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The programme for professional development of chemistry teachers' assessment competency

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Abstract: The aim of this paper is to investigate the effects of the programme for professional development of chemistry teachers on their competencies for conducting formative and summative assessment in chemistry teaching. The programme participants were 30 chemistry teachers from primary and secondary schools. Data were collected using a questionnaire at the beginning and at the end of the programme implementation. The programme included four workshops with the same structure: the introduction, group work and the discussion of the results obtained through group work. The workshops focused on: *i*) the assessment as a support for chemistry learning; *ii*) the harmonization of teaching and learning activities, formative and summative assessment, feedback from formative assessment and the criteria used to evaluate students in summative assessment; *iii*) the evaluation of the validity of tasks used for formative and summative assessment according to the curricula aims and the educational standards; *iv*) designing tasks for monitoring students' progress towards certain educational standards. Teachers' responses show the impact of the programme for the development of their competencies for assessment, particularly regarding formative and summative assessment and designing various kinds of assessment in accordance with the achievement standards.

Keywords: in-service teacher training; formative evaluation; summative evaluation.

INTRODUCTION

Teacher knowledge was first described as a symbiosis of subject content knowledge and pedagogical knowledge necessary for the transformation of teaching topics into specific classroom activities by Shulman[1] through the model of pedagogical content knowledge (PCK). Similar models were later developed, with the emphasis on subject content knowledge as a component which provides

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a necessary foundation and which should be integrated with pedagogical knowledge.[2] By integrating these components specific and general pedagogical context is formed.[3] Subject content knowledge plays a crucial role in the meaningful integration of the other components of teacher knowledge.[4,5] The component "assessment of scientific literacy" was introduced by Magnusson[6] *et al.* within their PCK model (1999). The component "knowledge of science assessment" includes both teacher knowledge of the dimensions of science learning and teacher knowledge of the methods used to assess students' learning within a specific topic. When introducing the component "subject matter specific pedagogical knowledge", Tamir[7] observed that testing and evaluation should also be a part of PCK. The subsequent models of PCK point out the need for better interconnection of the components which constitute PCK,[8] as well as the nature and strength of the connection among them.[9] The interconnection and mutual dependence of all PCK components indicate that the teachers who have better knowledge of teaching strategies can also better assess students' knowledge.

In the literature and research studies, a component of PCK referred to as "teachers' assessment competence or teacher competency in educational assessment" comprises the teachers' competency in the situations which require assessment of students' knowledge. Based on the understanding of competences as a measurable ability the model of teachers' assessment competence, which enables a teacher to fulfil the requirements of assessment and quantification of knowledge in a wide range of situations, was developed.[10] This model integrates cognitive judgment processes, assessment practices and the products of assessments. It is also defined as assessment literacy (AL).

The significance and complexity of teacher knowledge of student achievement assessment can be represented using the conceptual framework teacher assessment literacy in practice (TALiP), which represents the sublimation of the research studies conducted and presented in the literature in the last several decades.[11] This framework connects two aspects of research studies – educational assessment and teacher education. Six principal components through which assessment literacy (AL) should be considered are pointed out: 1. the knowledge base of assessment, 2. teacher conception of assessment, 3. institutional and socio-cultural contexts, 4. TALiP the core concept of the framework, 5. teacher learning and 6. teacher identity (re)construction as assessors.

Since education and its requirements change during every teacher's career, it is necessary for teachers to improve their competencies through the programmes of professional development and training.[12] The need for continuous teacher development is particularly important in the situation when some significant changes in the education system are introduced due to reforms or new regulations.[13,17] However, it seems that not enough attention is devoted to teachers' competences to conduct assessment of knowledge[18] within these programmes.

