Pedagogical Paper

Motivational Profiles of Slovenian High School Students and Their Academic Performance Outcomes

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Abstract

Self-determination theory defines motivation as a multidimensional concept, with autonomous and controlled motivation as central factors of broader distinctions. Previous research has proven that academic achievements are positively correlated with autonomous motivation. Students from 10 Slovenian *grammar schools* were involved in empirical study, in which a cluster analysis revealed two motivational profiles: a low quantity motivation group (low controlled and autonomous motivation) and a good quality motivation group (high autonomous and low or average controlled motivation). Statistically significant differences between the two identified motivational profiles were found for students' general as well as chemistry performance in three grades of schooling. Furthermore, a good quality motivation group is also more in favour of autonomy-supportive teaching methods used in chemistry classes. Examination of students' opinions about important chemistry topics, and on the other hand, unimportant ones, and not connected with life, reveals that the basic reason for distinction might lie in the chemistry teacher's approach used while presenting these topics. Some chemistry teachers are not using an autonomy-supportive way of teaching which would contribute to better teaching outcomes; therefore a need for further research on Slovenian chemistry teachers' motivation and their teaching approaches was recognized.

Keywords: High school chemistry, students' motivational profiles, students' opinion about chemistry topics, chemistry teacher's approach to teaching

1. Introduction

In the last decades motivation has been targeted by teachers, parents and researchers as one of the key factors determining whether or not students succeeded at school. The central focus on motivation research is therefore on the conditions and processes that facilitate persistence, performance, healthy development, and vitality of our endeavours. Most theories have treated motivation as a unitary concept that varies in amount,[1] but by contrast, Self Determination Theory (SDT) of motivation has revealed new insights and dimensions of motivation.[2,3] The theory focuses on the types, rather than just the amount, of motivation, paying particular attention to autonomous motivation, controlled motivation, and motivation as a predictor of performance, relational, and well-being outcomes.[1] Motivation is defined as a multidimensional concept that varies in terms of quality. Student motivation is of high quality when primarily based on autonomous motivation, i.e. intrinsic (for example learning is facilitated by enjoyment), identified (for example learning is driven by a wish for good grades), and integrated regulations (for example learning is facilitated by a recognized awareness of the importance of knowledge for future studies), and it is of poor quality when based on controlled motivation, i.e. external (for example learning is driven by rewards), and introjected regulations (for example learning is facilitated by a wish to satisfy expectations of others).[4] Thereby, the meaning of different levels of motivation are as follows: (1) intrinsic motivation refers to motivation that comes from inside an individual rather than from any external or outside rewards, (2) extrinsic motivation refers to behaviours which are not engaged for their own sake but for instrumental purposes. A series of research outcomes have proven that autonomous academic motivation is positively associated with academic achievements.[5–8]

In addition, research findings revealed that some types of motivation were subject specific, whereas others were not; for example intrinsic motivation differed in intensity for maths, writing, and reading.[9] Furthermore, autonomous motivation has been found to be more in evidence when students experience satisfaction of their basic psychological needs for competence, relatedness, and autonomy. Examination of different aspects of SDT in the domain of education has shown that in classrooms in which teachers were autonomy-supportive, students were more intrinsically motivated, they also felt more competent at school work (i.e., they had higher academic self-concept).[10–12] The autonomy-supportive style of teaching also led to greater learning performance outcomes than did the controlling style. The autonomy-supportive style of teaching is primarily related to a relaxing classroom atmosphere, which according to neuropsychological research studies is crucial for effective learning to occur. Information associated with positive emotions is assimilated through the hippocampus and further processed in the cerebral cortex, while the information associated with negative emotions is assimilated through the amygdale. The amygdale conditions the organism when quick reactions are needed, for instance in situations that involve conflicts, or fleeing. Therefore, the amygdale is not of help when recalling experiences and factual knowledge, or when knowledge is processed.[13–17]

2. Purpose of the Study

The purpose of this study was to complement extant variable-centered research that focuses on the dimensions of autonomous and controlled motivation for identifying motivational profiles.[18] Therefore the goals of the study are to examine: (a) how different types of motivation proposed by Self-Determination Theory (SDT) could be clustered into distinct motivational profiles of Slovenian high school students, (b) how clusters' membership correlates with the students' general achievements and in particular achievements in science – chemistry, and (c) how clusters' membership correlates with students' preferences towards specific chemistry teaching and learning methods. An additional purpose of the study was to identify chemistry content and concepts which are, according to students' opinions, interesting and important for their life, and those which are dull and unimportant and might be omitted from the high school chemistry curriculum.

