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Abstract. *The present study addresses the pedagogical philosophy of secondary science teachers in Bulgarian schools. Information on science teachers' methods of teaching and learning has been gathered by an interview protocol consisting of six open-ended questions, with a numerical scoring analysis: Teachers Pedagogical Philosophy Interview. The results report that the majority of Bulgarian teachers surveyed rank in the middle of the scale which is an indication that they blend teacher-centred and student-centred style of instruction. A previous our research based on a different survey instrument led to similar conclusions. In addition, the survey reveals that teachers show attitudes to change their teaching methods and classroom practices towards the constructivist approach.*

Key words: *constructivist environment, teachers' attitudes, Teachers Pedagogical Philosophy Interview.*

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SCIENCE TEACHERS' ATTITUDES TOWARDS CONSTRUCTIVIST ENVIRONMENT: A BULGARIAN CASE

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Introduction: Constructivist Philosophy and its Application in Teaching

Constructivism as epistemology is founded on the premise that people construct their knowledge, skills and attitudes of the world through experiencing things and reflecting on those experiences, therefore knowledge cannot simply be transmitted from one person to another. New knowledge is constructed on the basis of prior knowledge and personal life experience as a result of targeted activities in a particular situation.

Researchers of constructivism discover its roots even in the works of ancient philosophers such as Confucius, Plato and Aristotle who develop the ideas that absolute truth does not exist thus knowledge does not transmit but it results from a subjective process of perception through understanding and experience (Coony et al. 1993; Pelech & Pieper, 2010; Stevenson & Haberman, 1998; Taylor, 1955).

Pelech & Pieper (2010, p. 10-12) discovers constructivist ideas in the works of medieval philosophers like St. Thomas Aquinas, St. Augustine, Giambattista Vico and Immanuel Kant as well.

If we come back to present day and turn to constructivist philosophy as a basis for intellectual development and professional training of people, we will inevitably connect constructivism with its most vivid representatives: the Swiss psychologist, epistemologist and biologist Jean Piaget (1896-1980), Russian psychologist Lev Vygotsky (1896-1934) and the American philosopher, founder of the functional psychology and reformer in education John Dewey (1859-1952).

Piaget is the creator of the theory of cognitive development – he studies the development of child intelligence and identifies



key stages in mental development of the child, which has an impact on learning. He is the founder of the so-called Geneva school of genetic psychology (Piaget, 1950), in which the cognitive development of children is investigated - children create knowledge, study through interaction with the surrounding environment. This interaction leads to structural changes in their mode of thinking, which means that Piaget sees restructuring of existing knowledge as a key element for the creation of new knowledge. The child moves from the earliest, sensorimotor stage of intellectual development to the stage of formal operations, of conceptual thinking by assimilating information from the world around it, adapting it to the immediate experience and transforming the knowledge already acquired (Piaget, 1936, 1937).

Lev Vygotsky is famous for his sociocultural theory according to which a fundamental role in the formation and development of knowledge plays human social and culture experience. While children construct knowledge individually in their everyday life they form, in terms of Vygotsky's theory, spontaneous concepts. Scientific concepts can only be acquired as a result of systematic instruction through formal school education (Выготски, 2005). "In the process of learning new structures arise and the old ones improve." (Выготски, 2005, p. 123). Everyday and scientific concepts differ in the manner in which they are acquired but they are interrelated, they are "one and the same process". Mechanical, accidental and spontaneous retention is a manifestation of humans as biological species, while logical thinking and creative imagination arise in the process of cooperation and communication, in which the speech plays a key role. In a child's development, social relationships and interactions are essential for developing knowledge. Each advanced function first happens as a collective, social activity and only after this appears as an individual's mental structure, i.e. mentality arises through various forms of cooperation with other people, and "internalize" as travels along the road from external social activity to individual mental activity (Vygotsky, 1997). Interrelation between spontaneous knowledge acquired in life situations and more abstract scientific knowledge which is formed in a classroom environment represents a constructivist vision that new knowledge is always based on the existing one. Learning requires social interaction and collaboration. Given his views on the importance of the social environment for the formation of knowledge, Vygotsky is considered among the most lucid representatives of the social constructivism. According to social constructivism, learning takes place through interaction with other students, teachers and ambient world (Vygotsky, 1978).