The complexity of the nature of knowledge assessment is caused by many inseparable educational and social functions which result from the structure and organization of the entire education system.[19,20] In a research study which investigated teachers' attitudes towards knowledge assessment, the items in the questionnaire related to four concepts of assessment: improvement, student accountability, school accountability and irrelevance.[21] There was not a statistically significant difference between the attitudes of primary and secondary school teachers towards school accountability and irrelevance. Primary school teachers agreed statistically significantly more with the statements which associated assessment activities with the potential for Improvement. Statistically significantly more secondary school teachers agreed with the significance of assessment for Student Accountability. There was a correlation of the concept of Improvement with School Accountability, but there was no correlation with Student Accountability. This means that the teachers were willing to assume the responsibility for improving school outcomes and quality and fulfilling their professional accountabilities, they were willing to include assessment in their professional responsibilities in order to improve teaching and learning process, but they were less aware of the significance of Student Accountability. The effects of assessment on teaching and learning, certification of learning and accountability of teaching were considered to have greater pedagogical-regulation significance by the primary school teachers, while they were considered to have greater societal-accreditation significance by the secondary school teachers.[19] The conducted cluster analysis showed that teachers could have different attitudes towards assessment at the same time.[22] More than half of the teachers (51 %) had moderate, average and homogenous views on different purposes of assessment which related to the attitudes that "Assessment improves teaching and learning", that "Assessment is valid for accountability" and that "Assessment is irrelevant". 28 % of teachers expressed their opinion that the most important purpose of assessment is to improve teaching and learning. Approximately 21 % of the teachers had a marked tendency to question the accuracy of assessment and believed that it had no impact on their teaching practice.

When evaluating the questionnaire items which related to the criteria of high quality assessment on an 1–5 scale, the teachers gave high grades for all ten criteria.[23] They identified "Transparency" as the most important criterion (4.50), while "Directness" (3.93) and "Reproducibility" (3.88) were considered to be the least significant. The results show that teachers consider the existing, classic assessment criteria equally important as some new ones (authenticity, cognitive complexity, costs and efficiency, directness, educational consequences and meaningfulness) which have been introduced with the orientation being shifted towards competency-based education and assessment. This finding was contrary to researchers' expectations since teachers are sometimes reluctant to accept such

changes, but this research study did not investigate whether the teachers actually appreciated and applied all assessment criteria in their teaching practice.

In view of the theoretical framework presented above, the aim of this paper was to establish the effects of the programme for professional development of chemistry teachers on their competencies for conducting formative and summative assessment in chemistry teaching. Based on the aim, the following research question was raised: How do teachers' attitudes towards the assessment in general and the formative and summative assessment of student achievements change under the influence of the programme for professional development of chemistry teachers' assessment competency?

EXPERIMENTAL

Assessment was the main focus of the two-day programme for professional development of chemistry teachers' assessment competency (PDChTAC), which was organized by the Serbian Chemical Society and the University of Belgrade – the Faculty of Chemistry. Four workshops were held in two days. The structure of all workshops was the same and they included an introduction, group work and a discussion of the results obtained through group work. The first workshop focused on assessment as a support for chemistry learning. The second workshop focused on the issue of how to harmonize teaching and learning activities, formative and summative assessment, feedback from formative assessment and the criteria by which students are evaluated in the summative assessment. Within the third workshop participants evaluated in groups the validity of tasks used for formative and summative assessment according to the curricula aims and the educational standards. In the fourth workshop the participants designed tasks for monitoring students' progress towards certain educational standards. Bearing in mind the research question, the data about the participants' attitudes towards assessment were collected using a questionnaire both before and after the programme realization. The completion of the questionnaires was on a voluntary and anonymous basis and in accordance with the Code of Conduct for Scientific Research of the University of Belgrade (http://bg.ac.rs/files/sr/univerzitet/univ-propisi/Kodeks-naucnoistrazivacki-rad-29.3.2018.pdf). The aim of the questionnaire completion was explained in several introductory sentences at the beginning of the questionnaire, and respondents were guaranteed the confidentiality of the data collected.

Sample

Thirty chemistry teachers from primary and secondary schools participated in the programme. The participants' demographic data are shown in Table I.

Out of the 30 participants, 29 were females, while one was a male. The largest number of the teachers were in 40–49 age group. Four fifths of the teachers in the sample had over 10 years of experience. University courses through which teachers could develop assessment literacy (Chemistry didactics, pedagogy and psychology) had been attended by 22 (73.3 %) participants.

Instrument

The questionnaire designed for this research study consisted of four parts: I – general information about the respondents; II – teachers' attitudes towards their usual practice of assessment of student achievements; III – teachers' general attitudes towards assessment of

student achievements; IV – teachers' attitudes towards competencies necessary for assessment of student achievements.