3. Method

3. 1. The Sample

In the research a total of 361 high school students (164 males and 197 females) participated from ten grammar schools from all Slovenian regions. In Slovenia after 9 years of primary education, students are enrolled in different types of high schools: e.g. in grammar schools (Slo. gimnazije), vocational schools or technical schools. The duration of high school education is three to four years. In this research only students from grammar schools, which last four years, participated. Their average age was 16.36 years. The sample represents an urban and rural population with mixed socioeconomic status.

3. 2. The Instrument

A 31-item questionnaire for assessment of students' motivation was designed on the basis of two questionnaires used in previous research[19,20] with the theoretical background from educational psychology research on motivation and self-concept.[3,21] Specifically, the instrument was designed to evaluate (1) different components of students' motivation for learning chemistry (i.e., controlled motivation based on extrinsic motivational stimuli, regulated motivation based on internalized and integrated motivational stimuli, intrinsic motivation, and academic self-concept), and (2) to identify students' preferences for different learning methods usually applied in chemistry classrooms. The questionnaire was complemented with two additional open-ended questions on students' preferences toward different chemistry contents, and general information on previous overall academic achievements and more specifically achievements in chemistry expressed in the form of grades (from 5 – excellent to 1 – failed).[22]

Administration of the instrument takes approximately 20 minutes in the classroom; students are asked to respond to simple declarative sentences on a 5-point Likert scale ranging from 1 – not at all true to 5 – very true for me. The instrument was administrated during chemistry classes at the end of the school year 2008/2009 (June 2009).

3. 3. Data Analysis

For the purpose of the students' motivational profiles identification data were analysed by the *K-means* clustering procedure. The relation between independent and grouping variables a t-test and Pearson's correlation coefficients were carried out using the SPSS statistical programme, version 17.0.

4. Results and Discussion

In order to identify the number of clusters in the data set based on the motivational dimensions defined by controlled and autonomous motivation, more specifically, intrinsic, regulated, controlled motivation and self-concept, *k*-means clustering was used.

The means for each cluster on each dimensions and *F* values from the analysis of variance on each dimension

Table 1: Comparison of the results of different values of *k*- applied in clustering

Dimension	*K2 – Mean*	*K2 – F*	*K3 – Mean*	*K3 – F*	*K4 – Mean*	*K4 – F*
INTRINSIC MOTIVATION	170.38	657.81	104.68	695.30	66.24	366.25
SELF-CONCEPT	160.95	596.44	100.43	632.35	66.51	408.09
CONTROLLED MOTIVATION	43.67	235.58	25.66	155.95	19.82	139.49
REGULATED MOTIVATION	173.64	581.99	102.55	485.93	67.48	307.97

Table 2: *K*-2 clustering

Initial Cluster Centres			Final Cluster Centres			Number of Cases in each Cluster	
	Cluster			Cluster		Cluster	1 171
	I	II		I	II		2 189
INTRINSIC MOTIVATION	1	5	INTRINSIC MOTIVATION	2	4	Valid	360
SELF–CONCEPT	1	5	SELF-CONCEPT	2	3	Missing	1
CONTROLLED MOTIVATION	2	3	CONTROLLED MOTIVATION	2	3		
REGULATED MOTIVATION	1	5	REGULATED MOTIVATION	2	4		

were used as indications for assessment of how distinct different *k* clusters are.[23]

The greatest differences between means for three of the four dimensions of clustering from the analysis of variance performed for each dimensions, were obtained for the *k*-2 clustering procedure, Table 1. Therefore, in further analysis, we decided to use the results of *k*-2 clustering of the data set based on four dimensions (intrinsic motivation, self-concept, controlled and regulated motivation).