Jerome Bruner, American psychologist and professor at Harvard University occupies a worthy place among the founders of the constructivist theory. His fundamental work "The Process of Education" (Bruner, 1960) has been recognized as a classic in the field of the 20th century education. It had a direct impact on the educational policy in the United States. In this book, Bruner develops the idea of the "spiral curriculum": "A curriculum as it develops should revisit these basic ideas repeatedly, building upon them until the student has grasped the full formal apparatus that goes with them" (Bruner, 1960, p. 13). Bruner argues that the school education and training programs must encourage intuitive "grasping" of students. These perceptions express the constructivist views that learning is an active process in which learners construct new concepts based upon their previous knowledge while the new one reaching its full assimilation.

The idea that truth as well as knowledge is always connected to a particular situation and should be seen in the context of this situation which is not static but dynamic, is intrinsic to the famous ideologues of the theory of pragmatism of truth such as James (1995) and Rorty (1991). Scientific progress is made possible thanks to the creation of theories and prediction of phenomena when new evidence and new hypotheses arise respectively. Knowledge varies depending on the situation and adapts to it. This means that it is restructured on the basis of experience, which is, in fact, a constructivist view.

John Dewey ranks among the supporters of pragmatism in the philosophy of science and develops it further. He professes ideas of instrumentalism as a pragmatist theory, holding that the value of an idea lies in its usefulness. Dewey argues that a scientific theory is an instrument which is relevant to the extent that predicts and explains phenomena better, but not to describe objective reality. Dewey's ideas have enormous impact on the educational reformation: instead of authoritarian teaching in which the teacher has a leading role, experimental and practical work are the source and means of knowledge (Blewett, 1960).

Philosophical theory of constructivism gave a new direction to the development of science of



education and pedagogical practice in the past three decades. Priorities of the scientific research are the school environment, and the role and place of teachers and students in it. Constructivist theory of learning has become one of the pillars of reforms in education in the world. Due to the nature of the scientific knowledge which is formed through observation, hypothesis, experiment, collecting and discussion of data, evidence and conclusions, constructivist theory has a particularly strong impact on science education. Renewed national standards of science in many countries are not focusing so much on the subject matter content as on ways of tackling it. Modern educational standards and science curricula are founded on active learning, implementation of approaches and methods that encourage students to ask questions, express opinions, to accept, justify and evaluate own and others' ideas, to transform and rationalize new information based on previous knowledge and to work together in cooperation with their classmates. It is stated in the American National Science Teaching Standards that: "Good teachers of science create environments in which they and their students work together as active learners" (National Research Council, 2010, p. 4).

Authors, among whom are Vermette¹, Foote et al. (2001), as well as Pelech & Pieper (2010) derive basic principles of constructivist learning, which can be summed up and formulated, as follows:

1. Learning is an active process in which learners participate through all of their sense perceptions, creating their own version of knowledge.
2. Learning consists both of constructing meaning and systematization of knowledge.
3. Students learn by doing. Physical and practical activities are necessary for learning, especially for children, but not sufficient alone: reflection of what happened is important too, ultimately learning occurs in mind. Dewey called this "reflective activity" (Dewey, 1955).
4. Learning involves language, too. Language and speech affect learning and the construction of knowledge. Students learn by telling, explaining and talking. Learning and language are inextricably bound, according to Vygotsky (1987).
5. Learning is a social activity. It is through relationships with other people: classmates, teachers, family and casual acquaintances that can provide a variety of other perspectives to reject or confirm the information. People learn to learn as they learn. "Students learn when they teach others, explain to others, or demonstrate a concept to others" (Pelech & Pieper, 2010, p. 33).
6. Learning is subjective and contextual. People learn depending on the specific situation, based on what they have already known, what they believe, according to their convictions, prejudice and fears.
7. Prior knowledge is necessary to learn. The new knowledge is widely seen as linked to the previous knowledge. The more we know, the more we learn.
8. Knowledge has various forms and therefore it is acquired in different ways.
9. Learning is a process that needs time to form new knowledge and simultaneously transform and give meaning to the existing basic knowledge.
10. The key component of learning is motivation.
11. With the implementation of constructivist teaching and learning practices, numerous researches have published their findings on the constructivist learning environments (Aldridge, Fraser & Taylor, 2000; Becker & Maunsaiyat, 2004; Bowen, 2000; Brooks & Brooks, 1993; Fraser, 1994; Hancock & Gallard, 2004; Haney & McArthur, 2002; Hollenbeck, 1999; Kahvecy & Ay 2008; Kim, Fisher & Fraser, 1999; Lord, 1997; Mellado, 1998; Savasci-Acikalın, 2009; Simmons et al., 1999; Yager & Penick, 1986).

Different instruments have been used (QTI², SLEI³, CLES⁴, WIHIC⁵, TPPI⁶) by educational researchers to identify the characteristics of constructivist learning environment. The Constructivist Learning Environment Survey (CLES) has been designed to enable monitoring of constructivist approaches to teaching (Taylor & Fraser, 1991).