The questionnaire contained 59 questions altogether: 6 multiple choice questions, one open-ended question, and 52 questions in which the respondents were asked to express the level of their agreement on a Likert-type scale.

TABLE I. Background data of the sample (N = 30), C – contribution of teachers in each category

Work place[a]	C / %	Age	C / %	Length of service	C / %	Education	C / %	University faculty[b]	C / %
PS	16.7	30-39	6.7	1-5	10.0	Undergraduate studies	80.0	UBFC	70.0
GS	36.7	40-49	60.0	6-10	10.0	Undergraduate and master studies	20.0	UNSFS	6.7
VS	40.0	50-59	30.0	11-15	26.7			UBFTM	3.3
PS, GS, VS	3.3	60+	3.3	16-20	20.0			UKFS	10.0
PS, GS	3.3			20-30	30.0			UPKMFSM	3.3
				30+	3.3			UBFP	3.3
								USFES	3.3

[a]PS – primary school, GS – grammar school, VS – vocational school; [b]UBFC: University of Belgrade – Faculty of Chemistry; UNSFS: University of Novi Sad – Faculty of Sciences; UBFTM: University of Belgrade – Faculty of Technology and Metallurgy, UKFS: University of Kragujevac – Faculty of Sciences; UPKMFSM: University of Pristina, Kosovska Mitrovica – Faculty of Sciences and Mathematics; UBFP: University of Belgrade – Faculty of Physics; USFES: University of Sarajevo – Faculty of Educational Sciences

To confirm the content validity, the questionnaire was examined by the members of the Department of Chemical Education, the University of Belgrade – Faculty of Chemistry, who were familiar with the construct of interest and the research subject, but who were not involved in designing and conducting the actual research study. They also reviewed readability, clarity and comprehensiveness of the questions in the questionnaire and provided a coherent estimation of the content validity of the questionnaire.

The reliability of the questionnaire was examined by means of Cronbach's α coefficient.[24] The value of Cronbach's α coefficient in the part with Likert-type questions was 0.873 for the first application of the questionnaire, and 0.866 for the second application of the questionnaire, which indicated a satisfactory level of the internal consistency of the instrument.

RESULTS AND DISCUSSION

Teachers' evaluations of the statements in the questionnaire provide an insight into the current practice of assessing and grading student achievements in the field of chemistry in our schools (Table II).

The most frequent evaluations of chemistry teachers regarding the assessment practice in our schools (Table II) will be presented in the following part of this paper. Teachers rarely change grading criteria based on the results of written assessment of students and decision on grades based on students' suggestions and arguments. However, they more often include the effort invested by the student

in the grade and the majority of them always or almost always provide their students with an explanation for the grades awarded. The largest number of teachers sometimes or very often grade their students in the lessons during which new material is introduced, but very often or always and almost always try to make assessment contribute to further learning.

TABLE II. The teachers' attitudes towards teaching practice of assessment of student achievements: 1– never or almost never; 2 – very rarely; 3 – sometimes; 4 – very often; 5 – always or almost always