Initial cluster centers, final cluster centers and number of cases in each cluster for *k*-2 clustering of the data set are shown in Table 2.

Cases in cluster I could be defined as a low quantity motivation group (i.e. low autonomous, low controlled) and members of cluster II as a good quality motivation group (i.e. high autonomous and low or average controlled).[18] Division of the sample into two motivational groups can be additionally justified by the nature of the tested population of students. Students who took part in the study are enrolled in general but competitive high schools (grammar schools). Their program is designed to provide students with good background knowledge from science, mathematics, languages, and humanities for further studies at the university level. Therefore, the majority of students have already at least tentatively decided on their future academic path, prior to high school enrolment. But, among them are also students who are still seeking for the most suitable future academic orientation, or even worse, might be enrolled in the program due to pressure and high expectations of their parents. We could expect that the first group of students would be primarily good quality motivated, while the second low quantity motivated.

We were further interested in the influence of these two motivational profiles on students' overall performance in different grades of schooling (1st , 2nd and 3rd grade) and in particular on their performance in chemistry at the 1st, 2nd and 3rd grade. For identification of the differences between two motivational profiles as defined by *k*-2 clustering of the data set, an independent samples t-test was performed, using as grouping variable *k*-2 classification of cases, Table 3 (mean values of overall academic performance) and Table 4 (differences in academic performance between two motivational profiles).

Statistically significant differences between two identified motivational profiles on the level of significance of 0.01 were found for students' general as well as chemistry performance outcomes in all three grades. Students

Table 3: Mean values of overall academic performance (O perf) and chemistry performance (Chem) of cases in Clusters I and II by Grade

Performance	*K 2*	N	Mean	Std. Deviation	Std. Error Mean
O_perf 1st g	Cluster 1	166	3.49	0.81	0.06
	Cluster 2	182	4.03	0.81	0.06
O_perf 2nd g	Cluster 1	114	3.33	0.82	0.08
	Cluster 2	117	4.07	0.82	0.08
O_perf 3rd g	Cluster 1	36	3.64	0.87	0.14
	Cluster 2	40	4.50	0.64	0.10
Chem 1st g	Cluster 1	166	3.19	0.96	0.07
	Cluster 2	182	4.01	0.93	0.07
Chem 2nd g	Cluster 1	114	2.88	0.92	0.09
	Cluster 2	117	3.96	1.00	0.09
Chem 3rd g	Cluster 1	37	3.27	0.87	0.14
	Cluster 2	40	4.45	0.68	0.11

Table 4: Differences in academic performance between low quantity and good quality motivation group

	t-test for Equality of Means					95 % Confidence Interval	
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Chem 1st g	–8.06	346	0.000	–0.82	0.10	–1.02	–0.62
Chem 2nd g	–8.51	229	0.000	–1.08	0.13	–1.33	–0.83
Chem 3rd g	–6.66	75	0.000	–1.18	018	–1.53	–0.83
O_per 1st g	–6.20	343	0.000	–0.54	0.09	–0.71	–0.37
O_per 2nd g	–6.84	229	0.000	–0.74	0.11	–0.95	–0.52
O_per 3rd g	–4.96	74	0.000	–0.86	0.17	–1.21	–0.52

who were classified in cluster II, for which higher initial cluster centres and final cluster centres for autonomous and controlled motivation were identified, perform better in chemistry as well as in all other subjects taught in the high school (overall performance) than those students to whom membership of cluster I was assigned. We can conclude that motivational profiles of students are crucial for their academic achievements, especially on complex or heuristic tasks that involve deep information processing or creativity, necessary to achieve high performance outcomes, i.e. in science subjects. The result is in line with the findings of other researchers.[1,24]

The impact of motivational profiles on the overall, and more specifically science (chemistry) achievements, was further confirmed by the correlation study between different dimensions of motivation and students' overall and chemistry performance in 1st, 2nd and 3rd grades, Table 4.

Medium correlations at the level of significance of 0.01 were found for intrinsic and regulated motivation and students' overall and chemistry performance at all three grades of schooling, while for controlled motivation low correlations in the level of significance of 0.01 were found for the overall and chemistry performance only for the 1st and 2nd grade. It can be concluded that with maturing, controlled motivation becomes less important, since students are becoming more autonomous and aware of the importance of high school educational outcomes for their future academic career.