The first research on teachers' perceptions of their teaching and integration of constructivist approach in the classroom environment in Bulgaria has been taken using CLES instrument (Hollenbeck et al., 2009; Boiadjieva et al, 2011). It has been administered in two versions: a teacher, and a student version. The latter is aimed at comparing students' perceptions on instruction to their teachers' self-reported



views, and thus to evaluate teachers' constructivist performance. The instrument TPPI was applied in a pilot study on the constructivist-oriented learning environment involving Bulgarian chemistry teachers' in the Sofia metropolitan area (Boiadjieva et al., 2009). The scope of the latter study was extended to Bulgarian science teachers throughout the country. The results are presented in this article.

Methodology of Research

General Background of Research

This study was conducted as a part of our research activities on the constructivist science teaching practices in the Bulgarian schools. The research questions address the science teachers' perceptions of teaching and learning: *What are the Bulgarian science teachers' pedagogical attitudes with regard to their practice? Do the Bulgarian science teachers apply a constructivist inquiry-oriented approach in classroom?*

Sample

The sample of research consisted of 30 secondary science teachers in 28 schools from 9 areas of Bulgaria.

Sampling data are presented in Table 1. The distribution of teachers by age, pedagogical experience and gender has been done so, to comply with the total for the country.

Table 1. Sample characteristics.

Age		Pedagogical experience		Gender	
up to 30 years	1	Up to 10 years	3	Women	27
31 – 40 years	5	11- 20 years	9	Men	3
41 – 50 years	18	21- 30 years	14		
Over 50 years	6	Over 30 years	4		

Instrument and Procedures

The research instrument Teachers Pedagogical Philosophy Interview (TPPI) is a questionnaire consisting of open type questions. In order to obtain more detailed and concrete answers concerning teaching and learning methods, we adapted the TPPI by reducing it up to 6 questions (Boiadjieva et al., 2009). They could be provisionally divided into two groups. The first group questions are related to the way of teaching. They suggest respondents describing themselves as teachers and highlighting the best qualities, which a good teacher should possess. The second group questions require answers related to the way of learning of both the teachers and their students.

The teachers' responses to the survey questions provide information on their views and perceptions of their role in science teaching as well as their relationships with students in the learning process.

The 30 surveyed teachers answered questions in written, individually and independently from each other. Each answer is evaluated by four experts. Three of them are university professors with experience in the field of chemical education and one is a novice teacher. Evaluation is determined by the scale, presented in Table 2. Experts independently ranked the teachers' responses attributed to them the relevant numbers of the scale from 1 to 5. Responses with a score of 4 or 5 relate to a constructivist, inquiry based and student-centered classroom, 1 and 2 – to traditional, teacher-centered teaching, 3 – to a transitional, between traditional and constructivist environment (Boiadjieva et al., 2009).

It should be noted that with few exceptions, the estimates of four experts coincide and do not depend on their professional experience.



Results of Research

Results were co-related for an average for each response and participating teacher. Table 2 reports the average expert scores (with accuracy up to 1) on the scale for the six questions of the survey.

Table 2. Teacher Pedagogical Philosophical Interview (TPPI) evaluation form and distribution of teachers' responses according to the average score.

Questions	Rating				
	1	2	3	4	5
Q1. Describe yourself as a teacher.	The teacher does not describe the self.	The teacher describes self through personality traits.	The teacher describes self as a professional.	The teacher describes self as sympathetic to the students.	The teacher describes self through the actions of the students.
Number of teachers	0	7	11	9	3
Q2. What are your main strengths as a teacher?	The teacher points to personality traits only.		The teacher is open to students, uses background to enhance instruction.		Strong content background, utilizes the skills and experience of others.
Number of teachers	7		18		4
Q3. How do your students learn best?	The same way I learn		By their own actions and interaction with the teacher.		All students learn differently.
Number of teachers	0		25		5
Q4. How do you, as a teacher learn best?	By a single method.		By visually doing and teaching the subject.		Through multiple methods.
Number of teachers	4		13		13
Q5. What does a "good learner" mean?	A good learner has natural ability to learn.		A hard worker, willing to learn, and ask questions.		A reflective teacher willing to take risks, and is inquisitive.
Number of teachers	2		15		13
Q6. How do you, as a teacher, know that your students have understood the material?	Student self reports, exams or assignment performance.		Based on classroom recitation and performance.	Student applies new information.	Based on student to student interactions.
Number of teachers	5		15	9	1

Discussion

Research results indicate that 1/3 of the teachers describe themselves as professionals, almost the same percent give priority to the interaction with students, while about 1/4 put emphasis on personal qualities (Q1). Therefore, the majority of Bulgarian science teachers do not show an attitude to work in a student-centred classroom. Only three teachers do not assign themselves in teacher-centred teaching style, but depicted themselves by students' actions. "I try to provide feedback to my class. [...] Very often I assign individual students or groups of students preparing a new lesson." writes one of these teachers. According to the philosophy of constructivist approach, students are the main actors in the process of learning, while the teacher is a mediator as well as a scientific advisor taking responsibility of the quality and purposefulness of corresponding educational activities.