Statement	Contribution, %				
	1	2	3	4	5
1. I change the criteria for grading written assessment of knowledge after gaining insight into students' results.	6.7	40.0	16.7	30.0	6.7
2. I include the effort invested by a student in his grade.	–	3.3	30.0	30.0	36.7
3. I change my decision about the grade after students' suggestions or arguments.	16.7	23.3	40.0	16.7	–
4. I create questions for oral assessment of knowledge before the lesson.	3.3	3.3	20.0	40.0	30.0
5. I use the material designed by my colleagues for assessment of knowledge.	20.0	30.0	36.7	13.3	–
6. I grade my students in the lessons when new material is introduced.	–	10.0	36.7	46.7	6.7
7. I provide an explanation for the grades given to my students.	–	–	–	10.0	90.0
8. I attempt to make knowledge assessment contribute to further learning.	–	–	–	23.3	76.7
9. Upon unsatisfactory results of assessing knowledge of certain concepts, I explain the same concepts again.	–	6.7	13.3	50.0	30.0
10. When assessing achievements I take into account the student achievement standards.[a]	13.3	6.7	10.0	40.0	30.0
11. I design tasks for written assessment of knowledge bearing in mind the student achievement standards.[a]	6.7	6.7	6.7	43.3	36.7
12. I design tasks for oral assessment of knowledge bearing in mind the student achievement standards.[a]	6.7	6.7	13.3	53.3	20.0
13. I design tasks for practical assessment of knowledge bearing in mind the student achievement standards.[*]	10.0	3.3	20.0	53.3	13.3
14. I provide feedback on the level of achievement and recommendations for further work to each student.	–	3.3	–	33.3	63.3
15. I make my decision on the final grade based on the results of formative and summative assessment of knowledge.	–	–	3.3	33.3	60.0
16. I give my tests to colleagues so that they evaluate their quality and validity before their application in practice.	13.3	20.0	20.0	33.3	13.3
17. I include my students in defining the criteria by which their achievements will be assessed.	6.7	20.0	13.3	53.3	6.7
18. I include my students in the assessment of other students' achievements.	10.0	10.0	23.3	40.0	16.7

[a]The student achievement standards at the end of compulsory education and at the end of general secondary education

The majority of teachers very often or always and almost always explain the concepts again after unsatisfactory results of assessment of knowledge. Teachers sometimes or very rarely use materials for knowledge assessment designed by their colleagues. The majority of teachers very often or always and almost always create questions for oral assessment of knowledge before the lesson. Generally, teachers very often or always and almost always take into account the student achievement standards, mostly during the process of designing the tasks for written assessment of knowledge, to a lesser extent when designing questions for oral assessment of knowledge and least for practical assessment of knowledge. The majority of teachers very often or always and almost always provide their students with feedback on the level of achievement and recommendations for further work, and they make their decision on the final grade based on formative and summative assessment of knowledge. 40 % of the teachers very rarely or sometimes give their tests to colleagues for the evaluation of quality and validity before using them in the classroom, while 33 % of them do this very often. Slightly more than half of the teachers very often include their students in defining the criteria for evaluating achievements, while one fifth does this very rarely. 40 % percent of the teachers very often include students in the evaluation of other students' achievement, while 23 % does this sometimes.

Teachers' attitudes towards the function of assessment before the realization of the programme for PDChTAC, and after the realization of the programme can be observed from the degree of agreement with the statements presented in Table III.

Since the same group evaluated these variables, the sample is not independent, so the Wilcoxon test was used to determine whether there were any statistically significant differences between the evaluations provided by the group before and after the realization of the programme for PDChTAC. Using SPSS output, the data analysis shows that the evaluations provided by the group are statistically significantly different for 6 out of 18 variables. In the following part the results for the attitudes of teachers which are statistically significantly different compared to the attitudes which had been expressed immediately before the beginning of the development programme will be presented.

The largest percentage of teachers mainly or strongly agreed that the assessment of student achievements is as important in the teaching process as acquiring new knowledge on both occasions when their attitudes were investigated using the same question within the research study. Upon the programme completion the number of teachers who strongly agreed with the above-mentioned statement increased ($z = -2.32$, $p < 0.05$). After the development programme a larger number of teachers expressed their opinion that they mainly agreed with the statement that student achievements should be assessed in each lesson ($z = -4.42$, $p < 0.0001$). A large number of teachers changed their attitude that each assessment of achievement should result in a grade, so two thirds of the participants

stated that they strongly or mainly disagreed with this attitude ($z = -2.26$, $p < 0.05$). After the programme the number of teachers who strongly agreed that the result of formative assessment enables a student to gain an insight into his current level of achievement increased ($z = -2.30$, $p < 0.05$), while none of the teachers expressed disagreement with this attitude anymore.

