USING THE SEMANTIC DIFFERENTIAL METHOD TO ASSESS THE LEARNING MOTIVATION AND ATTITUDE OF FIRST-YEAR STUDENT'S TOWARDS CHEMISTRY IN UNIVERSITY OF EMERCOM OF RUSSIA

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ABSTRACT

It is an interesting to obtain an objective view of students' attitude toward a certain discipline and to construct effective pedagogical diagnostics based on the obtained data. Such data relates to both the academic performance of students and also their emotional attitude towards a subject and motivation to study it. This research study, using the semantic differential method, used a survey tool for measuring students' attitudes towards "Chemistry" as a body of knowledge and practical use. A questionnaire was administered to first-year students from the University of EMERCOM of Russia, who were studying Chemistry as a basic discipline. Methods of graphical and factor analysis were used to process the data obtained during the study. The concurrent results of both methods prove the applicability of the graphical data processing method for small subject groups' analysis, when factor analysis was not sufficiently accurate. As a result of statistical data processing, four basic factors, reflecting the students' attitude to the Chemistry course, were identified. The learners were seen having different attitudes depending on the major chosen, on gender and on the nature of the educational group. A lack of understanding of the role of Chemistry in professional disciplines was found to be a major cause for low learning motivation. It was also revealed that academic performance could be increased by monitoring the students' emotional states. A combination of both factor analysis and graphical data processing made this study both qualitative and quantitative.

Contribution/Originality: The primary contribution of this research is to investigate the pedagogical diagnostics method of students' emotional perception in an educational process, based on the differential method, which allows tracking of the change in attitude towards a subject during training and choose teaching methods that increase motivation for learning.

1. INTRODUCTION

The issue of providing high - quality education to meet world standards is vital in Russian pedagogical domain. Education that embraces a qualitative system of knowledge, abilities and skills are in high demand in both the professional environment and society in general. Besides, the final results ending in highly qualified graduates, the notion of quality in education also means a process aimed at achieving the planned results based on subjective factors (including teacher and student potential) and the objective external conditions in which the educational institutions operate. However, the quality of education and a command over the subject at universities is still

determined by the grades that a learner acquires, which is also a parameter that any educational institution aims at improving to prove its academic performance (Baskin *et al.*, 2017). This method of diagnosis does not allow identifying and taking into account individual characteristics of a student, now does it allow the assessment of a student's feelings during the learning process. In other words, there is no method to take into account and eliminate the negative trends that diminishes motivation for educational activities.

The quality and quantity of acquired knowledge depends not only on the intellect and abilities of a teacher, but is also determined by psychological characteristics of a person (self-control, self-confidence, perseverance) and motivation to attain knowledge. However, based only on control and analysis of students' academic performance, it is impossible to identify the forms and methods for encouraging learning activity and to expect a positive attitude towards the subject from students. Moreover, it is also essential to consider factors like emotional attitude towards the learning process, students' changing dynamics during the process, and their self-evaluation of the subject itself. Identification and consideration of individual characteristics are also impossible without the correct organization of pedagogical diagnostics. A teacher's activity is based on both intuitive and rational approach and aims at identifying opportunities and professional preferences of future young specialists (Baskin and Gutnik, 2013).

First-year pedagogical diagnostics is particularly important when studying basic subjects. One of the major problems of studying disciplines such as chemistry, physics, mathematics and foreign languages in technical universities is the learners' lack of motivation, which negatively affects the quality of learning performance. Most young people dream of becoming professionals in a particular field and enter a university immediately after their school graduation, where they face a problem of studying multiple professional-field-unrelated subjects – chemistry, for instance. The insufficient learning curve in basic subjects as well as lack of interest in a subject, not only leads to a decrease in learning effectiveness but also reduces the percentage of residual knowledge. Hence this study was required to examine and understand variables that can create an effective method of pedagogical diagnosis based on students' academic performance as well as their emotional attitude and motivation towards the subject. The study also investigates whether such an attitude transforms, increases or decreases, later in senior courses when a student has completed the learning of the basic disciplines.