An average score of 3 ranks the responses to the **second question** in the middle of the scale. These teachers believe that the best teacher combines the best qualities of a traditionalist and a constructivist



teacher, because he is open to students. Four of the teachers rely on the skills and experience of their students. As in the previous question, about 1/4 of the teachers give priority to their personal qualities. Mutual respect between teacher and student is one of the main characteristics of the constructivist environment. In traditional teaching, the teacher plays a leading role in teaching and learning and therefore, the students are required to comply with him to be obedient (Blewett, 1960). A teacher who writes: "I have a professional attitude to work, I demand respect from students." might be attributed to the traditionalists.

The second group of survey questions (Q3, Q4, Q5 and Q6) requires answers related to the way of learning of teachers themselves and their students.

In their responses to the **third question**, 25 teachers specify that their students learn mostly through their own actions and their interaction with the teacher. Students need: "more exercises, experimental activities, problem solving", "an accessible and sound subject matter content", and "use of presentations in the new lesson". The constructivist learning environment requires students to work together, to assist each other, and more importantly to follow their own pace of work after their abilities and attitudes. This is the way they have to be transformed from passive observers into active constructors of their own knowledge. Hence, research work, inquiry-based learning, hands-on activities, discussions, resolving of case studies, independent presentation of results from the activities of own, self-organization and discussion of experiments can be viewed as opportunities for constructivist learning. Only five of the surveyed teachers have indicated similar practices.

Question four requires the teachers to describe how they learn themselves. Here the opinions divide into halves. The specificity of science as a school subject needs a visualization of theories, phenomena, and processes for their better understanding. This is the reason why almost half of the teachers consider visualization and reading as top priorities in their preparation for lessons and learning. Thirteen teachers except the ones mentioned above, point out that an important way to learn and exchange experience with colleagues are workshops, conferences, and training to get additional qualifications. This indicates that teachers are quite willing to learn more how they could be more effective educators in their classrooms, and reflect a shift from the traditional towards constructivist attitudes of Bulgarian teachers.

The fifth question concerns the main features of the good learner. Teachers' responses can be related equally to the categories, corresponding to scores of 3 and 5. Teachers depict that a good learner should "be competent on various issues", "not to reproduce, but to think and understand the studied material", "be concentrated, in-depth studying, persistent, and consistent in learning". Half of the teachers indicate personality traits which are typical of a constructivist learning environment: "to be motivated to explore new, unknown fields of knowledge", "to be able to participate in a debate giving reasons and arguments", "to be inquisitive and to evaluate the usefulness of knowledge", "to deal with cases and to be active in class and outside it", "to be willing to participate in different activities". These answers can be considered as a good sign of willingness to develop such qualities in the students. This can be realized by new approaches and teaching methods.

The **sixth survey question** aims to identify indicators, by which teachers judge whether students have learned their lessons. Half of the teachers state that students should: "demonstrate skills to answer test items and to have problem-solving competences as well as to deal with practical activities", "answer questions related to chemistry content knowledge", "perform individual tasks", "participate in lectures and discussions on learned subject matter". About one-third of the teachers consider the application of new knowledge in different situations as an important criterion for successful learning. Almost as many are the teachers who hold views that the results of examinations and tests are determining evidence for understanding the studied material. Only one teacher is scored by experts with 5. For him it is important that "students participate willingly in classroom activities and help their classmates when they do not understand the teaching content".

As stated in the beginning, the TPPI survey is one of the instruments that reveal teachers' views with regard to their role in science teaching and beliefs of how their students learn best. A verbal description corresponding to the expert evaluation with the highest frequency for a response, which we called "consensus response characteristics", is presented in Table 3.



Table 3. Consensus characteristics of the teachers' responses.