TABLE III. Teachers' attitudes towards the assessment of student achievements; i – at the beginning of the programme realization; f – at the end of the programme realization: 1 – strongly disagree; 2 – mainly disagree; 3 – both agree and disagree; 4 – mainly agree; 5 – strongly agree

Statement		Contribution, %				
		1	2	3	4	5
1. Assessment of student achievements and acquiring knowledge are equally important parts of the teaching process.	i	–	–	3.3	36.7	60.0
	f	–	–	–	13.3	86.7
2. Student achievements should be assessed in every lesson.	i	–	–	23.3	30.0	46.7
	f	–	–	6.7	46.7	46.7
3. The outcome of each assessment should be a grade.	i	13.3	16.7	50.0	20.0	
	f	23.3	43.3	26.7	6.7	–
4. Written, oral and practical assessment can provide the same kind of feedback on student achievements.	i	6.7	20.0	33.3	33.3	6.7
	f	13.3	30.0	26.7	23.3	6.7
5. One kind of assessment is sufficient to gain an insight into student achievements.	i	50.0	40.0	6.7	–	3.3
	f	76.7	20.0	3.3	–	–
6. The results of formative assessment provide a student with an insight into the current level of his achievements.	i	3.3	6.7	13.3	63.3	13.3
	f	–	–	13.3	43.3	43.3
7. Being familiar with the assessment criteria contributes to better student achievements.	i	–	3.3	3.3	53.3	40.0
	f	–	–	3.3	40.0	56.7
8. Providing an explanation for the grade has a positive impact on student's subsequent work.	i	–	–	6.7	30.0	63.3
	f	–	–	–	36.7	63.3
9. Students learn through the process of achievement assessment.	i	–	–	13.3	50.0	33.3
	f	–	–	13.3	36.7	50.0
10. The results of achievement assessment depend on the type of assessment applied.	i	–	10.0	30.0	46.7	10.0
	f	–	–	43.3	43.3	13.3
11. Good practice in achievement assessment includes a discussion on the level of knowledge achieved by students.	i	–	–	13.3	36.7	50.0
	f	–	–	10.0	43.3	46.7
12. Unannounced assessment of knowledge leads to worse results than announced assessment.	i	–	3.3	36.7	30.0	30.0
	f	–	13.3	36.7	26.7	23.3
13. Formative assessment of knowledge requires special preparation and analysis.	i	–	3.3	26.7	46.7	23.3
	f	–	10.0	20.0	36.7	33.3
14. Knowledge assessment should present learning in a new context.	i	–	3.3	10.0	76.7	6.7
	f	–	6.7	10.0	40.0	43.3
15. Knowledge assessment should enable the improvement of learning strategies.	i	–	–	–	53.3	43.3
	f	–	–	6.7	43.3	50.0
16. Students can draw conclusions about the level of their achievements based on their grade.	i	–	3.3	43.3	40.0	13.3
	f	–	–	20.0	56.7	23.3
17. A grade higher than the current level of achievement has a positive effect on student's further progress.	i	–	10.0	43.3	36.7	10.0
	f	–	13.3	33.3	40.0	13.3
18. Formative assessment excludes summative assessment.	i	23.3	23.3	43.3	6.7	3.3
	f	53.3	26.7	13.3	3.3	3.3

Furthermore, the number of teachers who mainly or strongly agreed with the statement that students can draw a conclusion about the level of their achievement based on the grade increased ($z = -2.83$, $p < 0.01$). There was a statistically significant difference in the number of teachers who had previously been undecided, but who expressed their opinion that they strongly or mainly disagreed with the statement that formative assessment excludes summative assessment after the programme completion ($z = -2.40$, $p < 0.05$).

There were no statistically significant differences in the teachers' attitudes for the other 12 statements after the programme completion, but the results show that there were certain shifts and changes. A higher percentage of teachers expressed their attitude that they strongly or mainly disagreed with the statements that written, oral and practical assessment can provide the same kind of feedback on student achievements and that one kind of assessment is sufficient to gain an insight into student achievements. Furthermore, a higher percentage of teachers mainly or strongly agreed that being familiar with the assessment criteria contributes to better student achievements, which providing an explanation for a grade has a positive impact on students' subsequent work and that students learn through the process of assessment of achievement.

The questionnaire was also used to investigate the teachers' attitudes towards their competencies for assessing student achievements. The results obtained through their responses are presented in Table IV.