Differences between the two motivational profiles were also detected in students' preferences toward teaching and learning methods used in chemistry classes, Table 5.

Statistically significant differences between the low quantity and good quality motivation groups of students at the level of significance of 0.01 were identified for two

Table 5: Correlations between students' performance and motivation dimensions

		O-per 1st g	O-per 2nd g	O-per 3rd g	Chem 1st g	Chem 2nd g	Chem 3rd g
INTRINSIC	Pearson Correlation	0.35**	0.43**	0.48**	0.44**	0.50**	0.57**
MOTIVATION	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000
	N	349	231	76	349	231	77
SELF–CONCEPT	Pearson Correlation	0.37**	0.43**	0.47**	0.46**	0.52**	0.59**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000
	N	349	231	76	349	231	77
CONTROLLED	Pearson Correlation	0.25**	0.27**	0.24*	0.29**	0.30**	0.31**
MOTIVATION	Sig. (2-tailed)	0.000	0.000	0.040	0.000	0.000	0.010
	N	349	231	76	349	231	77
REGULATED	Pearson Correlation	0.38**	0.46**	0.51**	0.47**	0.51**	0.57**
MOTIVATION	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000
	N	349	231	76	349	231	77

Table 6: Mean values of preferences toward different teaching and learning methods for cases in Cluster I and II

		N	Mean	Std. Deviation	Std. Error Mean
Lecturing	Cluster I	167	2.89	1.24	0.10
	Cluster II	190	3.35	1.19	0.09
Individual work with textbook	Cluster I	167	2.10	1.16	0.09
	Cluster II	188	2.44	1.16	0.08
Hands-on experimental work	Cluster I	167	3.74	1.20	0.09
	Cluster II	186	4.16	0.92	0.07

Table 7: Differences in preferences toward different teaching and learning methods between low quantity and good quality motivation groups

	t-test for Equality of Means 95 % Confidence						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Interval Lower	Upper
Lecturing	–3.54	355	0.000	–0.46	0.13	–0.71	–0.20
Individual study with textbook	–2.80	353	0.005	–0.35	0.12	–0.59	–0.10
Hands-on approach	–3.75	351	0.000	–0.43	0.11	–0.65	–020

teaching/learning methods: teacher lecturing, and the hands-on approach in experimental work. The good quality motivation group (Cluster II) of students express greater preference toward teacher's lecturing and autonomous experimental work, this group also values more independent study with the textbook, although in this case at the level of significance of 0.05. The good quality motivation group of students are more autonomous, therefore they prefer teaching approaches where their tendency for autonomous study, (i.e. hands-on experimental approach, independent study with the textbook), is stimulated. But at the same time they are also better aware of the importance of teacher explanations for deeper understanding of different chemistry concepts, than are the low quantity motivation group of students.

As an additional contribution to the study we also want to identify, on the one hand, chemistry topics and concepts which are according to students' opinions important and related to their life experiences, and on the other hand those chemistry topics which they considered unimportant or dull. Students had to indicate at least three chemistry topics in each category (important and unimportant) and from a list of reasons choose the appropriate ones to justify their selection. Important and interesting chemistry topics (according to students' opinions) are presented in Figure 1, while reasons for their selection are given in Figure 2.

As important and interesting chemistry topics according to students' opinions, 8 topics from general, inorganic and organic chemistry were selected. Students ranked high two topics: "*acids, bases, pH"* (12.30%), and "*organic compounds and their reactions*" (10.70%). Frequencies for other explicitly mentioned topics are between 4.10% and 7.60%. Among "*other topics*" (33.40%) those with a frequency less than 4% are included and their selection covers almost all topics, of the high school chemistry curriculum.

Among the reasons for the selection of topics as interesting and important, apart from "*personal interest*" (42.38%), the method of their introduction in the classroom "*experimental approach*" and "*usefulness in life*" gained the highest rank, 38.78% and 31.01%, respectively.

Frequencies of unimportant and dull or not useful chemistry topics are presented in Figure 3 and reasons for their selection in Figure 4.