2. LITERATURE REVIEW

A study was carried out to analyze the attitude towards the subject of "Chemistry" using psycho-semantics as one of the methods of research. In Russia, teachers do not widely employ these tools for studying attitudes towards academic disciplines, and consequently, do not use them on curriculum and lesson plans creation and design. However, in global psycho-pedagogical studies, psycho-semantics methods are universally applied to the analysis of educational process in such subjects as Mathematics, Physics, Biology, Chemistry, and other natural sciences (Shoaib and Mujtaba, 2016; Pysny *et al.*, 2017; Sunar and Shaari, 2017; Baskin and Svidzinskaya, 2018; Tung and Van Anh, 2018).

Another study focuses on assessment of the phenomena such as beliefs, motivation, emotions, and perceptions that are not directly observable and use of special tools such as inventories, surveys and measurement scales. In this study, individuals indicate their preference through their degree of agreement with statements on a measurement scale. Items containing these statements are constructed with three common response formats: dichotomous, semantic-differential, and Likert scale (Osborne *et al.*, 2003; Lovelace and Brickman, 2013).

Among these types, the Likert-type scale method is a psychometric scale commonly involved in research that employs questionnaires. It is most popular in terms of studying attitude to science in general and its streams like Chemistry, Physics and Mathematics, in particular. The attitude towards science is measured through questionnaires consisting of Likert-scale items that require students to respond on five options such as "strongly agree/agree/neither agree nor disagree/disagree/strongly disagree" (Osborne *et al.*, 2003; Lovelace and Brickman, 2013). In particular, five or seven-point Likert scales ranging from 12 to 76 items should be developed in order to

determine the attitude to the subject of Chemistry depending on the aims and objectives of an experiment (Sumarni et al., 2018).

Studies reveal that a control over the emotional state of students and their attitude towards studying can be implemented by conducting a survey employing psycho-semantic methods that allow tracking of factors that cause a decline in the quality of education as well as contribute to the creation of comfortable educational environments. Such methods are particularly useful when emotional and subjective attitudes towards objective phenomena or to what constitutes the inner world of an individual are to be quantitatively described (Kozhevnikova and V'yzhanina, 2016). Results of the research proved that a teacher can timely adjust all organizational forms of the educational process and select the most effective methods to expose the potential of students as well as the whole educational institution.

A respondent is asked to fill out a survey form containing a set of antonyms (descriptors). He/she evaluates the studied subject based on his/her inner feeling towards the subject with the corresponding value on the rating scale. As a result, unconscious associative links are derived between the subjects in the consciousness. This method makes it possible to characterize the emotional attitude to the subject both qualitatively and quantitatively (Kozhevnikova and V'yzhanina, 2016).

In our opinion, the most promising method is the semantic differential method developed under the guidance of the American scientist Charles Egerton Osgood in 1957. This method facilitated individual perception of the phenomena under study. The basis of the method was the theory that an evaluated object was important for an individual not only because of its objective content but also due to the personal attitude of a person towards an object. With the help of bipolar scales, the semantic differential defines a multidimensional space, called semantic space, for result estimation. The phenomenon or indicator considered receives an estimate according to each of the scales that makes it possible to describe the object as a point in the semantic space. This psycho-semantic method encompassing a wide scope of indicators affecting the attitude of a person to an object of research is designed in a way that a respondent cannot predict its final result within the course of the survey. This makes it possible to conduct pedagogical diagnostics and attain an objective picture of the individual's emotional-semantic attitude to the object.

Osgood's standard Semantic Differential has three integrating factors of the semantic space: evaluation, potency and activity. These factors are universal and correspond to a three-component emotion description model (pleasure – tension – excitation). However, during the method application in various fields of activity investigating human perception and behavior such as sociology, psychology, linguistics, pedagogy, advertising, etc., scientists develop a large number of specialized semantic differentials. Moreover, more than 2800 antonyms characterizing the respondent's possible perception of a phenomenon or a subject were suggested for the creation of bipolar scales (Toglia and Battig, 1978).