Question	Consensus response characteristics
Q1. Describe yourself as a teacher.	The teacher describes self as a professional.
Q2. What are your main strengths as a teacher?	The teacher is open to students; uses the background to enhance instruction.
Q3. How do your students learn best?	Students learn through their own actions and interaction with the teacher.
Q4. How do you, the teacher, learn best?	Half of the teachers: through visual resources and further reading; the other half: by different learning styles.
Q5. What does a "good learner" mean?	Half of the teachers: works hard, is willing to learn, and asks questions. The other half: thinks, contemplates, is ready to take risk, and is curious.
Q6. How do you, as a teacher, know that your students have understood the subject matter?	Half of the teachers point out: At what students show in class. Nine teachers: The student applies new knowledge.

As it can be seen in Table 3, consensus characteristics are oriented to the centre of the scale, which means that most of the Bulgarian teachers surveyed use teaching and learning methodology, which can be described as mixed between traditional and constructivist. The survey results largely coincide with those of another our survey conducted with teachers only from Sofia (Boiadjieva et al., 2009). Therefore, the place does not affect the characteristics discussed in the survey. The profile of science teachers, with very few exceptions, is the same. This is probably influenced by both traditions of pre-service teacher training programs and the established traditions in science teaching in the Bulgarian school.

It is of interest to compare the views of the teachers surveyed by TPPI and the perceptions of their students interviewed using CLES. The contents of CLES are commented in detail in our other publications (Boiadjieva et al, 2011; Hollenbeck et al, 2009). Here we will discuss only those students' answers in the five categories of CLES: Scientific Uncertainty, Critical Voice, Shared Control, Student Negotiation, which are relevant to the present study.

In the category of **Critical Voice**, 40% of the students indicate that they are almost never or rarely interested in the way they are taught. This means teachers do not share with the class their reasons for choosing their teaching strategies. Student engagement in teaching and learning can be achieved by reforming of both science curriculum and classroom practice.

Consensus response characteristics to question 2 of TPPI show that teachers are open to students and use the learning background to improve instruction (18 teachers). Only four teachers state that they utilize the skills and experience of their students, in other words, they encourage them to become active participants in learning and teaching, and thus create a learning environment, which is called by constructivists "student-centred instruction".

Responses to the TPPI question 2 are also relevant to the category Shared Control of CLES. According to the responses in this CLES category students perceive the learning environment rather teacher-centred than student-centred, and clearly state that they wish to be active participants in classroom teaching and learning. On the other hand, teachers like "active, initiatory" students but still hold that the teacher should be the one who "lays down the rules." Only three teachers in TPPI describe selves by the actions of their students.

In Student Negotiation category the answers of students approach to the features of the constructivist classroom. They recognize the need of cooperation in learning. For teachers, it is important as well. In their answers to questions 5 and 6 of TPPI most of the teachers relate successful learning to methods, which involve communication and cooperation, and teamwork.

Conclusions

TPPI results of the survey show that in both sets of questions, the answers of the majority of teachers surveyed rank in the middle of the scale, which characterizes them as teachers of traditional-constructivist type. Their students, according to CLES, also place them into this category. Still, the attitude of teachers towards constructivist change is obvious.



Implementation of such a change towards a constructivist learning environment requires several measures.

Teachers can apply constructivist principles at school only, if they themselves are taught in this way, or teachers teach the way they were taught. Therefore, a proper education of pre-service teachers is of great importance. It should include inquiry, interactive, and hands-on activities. The ability to conduct inquiry while interacting with students should be a key outcome for pre-service teachers.

There are strong demands for teachers to continuously update their knowledge and skills: surveyed teachers declare ambition to share experience and collaborate with colleagues, to participate in various forms of training, seminars and qualifications. Teachers who receive more professional development feel more effective. Therefore, access to continuous quality professional development is vital for in-service teachers.

The implementation of constructivist approach and the shift from traditional to student-centred classroom must strongly find its plan in the upcoming revision and renewal of the Bulgarian educational standards and programs. They have to be focused not only on "what to study?" but also "how to be learnt?". At this stage, the regulatory documents do not encourage the implementation of constructivist teaching approach, so a change and improvement of the National science standards is necessary.

National Educational Standards for teachers have to be developed. They would set criteria for professional preparation and training of future and current teachers. The standards will help teachers to provide an environment in which students interact and assist one another, working collaboratively, until the tasks are internalized. These criteria will motivate teachers to improve their professional development as they will be able to measure themselves against the standards of their profession.

Notes

- ¹ http://findarticles.com/p/articles/mi_qa3673/is_1_122/ai_n28879472/?tag=content;col1
- ² httpQTI – Questionnaire on Teacher Interaction
- ³ http SLEI – Science Laboratory Environment Inventory
- ⁴ CLES – Constructivist Learning Environment Survey
- ⁵ WIHIC – What Is Happening In this Class
- ⁶ TPPI – Teachers Pedagogical Philosophy Interview

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