The Wilcoxon test was used to determine whether there were any statistically significant differences in the evaluations obtained from the group. Using SPSS output, the data analysis shows that the evaluations obtained from the group is statistically significantly different for 8 variables. In the following part the results for teachers' attitudes between which there was a statistically significant difference after the realization of the programme for PDChTAC are presented. In comparison with the initial evaluations, a higher percentage of teachers strongly agreed that they could monitor and evaluate the effectiveness of their work based on the results obtained through knowledge assessment ($z = -2.97$, $p < 0.005$) and that they understood the concepts of formative and summative assessment ($z = -3.54$, $p < 0.001$). Almost all teachers mainly or strongly agreed that they were competent to design and realize formative assessment of knowledge ($z = -2.37$, $p < 0.05$) and summative assessment of knowledge ($z = -2.99$, $p < 0.05$).

The number of teachers who considered that they were competent to design and conduct written assessment in accordance with the achievement standards also increased ($z = -2.07$, $p < 0.05$) after the development programme, and none of the teachers expressed disagreement with this statement.

TABLE IV. The teachers' attitudes towards the competencies for assessing student achievements; i – at the beginning of the programme realization; f – at the end of the programme realization: 1 – I strongly disagree; 2 – I mainly disagree; 3 – I both agree and disagree; 4 – I mainly agree; 5 – I strongly agree

Statement		Contribution, %				
		1	2	3	4	5
1. I meet the competency standards for the teaching profession.	i	–	–	–	36.7	63.3
	f	–	–	3.3	46.7	50.0
2. I am competent to design and conduct knowledge assessment in accordance with the student achievement standards.	i	–	–	16.7	43.3	36.7
	f	–	–	6.7	60.0	33.3
3. I successfully adapt knowledge assessment to students' individual abilities.	i	–	6.7	30.0	40.0	23.3
	f	–	–	26.7	60.0	13.3
4. I can monitor and evaluate the effectiveness of my work based on the results obtained through knowledge assessment.	i	–	–	23.3	66.7	10.0
	f	–	–	10.0	53.3	36.7
5. I am competent to assess student achievements using various types of assessment.	i	–	–	6.7	50.0	40.0
	f	–	–	3.3	56.7	36.7
6. I understand the concepts of formative and summative assessment.	i	3.3	6.7	30.0	36.7	20.0
	f	–	–	3.3	33.3	63.3
7. I am competent to design and conduct formative assessment of knowledge.	i	–	3.3	30.0	40.0	26.7
	f	–	–	3.3	56.7	40.0
8. I am competent to design and conduct summative assessment of knowledge.	i	–	6.7	30.0	36.7	26.7
	f	–	–	–	50.0	50.0
9. I am competent to design and conduct written assessment of knowledge in accordance with the goals of chemistry education.	i	–	–	6.7	36.7	56.7
	f	–	–	–	43.3	56.7
10. I am competent to design and conduct oral assessment of knowledge in accordance with the goals of chemistry education.	i	–	–	–	50.0	50.0
	f	–	–	–	40.0	60.0
11. I am competent to design and conduct practical assessment of knowledge in accordance with the goals of chemistry education.	i	3.3	–	6.7	63.3	26.7
	f	–	3.3	10.0	40.0	46.7
12. I am competent to design and conduct written assessment of knowledge in accordance with the achievement standards.	i	3.3	3.3	13.3	46.7	33.3
	f	–	–	10.0	43.3	46.7
13. I am competent to design and conduct oral assessment of knowledge in accordance with the achievement standards.	i	3.3	3.3	20.0	36.7	36.7
	f	–	–	6.7	43.3	50.0
14. I am competent to design practical assessment of knowledge in accordance with the achievement standards.	i	6.7	3.3	26.7	36.7	26.7
	f	–	3.3	16.7	46.7	33.3
15. I have improved my competencies for monitoring and evaluating student achievements through professional development programmes.	i	10.0	3.3	20.0	30.0	36.7
	f	–	–	6.7	40.0	53.3
16. I have improved my competencies for monitoring and evaluating student achievements by reading specialized and scientific publications.	i	6.7	6.7	6.7	53.3	23.3
	f	–	–	10.0	56.7	33.3

A considerably higher percentage of teachers mainly or strongly agreed that they were competent to design and conduct oral assessment of knowledge ($z = -2.54$, $p < 0.05$) and practical assessment of knowledge ($z = -2.05$, $p < 0.05$) in accordance with the achievement standards. Responding to the statement which referred to the previous improvement of competencies for monitoring and evaluating student achievements through professional development programmes, the teachers obviously included their experience of attending the programme for PDChTAC ($z = -2.50$, $p < 0.05$).