In chemistry education, Dalgety et al. (2003) used a semantic differential format to develop items to measure attitudes toward chemistry and chemistry self-efficacy. In 2008, K. F. Bauer developed a method for evaluating the attitude to Chemistry as a body of knowledge or practices using 20 pairs of antonyms. Students who studied Chemistry filled in the developed survey form at regular time intervals while completing the discipline course. K. F. Bauer revealed the changing dynamics in attitudes towards Chemistry and proved that the attitude to the discipline is interdependent on academic performance. It also shows attitude is determined by the duration of the disciplinary course and initial level of students' preparation. Bauer reported a four factor solution described as: Interest/ Utility; Emotional Satisfaction; Anxiety; Intellectual Accessibility. One single item was independent of the other four factors and described with the term 'Fear' (Bauer, 2008). This method became widespread and was used to evaluate the attitude of college-level students in the Pacific Islands towards Chemistry (Brown et al., 2014). In 2011, Bauer's method was refined by Xu and Lewis by reducing the number of items from its original 20-item form and five latent constructs to eight adjective pairs in two factors: "Emotional satisfaction" and "Intellectual accessibility" (Brandriet

et al., 2011; Xu and Lewis, 2011). In 2015, a shortened semantic differential method was used in Turkey for high school students' attitudes toward chemistry (Kahveci, 2015; Sen *et al.,* 2016).

Processing of the results obtained by the method of semantic differential is traditionally carried out by the factor analysis method (Bauer, 2008). This method of mathematical statistics self-integrates qualitative and structural-quantitative analysis of the subject of research and makes it possible to reveal internal, hidden object characteristics non-observed directly, the number of which is small and which, in fact, determine the values of the observed parameters. Factor analysis helps identify survey items that show similar response patterns. A group of similar items defines what is called a "factor". The factors identified as a result of the analysis can be used for complex phenomena explanation while finding solutions of various scientific and pedagogical problems. Factor analysis conduction aiming at identifying the factor influence, comparison of their structure for various groups of students and manipulations of the variables effectiveness evaluation, which determine the differences (or, on the contrary, identity) of the structure of factors in these groups, as a rule, is employed in a comparative pedagogical experiment (Lebedeva, 2003).

The disadvantage of the method is that the number of variables (antonyms) should be about three times more than the number of respondents (Lebedeva, 2003). To use the semantic differential method for the purpose of qualitative assessment of the emotional state and attitude dynamics of small respondents groups, a graphical method of interpreting the results of surveys was applied (Baskin *et al.,* 2017). The graph looks similar to the survey form issued for the respondents. The mean value of the indicator obtained after processing the survey forms respondents groups for this pair of antonyms corresponds to a point on the scale. The closer the point is to the corresponding antonym, the more this definition corresponds to the student's idea of the subject (Baskin *et al.,* 2017). The connected points perform a broken line. The location of these lines on the survey form relative to pairs of antonyms, and comparison for different groups determine the attitude of respondents to the subject of the study and its qualitative changes.

3. PURPOSE OF THE STUDY

The research aims to study the emotional, motivational and semantic attitude of St. Petersburg University of EMERCOM of Russia students towards the subject of "Chemistry" using the semantic differential method when studying the discipline during their first year, as well as in the whole program, to create an effective method of pedagogical diagnosis which includes not only data on academic performance but also the emotional attitude to the subject and motivation for its study. It also examines the possible transformation of this attitude later at senior courses, when the teaching of basic disciplines is completed. The research study has the following parameters to examine:

1. Semantic differential method application for monitoring the attitude towards basic subjects, namely "Chemistry".
2. Appropriateness of using semantic differential method to examine the influence of perception and attitude towards a subject and its consequences on the motivation for learning the basic subjects such as "Chemistry" at a University
3. Analysis of differences depending on gender and the form of education e.g. state-financed education for cadets and students; and tuition-fee for students only.
4. Graphical and mathematical processing of the data obtained by the semantic differential method using factor analysis in order to identify the influence of factors and compare their structures.
5. Uses of data obtained by the semantic differential method for the purposes of pedagogical diagnostics.

4. METHODS OF RESEARCH

The sample of the study comprised cadets and first-year students of St. Petersburg University of State Fire Service of EMERCOM of Russia, who had completed the course of General Chemistry covering 50% of the Chemistry Course. These participants were specializing in Fire Safety, Forensic Examination, Mining, System Analysis and Management. There were 128 subjects participating in the research, 24% of whom were women and 76% men. Fifty five percent of respondents were university cadets and 45% studied in student groups. Overall, 9 student groups participated in the experiment Table 1. The choice of the University was of particular interest, as it offers education in two different forms: first it offers education to cadets who are future officers, firefighters and rescuers living in barracks under course officers' supervision, following strict rules. Second, there are civil students without any restrictions. The researchers were interested in assessing the changing dynamics in the learners' attitudes towards basic subjects depending on the system of education and gender of the learners.