From Figure 3 it can be revealed that the most unpopular topic in the high school chemistry curriculum is related to "*organic compounds and their reactions*"

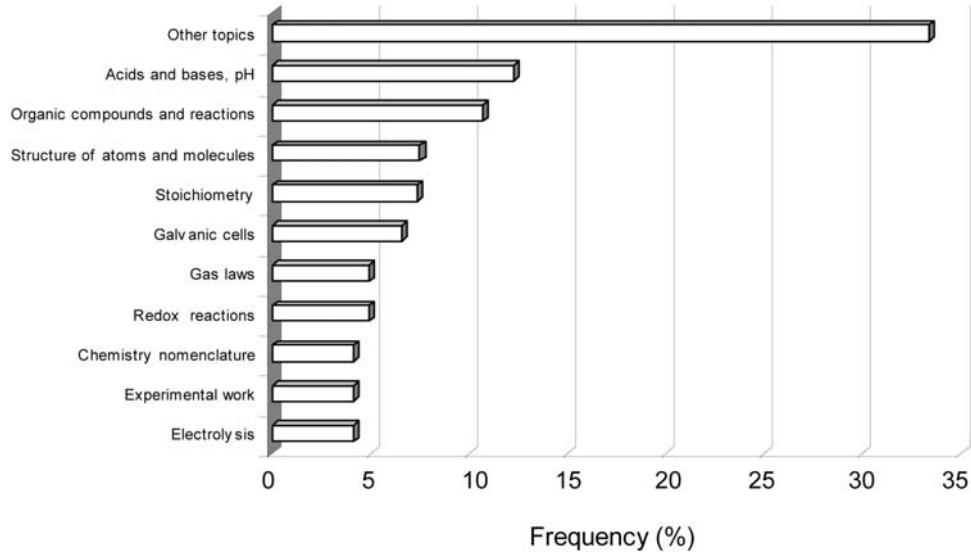

Figure 1: Interesting and important chemistry topics

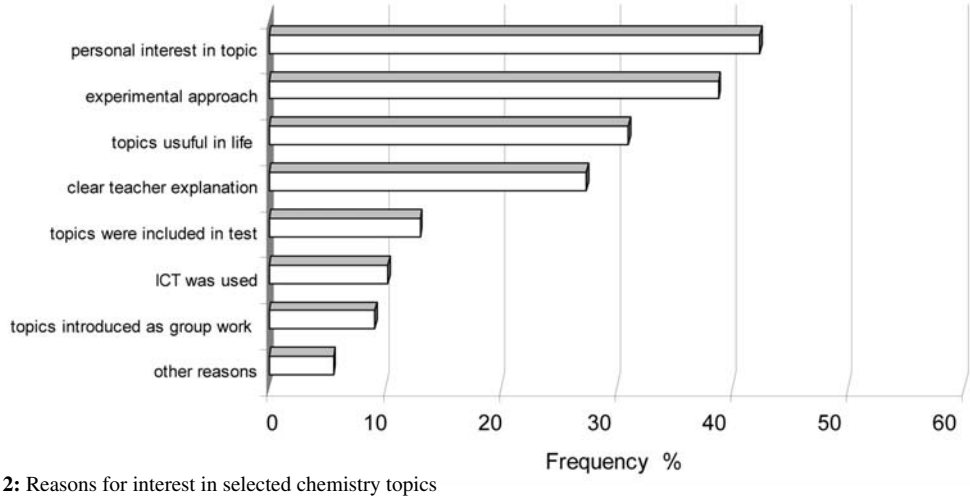

Figure 2: Reasons for interest in selected chemistry topics

(21.65%); this content is followed by "*inorganic chemistry topics and reactions*" (8.82%), also topics on "*enthalpy of chemical reactions*" and "*electrolysis*" are high on the unpopular list (7.84%). The following topics appear on both lists: organic compounds and reactions, structure of atoms and molecules, stochiometry, chemical nomenclature and galvanic cells.

