi eksperimentalne nastave od prvoga do četvrtoga razreda osnovne škole.

Stajališta učitelja o kontinuiranome znanstvenome obrazovanju i metodama integriranoga poučavanja znanstvenih sadržaja

Visoki je postotak učitelja (84.1%) istaknuo da se želi stalno usavršavati u području znanosti jer su svjesni da brzi znanstveni razvoj kontinuirano zahtijeva inovacije u integriranome poučavanju znanstvenih sadržaja. Smatraju da raspolažu nižom razinom znanja iz fizike i kemije (Tablica 6), u odnosu na biologiju, što je rezultat veće zastupljenosti sadržaja iz biologije (nego fizike i kemije) u nastavnom planu i programu za osnovne škole. Učitelji naglašavaju da nisu metodički osposobljeni za prenošenje znanstvenih sadržaja i njihovo prilagođavanje individualnim potrebama učenika. Nije značajan postotak učitelja koji ne žele stalno usavršavanje iz prirodnih znanosti (15.9%). Tvrde da su tijekom svog institucionalnog obrazovanja stekli dovoljno znanstvenoga znanja, potrebnoga za realizaciju razredne nastave, to jest znanja koje može odgovoriti potrebama

učenika. Znatiželja i spremnost da nauče više o svijetu tipična je za učenike od prvoga do četvrtoga razreda. Takvo stajalište maloga broja učitelja može oslabiti motivaciju učenika za učenjem o prirodi i provedbom samostalnog istraživanja. Nisu poticani na rad, imaju tradicionalno stajalište o obrazovanju, odnosno ne shvaćaju važnost stalnih inovacija u nastavi o prirodi i nastavno gradivo ne približavaju zanimanjima i potrebama učenika.

Na temelju rezultata ankete slijedi zaključak da je nužno kreirati model trajnog usavršavanja učitelja u području prirodnih znanosti te ugraditi odgovarajuće promjene u nastavni plan i program za obrazovanje učitelja. Te bi promjene trebale omogućiti učiteljima bolje znanje iz različitih područja znanosti, tehnike i tehnologije, povijesti i filozofije znanosti, te bolje znanje o metodama potrebnima za integriranu nastavu iz područja prirodnih znanosti. Važno je da obrazovni sustav Republike Srbije podupre promjene u tom segmentu obrazovanja učitelja, to jest da podupre obrazovanje učitelja koji će integrirano poučavati o znanosti u ranoj školskoj fazi. Tako ćemo dobiti stručne učitelje koji će utjecati na poboljšanje znanja osnovnoškolaca o prirodi te im omogućiti da se lakše uključe u provedbu nastave o znanstvenim sadržajima u kasnijoj predmetnoj nastavi.

ZAKLJUČAK

Većina učitelja samostalno priprema popis mogućih izbornih predmeta što ih nude učenicima. U taj popis uglavnom uvrste ekološki predmet Čuvari prirode pa ga učenici uglavnom biraju. Njegova je realizacija tri puta veća od sljedećega predmeta na popisu, Od igračaka do računala, drugoga po redu po omiljenosti među učenicima. Ruke u tijestu predmet je što ga učitelji najmanje nude i učenici se najmanje zanimaju za njega; njegova je realizacija također najslabija u usporedbi s ostalim izbornim predmetima. Stajališta učitelja o izbornim predmetima znanstvenog usmjerenja utječu na zanimanje učenika. Mali broj učitelja smatra da su osposobljeni za kvalitetnu primjenu znanstvenih sadržaja u nastavi na razini osnovnoškolskog obrazovanja. To je razlog zašto nekolicina njih učenicima nudi izborni predmet Ruke u tijestu. Ovaj predmet od učitelja zahtijeva viši stupanj znanstvenog obrazovanja, eksperimentalne nastavne metode, te sposobnost metodičkog prijenosa sadržaja i njegove prilagodbe mentalnim i fizičkim obilježjima učenika. Anketiranim je učiteljima potrebno kontinuirano usavršavanje u području znanosti, kao i pomoć suradnika. U nastavnim planovima i programima za napredno obrazovanje učitelja potrebno je povećati zastupljenost znanstvenih sadržaja, laboratorijskih vježbi i nastavnih metoda integriranoga poučavanja znanstvenih disciplina. Obrazovni bi sustav u Republici Srbiji trebao uvesti obrazovanje učitelja specijaliziranih za integrirano poučavanje prirodnih znanosti u razrednoj nastavi.