Table-1. Distribution of respondents by majors, the form of education and gender.

Major	Form of education	Number of studying groups	Male respondents	Female respondents
Fire Safety	Budgetary free course, cadets	3	20	6
Forensic Examination	Budgetary free course, cadets	2	27	6
System Analysis and Management	Budgetary free course, cadets	1	12	0
Forensic Examination	Fee-paying course, students	2	25	19
Mining	Budgetary free course , students	1	13	0

Original statistical table based on the respondents' number, their major and gender.

Chemistry was chosen as the subject of this study, due to the fact that this discipline requires a wide range of pedagogical practices while teaching. Students need to practice theoretical principles, using computational methods in the class, and carry out experimental studies in laboratories. Chemistry as an academic discipline forms the basis for preparing experts in engineering and other specialized disciplines. Chemistry also serves as a basis for fire safety of technological processes study, fire tactics, forensic expert research methods, fire-technical expertise, conduction technical engineering inquiry, etc. Last, but not the least, topics studied in the chemistry course are related to the surrounding reality - for instance, environmental pollution, food quality, medicine, and household chemicals. In addition, they deal with fires and their elimination as well as mine accidents, natural disasters consequences and like.

The choice of antonyms to compose a survey form on the attitude of respondents to the subject of Chemistry was the most difficult stage of the study. The term "attitude" (relating to Chemistry in our case) was determined by a combination of cognitive, affective-evaluative and behavioral factors (Demchenko, 2013; Heng and Karpudewan, 2015). The cognitive component, standing for learning, is associated with the desire to gain knowledge in a subject. The affective-evaluative component mostly determines emotional constituent, expressed by the respondent's attitude and perception of a subject. The behavioral component reflects regulatory-effective factors determined by the motivation to commit some acts in the learning process. The meaning of each of the components changes regularly in the course of the learning process that forms the scope of acquired knowledge. Since Chemistry is a basic academic subject and studied in St. Petersburg University of State Fire Service of EMERCOM of Russia by first-year students, the authors found it important to evaluate not only its intellectual accessibility and emotional satisfaction in the course of studies but also its utility for students. Unless we understand the usefulness of the knowledge obtained, it is impossible to develop motivation to obtain it, and thus to achieve the quality standard of education.

While selecting antonyms, the researchers were determined to characterize the subject of Chemistry in a detailed manner. The researchers also aimed to avoid subjectivism in order to eliminate any pressure on the respondents during the survey. This was essential in order to obtain the expected result as well as to differentiate a student's attitude to a subject from that to the teacher holding the class. For this reason, an analysis of previous literature dedicated to the semantic differential method survey forms was carried out (Serkin, 2007). The students themselves were involved in the process of selecting antonyms. They were asked to find the most suitable definitions from which their point of view could characterize Chemistry. As a result, an inventory was compiled containing 20 antonyms.

The respondents' involvement during the process of creating the survey form contributed to the increase in interest in research; increased their openness while filling out forms which undoubtedly improved the quality and effectiveness of the survey. As a result, cadets and students showed great interest in the experiment and agreed with its findings and results, a very encouraging phenomenon for the researchers.

When compiling the questionnaire, multidirectional scaling was used. It means that the values of antonyms characterized a questionnaire item from positive to negative and vice versa. This measure excluded positional style of answers when a respondent would start giving univocal answers after some time. A seven-point scale with a changing value from +3 (maximum correspondence) to -3 (minimum correspondence) through zero was inserted between antonyms.

The forms were printed out on separate sheets, which were to be filled manually by respondents. The respondents marked the value for each pair of antonyms on the scale which, from their perspective, most accurately corresponded to the subject of Chemistry. The time allocated for filling in the form was five to ten minutes. Students' names or other personal information were not asked.

5. ANALYSIS

The survey results analysis was carried out in two stages. At the first stage, graphical data processing was carried out to compare the attitude of respondent groups studying in different majors to the subject of "Chemistry." In the second stage, such features were identified in groups of boys and girls, to study the gender specific perception towards the Chemistry subject.