It is interesting to examine the frequencies of reasons for the selection of unpopular chemistry topics, again the highest on the list is "*absence of interest*" (65.37%), however the next two reasons "*topics are not useful in life*" (30.19%) and "*incomprehensible teacher's explanation*" (27.15%) are worth exploring more deeply. The emerging question is: How is it possible that students do not recognize the importance of organic compounds for their life? It is obvious that the reason lies in teacher's approach when presenting concepts from organic chemistry, e.g. organic compounds, their structure, properties, and reactions. The teacher should articulate the conditions of teaching and learning in the classroom in such a way that good learning outcomes are most likely to occur.[19,25] It is his/her responsibility to seek relations between concepts taught and students' life experiences, since he/she is the one who decides which teaching/learning method should be the most appropriate for a given set of concepts. The teacher's incomprehensible and dull explanations of concepts (27.15%), which are most often complemented with "chalk and talk", neglect of experimental approach (8.81%) and ICT (4.16%), are good enough reasons for students to perceive organic chemistry as unimportant and unconnected to their life. The teacher must be able to adopt an autonomous motivation style toward students, so that they become more autonomous and engaged constructively in – and learn from – uninteresting, but personally important, lessons.[25–27] This part of the study reveals that research based on observations of chemistry teachers' behaviour in the real classroom settings, as well as study on their motivation for teaching are needed in order to change their attitude towards their classroom activity, so that they may be able to provide encouragement, help,

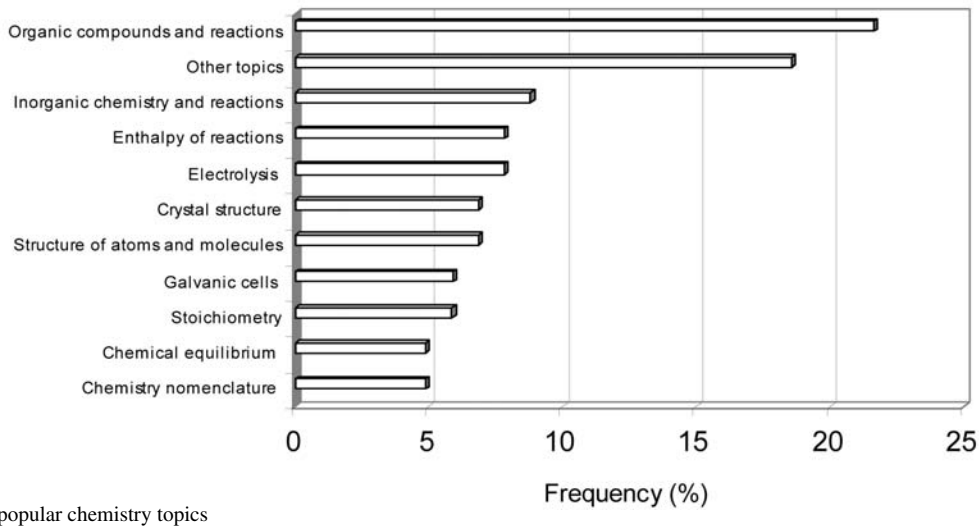

Figure 3: Unpopular chemistry topics

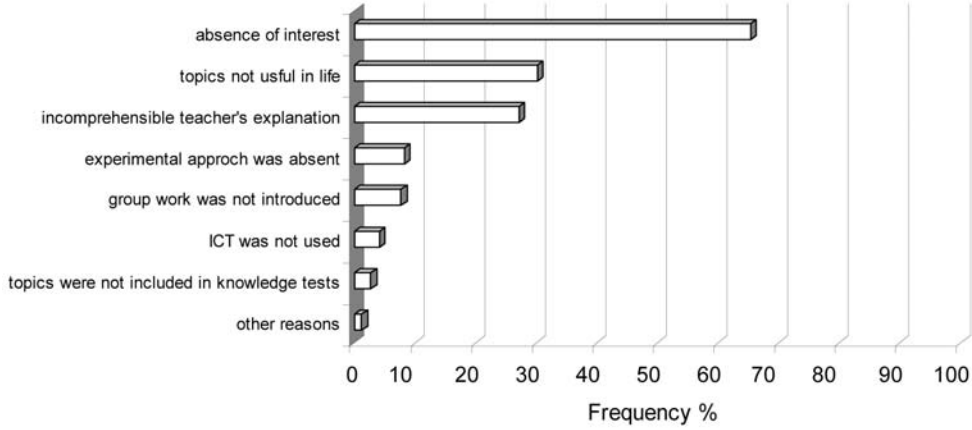

Figure 4: Reasons for absence of interest

comprehensible instructions, and expectations to their students in an autonomy-supportive way.[4,20,28]