As far as the other statements are concerned, there was no statistically significant difference between the responses given before and after the development programme, but a higher percentage of teachers mainly or strongly agreed with the statement that they were competent to design and conduct knowledge assessment in accordance with the student achievement standards and that they adapted knowledge assessment to individual abilities of their students.

CONCLUSION

Teachers' responses regarding their assessment practice, *i.e.*, how it is conducted in schools, indicate that teachers attempt to harmonize it with the requirements prescribed by primary and secondary school regulations (they provide their students with an explanation for their grades, they attempt to make assessment contribute to further learning, they make their decisions about final grade based on the results of formative and summative assessment, they provide their students with feedback and guidelines for subsequent work, they explain the material again in case their students failed to learn it, they take into account students' effort when assessing them, they plan assessment in accordance with the student achievement standards). However, they more rarely consider the criteria which they use to decide upon grades and they more rarely consider grades in the light of students' arguments. Based on teachers' responses it can be observed that they do not cooperate enough with their colleagues as far as assessment is concerned, both regarding the use of material developed by others and asking their colleagues' opinion about the quality and validity of the instruments they use to assess student achievements.

The two-day professional development programme for chemistry teachers, which focused on strengthening their competencies for assessment, influenced the teachers in such a way that there were statistically significant differences regarding their more positive attitudes towards the following statements:

– knowledge assessment and learning are equally important segments of teaching;
– knowledge assessment should be conducted continually (in every lesson);
– formative assessment helps a student gain an insight into his current level of his achievements;

– grades enable students to gain an insight into their level of achievements.

In addition to this, the programme has caused a statistically significant increase in the number of teachers who disagree with the statements that each assessment of achievement should result in a grade and that formative assessment excludes summative assessment.

As far as the statements which refer to the competencies for assessment are concerned, after the programme, a statistically significant percentage of teachers have a more positive attitude towards the following statements:

– they can monitor and evaluate the effectiveness of their work based on the results of knowledge assessment;

– they understand the concepts of formative and summative assessment;

– they are competent to design and conduct formative and summative assessment of knowledge.

Upon the programme completion, there was a statistically significant increase in the number of teachers who evaluated that they were more competent to design and conduct written, oral and practical assessment based on the achievement standards.

Teachers' responses show the impact of the programme for the development of their competencies for assessment, particularly regarding formative and summative assessment and designing various kinds of assessment in accordance with the achievement standards. This is a unique teacher development programme in our education system which has changes identified in the knowledge, skills and attitudes of the teachers upon its realization.

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ИЗВОД

ПРОГРАМ ПРОФЕСИОНАЛНОГ РАЗВОЈА КОМПЕТЕНЦИЈА НАСТАВНИКА ХЕМИЈЕ ЗА ПРОВЕРУ ЗНАЊА

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Циљ овог рада је испитивање ефеката програма за професионални развој наставника хемије на њихове компетенције за извођење формативног и сумативног оцењивања у настави хемије. У програму је учествовало 30 наставника хемије из основних и средњих школа. Подаци су прикупљени помоћу упитника, примењеног на почетку и на крају реализације програма. Програм се састојао од четири радионице са истом структуром рада: увод, групни рад и дискусија резултата групног рада. Радионице су биле посвећене: 1) оцењивању као подршци учењу хемије; 2) усклађености активности наставе и учења, формативног и сумативног оцењивања, повратних информација формативног оцењивања и критеријума за сумативно оцењивање; 3) процени ваљаности задатака за формативно и сумативно оцењивање у складу с циљевима наставних програма и образовним стандардима; 4) припреми задатака за праћење напретка ученика

према одређеним образовним стандардима. Одговори наставника показују допринос програма развоју њихових компетенција за праћење и проверавање ученичких постигнућа, посебно у вези с формативним и сумативним проверавањем и припремањем различитих начина проверавања усклађено са стандардима постигнућа.

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