Since this study adopted a qualitative approach, it was essential that the number of respondents in each sample group should be sufficient for conducting a qualitative data processing research using mathematical statistics method (Lebedeva, 2003). For this reason, it was easy to present the results of the study in graphs where the point on the scale corresponded to the mean obtained by the analysis of the data given by the respondents for this pair of antonyms Figure 1,2.

For clarity, the antonyms on the graphs were arranged in the manner they appear in the semantic differential inventory. The descriptors characterizing the conditionally positive attitude to the subject of Chemistry were on the right, whereas the conditionally negative ones were on the left. In the second stage, the data obtained by the survey of combined groups of cadets and students were processed using factor analysis.

To ensure that the number of students in each group does not affect the results of factor analysis, 2 groups of respondents were formed for the survey results analysis:

- Cadets (mixed group) 71 people
- Students (mixed group) 57 people

All data were collected and transferred to Excel and SPSS Software. The internal structure of data was assessed using the principal component method. The structure was explored using Varimax rotation. The data were analyzed in terms of suitability for factor analysis. Both the Kaiser–Meyer–Olkin (KMO) and Bartlett's test suggested that factor analysis was feasible Table 2. An initial four factor solution, based on eigenvalues >1, was suggested. Cronbach's α was used as a statistical item to indicate the internal consistency of the items which

contributed to the factor. Its value for all factors was above the recommended value 0.7. The correlation between factors lies within -0.27 – 0.38 which proves the independence between these factors. The threshold for significant factor loadings of the items was accepted as 0.50, a commonly used threshold value for small sample sizes that indicates strong loading.

Table-2. Kaiser–Meyer–Olkin and Bartlett's test results.

Fit Indices	Cadets	Students
Sample size, (N)	71	57
KMO	0.74	0.71
Chi-square, (χ^2)	671	622
Degree of freedom, (df)	190	190
p-level	0,000	0,000

Original table based on the results of factor analysis in SPSS Statistics, reflecting the Kaiser-Meyer_Olkin (KMO) and Barlett's tests results adequacy and indicating the expediency of factor analysis.

6. RESULTS AND DISCUSSION

The majority of applicants entering St. Petersburg University of State Fire Service of EMERCOM of Russia had a great respect for their future heroic specialty, as the external attributes and prestige of the chosen profession are highly important for them. This is quite natural, as the full picture of what the profession actually entails is not yet realized in the mind of the junior cadets and students who have just graduated from school. Therefore, they take their external experience as the source for the creation of their own future professional definition. Studies conducted via the Ural Institute of State Firefighting Service showed that young people entering university are primarily professionally motivated and least think about the future educational activities (Demchenko, 2013).

The real situation that first-year students (and especially cadets) encounter often causes a feeling of frustration, which is connected with a change in the study form, strict discipline requirements, and the necessity to perform routine official duties. Instead of mastering the heroic firefighter or rescuer profession, young people start with studying basic subjects that are least connected with their future role of saving lives (e.g. antonym "Theoretical" has a high value for all groups of respondents) Figure 1,2.
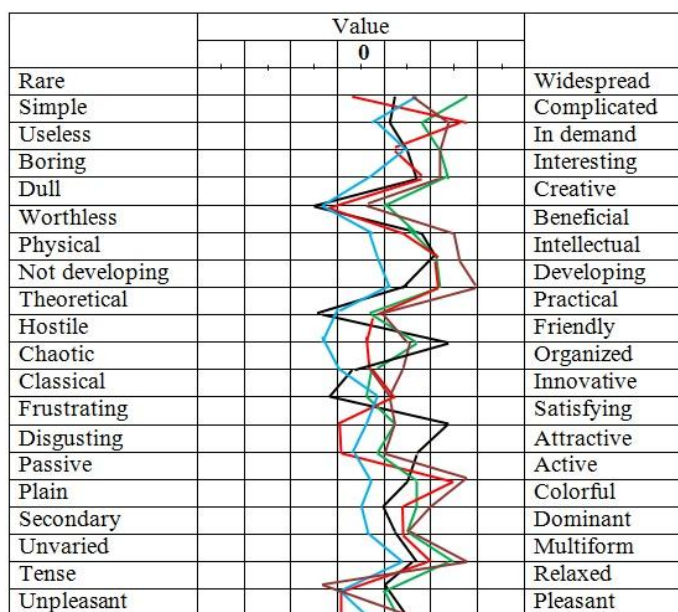
Meanwhile, the number of hours dedicated to chemistry classes in Russian schools has been steadily declining in recent years, and the discipline's prestige is also decreasing. Applicants enter university with very low basic knowledge of the subject, but with big plans to pursue their course on forensic examination and view their profession as humanitarian. It is this group of respondents that considers the mastery over the discipline to be highly complicated Figure 1,2.