5. Conclusions

From the results of the study, five conclusions can be drawn. First, two distinct motivational profiles of Slovenian high school students were revealed by *k-means* clustering of the data set obtained from Slovenian high school students' motivational dimensions responses (intrinsic, regulated, controlled motivation and self-concept); the low quantity motivation group and the good quality motivation group. Second, motivational profiles of the students proved to be crucial for their academic achievements; students from the good quality motivation group perform better in chemistry and in all other subjects taught in high school (overall achievement) than students from the low quantity motivational profile. Third, differences between the two motivational profiles are also evident from their preferences towards different teaching and learning methods used in chemistry classrooms. The good quality motivation group of students are more inclined toward more autonomous teaching/learning approaches (i.e. hands-on experimental approach, independent study with textbook) than the low quantity motivational group. However, students from the good quality motivation group value more the teacher's lecturing, than do students from the low quantity group, since they are more aware of the importance of teacher's explanation for a deeper understanding of chemical concepts. Fourth, reasons for unpopular and according to students' opinions unimportant chemistry topics (i.e. organic chemistry, enthalpy of reactions, electrolyses) lie in teachers' approaches used in presenting "*unpopular*" concepts. Teachers are not using enough the autonomy-supportive way of teaching/learning which would contribute to better teaching and learning outcomes. Finally, research based on observations of Slovenian chemistry teachers' behaviour in the real classroom settings, as well as study on their motivation for teaching are needed in order to change their attitude towards their classroom activity.

However, future research and practice should examine current research findings more deeply, as they implicate the crucial role of teaching approach on fostering the high school student's motivation that supports meaningful learning and academic outcomes (i.e., quality motivational profile). As Frenzel et al. stated »classrooms that are charactized by enjoyment of teaching and learning provide optimal grounds for overcoming obstacles and promoting positive development and achievement«.[29]

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Povzetek

Teorija samoodločanja (angl. self-determination theory) opredeljuje motivacijo kot večdimenzionalnem pojem, ki kot temeljna pojma razlikovanja med različnimi ravnmi motivacije definira avtonomno in kontrolirano motivacijo. Že opravljene raziskave kažejo, da so učni dosežki v pozitivni korelaciji z avtonomno motivacijo. V pričujočem prispevku je predstavljena empirična študija, v kateri so sodelovali dijaki 10 slovenskih gimnazij. Analiza klastrov je razkrila dva motivacijska profila dijakov: *motivacijsko skupina nizke kvantitete* (angl. a low quantity motivation group; nizki avtonomna in kontrolirana motivacija) in *motivacijsko skupino dobre kvalitete* (angl. a good quality motivation group; visoka avtonomna in nizka ali povprečna kontrolirana motivacija). Med identificiranima motivacijskima profiloma obstajajo statistično pomembne razlike tako za splošni uspeh dijakov, kot tudi za uspešnost dijakov pri kemiji. Dijaki *motivacijske skupine dobre kvalitete* so tudi bolj naklonjeni pouku kemije z uporabo učnih metod, ki podpirajo avtonomnost (angl. autonomy-supportive teaching methods). Preučevanje mnenj dijakov o pomembnih in manj pomembnih kemijskih vsebinah nakazuje, da je možen razlog za razlike v učnih pristopih, ki jih uporabljajo učitelji kemije pri poučevanju teh vsebin. Izkazalo se je namreč, da nekateri učitelji ne uporabljajo pristopov, ki bi podpirali avtonomnost dijakov in bi tako lahko prispevali k boljšim učnim rezultatom. Iz tega razloga je bila v prispevku prepoznana potreba po nadaljnjih raziskavah posvečenih motivaciji slovenskih učiteljev kemije in preučevanju učnih metod, ki jih uporabljajo.