The results of the graphical interpretation of the data characterize the negative attitude of cadets - future officers and firefighters – towards the subject of Chemistry Figure 1. Low scores for such descriptors as "In demand", "Beneficial", "Developing", and "Dominant" show that students do not understand the purpose of studying this subject or do not see how chemistry is related to their future specialty. The subject does not evoke interest in students, which means that they are not motivated to acquire knowledge. This is confirmed by a low average score obtained in the chemistry exam ("Forensic examination" – 3.7, "Fire safety" – 3.8, with the system of knowledge evaluation: 2 – unsatisfactory, 3 – satisfactory, 4 – good, 5 – excellent). Constant academic failures and disciplinary sanctions cause negative feelings and unwillingness to study chemistry (high values of "Hostile", "Disgusting", "Unpleasant" descriptors).

The findings also revealed that a negative attitude of cadets towards the subject was often connected with ineffective self-preparation process organization, excessive management control and the necessity to perform many service duties, which reduces the value of the knowledge obtaining process.

The cadets and students majoring in System Analysis And Management, as well as Mining, showed higher results in their attitude towards Chemistry. It suggests that since Chemistry was a component of fewer courses in

their study curriculum, there were less strict requirements for the successful completion of assignments. The knowledge gained in schools appeared sufficient for them to fulfill the curriculum requirements. Secondly, the groups consisted of smaller number of students, and therefore the teacher had more opportunities to adopt the individual approach. As a result, young people attended classes with more pleasure (descriptors "Satisfying", "Relaxed" and "Pleasant" have a higher value). They characterized chemistry as a friendly, interesting, developing discipline, although they were unsure of the necessity to study it (with low value for "In demand" descriptor). The average score obtained at the Chemistry exam was higher – 4.0 for mine rescuers and 4.3 for future specialists in System Analysis And Management.

Figure-1. First year cadets' and students' survey results.
Original chart based on the data obtained when processing semantic differential forms filled out by respondents.

Fee-paying Forensic examination department students gave the most positive assessment of the discipline (high values for "Active", "Beneficial" descriptors). They noted its diversity and developing character. However, their average chemistry exam grade was the lowest – 3.6.
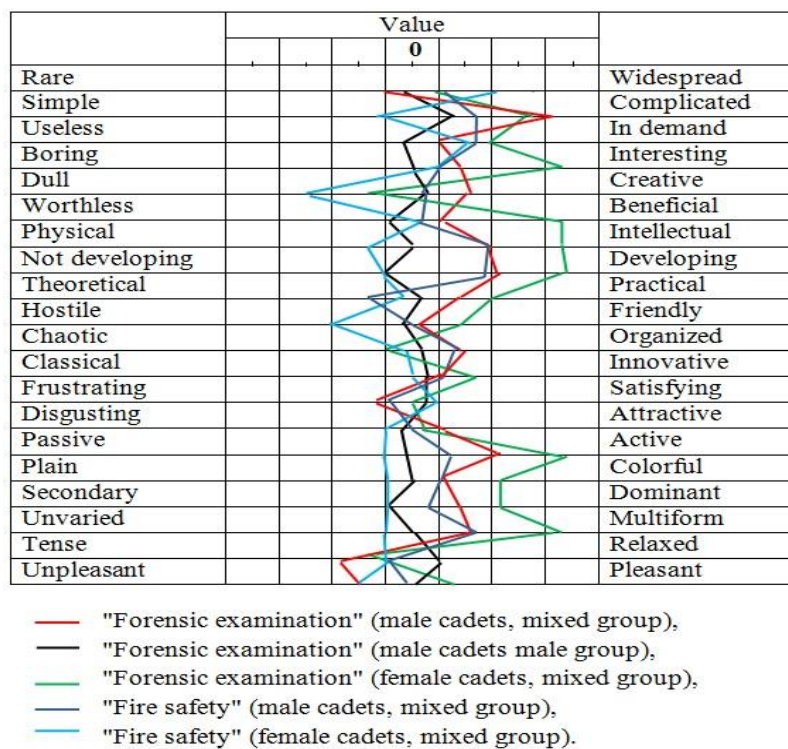
The attitude to the subject does not always determine the grade that a student receives in a subject (Brown *et al.*, 2015). The student's learning performance is affected not only by the interest in a subject but also by factors such as financial situation, scholarship, tuition fees, gender, adaptation ability to university conditions, desire to affirm oneself in a group, and the ability to use free time for personal purposes. The prevailing factors for a specific group at a given time largely determine the learner's desire to get a higher grade.

While we are against the fee-paying system of education in general that students who pay for their education are likely to take their studies more seriously and view them more positively. In contrast to the cadets and students of the budget form of education, first-year students of the fee-paying department had already understood the value and necessity of the acquired knowledge and therefore viewed their studies not as a necessary and unpleasant work. Instead, they regarded studies as a service that they pay for and understood the fact that its quality will greatly determine their future. Low grades in subjects for this group of respondents were related to lack of class attendance control and the fact that many students had to work from their junior years to be able to pay for their tuition.

Among the groups participating in the experiment were coeducational groups from the Forensic Examination (30% girls among all cadets studying) and Fire Safety (10-15% girls among all cadets) majors. In the student groups in these majors, girls make up 50% or more. As a rule, girls took the learning process more seriously, as they were also more diligent and positive. They viewed the importance of obtaining excellent grades; they were usually ready to help their male classmates, and serve as a good example for them – emotionally in particular. The comparison of two groups of cadets of the 1st course, studying "Forensic examination" showed that with the same intellectual potential of students, the attitude to the subject "Chemistry" in the coeducational group (30% of girls and 70% of boys) was more positive, and the estimates were higher than that of the group, consisting of boys only Figure 2.

The average grade at the Chemistry exam in the male group was 3.3, whereas in the coeducational group it was 3.8 and in the girls group it was 4.0. However, in the Fire Safety groups, where the number of girls was in 1:3 ratio for a group of about 20-25 boys, with good performance indicators, the girl's attitude to the subject of "Chemistry" was extremely negative Figure 2. This might be explained by the fact that in higher education institutions of security, defense and law enforcement agencies with fewer girls studying, they try to take leading positions in male groups. In general, they are physically weaker, and they, therefore, tend to outperform boys in their studies or social activities. As a result, female cadets struggle more often to get through the junior years (with its new conditions and social environment). Thus, when a difficulty arises in the course of learning a discipline, girls experience a much deeper and stronger negative attitude.

	Value 0	
Rare		Widespread
Simple		Complicated
Useless		In demand
Boring		Interesting
Dull		Creative
Worthless		Beneficial
Physical		Intellectual
Not developing		Developing
Theoretical		Practical
Hostile		Friendly
Chaotic		Organized
Classical		Innovative
Frustrating		Satisfying
Disgusting		Attractive
Passive		Active
Plain		Colorful
Secondary		Dominant
Unvaried		Multiform
Tense		Relaxed
Unpleasant		Pleasant

——— "Forensic examination" (male cadets, mixed group),
——— "Forensic examination" (male cadets male group),
——— "Forensic examination" (female cadets, mixed group),
——— "Fire safety" (male cadets, mixed group),
——— "Fire safety" (female cadets, mixed group).

Figure-2. The survey results of first-year cadets and students majoring in Forensic examination and Fire safety.
Original chart based on the data obtained when processing semantic differential forms filled out by respondents.

At the second stage, data was obtained after processing of survey forms by factor analysis. The Factor analysis results are shown in Table 3.

Table-3. Attitude toward Chemistry. Inventory items with factor and rotated factor loadings.

	Cadets				Students			
	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
Variance explained, %	18.88	15.48	14.85	8.79	22.66	18.09	14.89	9.18
Polar Adjectives								
Dominant/ Secondary	0.793				-0.563			
Widespread/Rare	0.751				0.621			
Developing/ Not developing	0.689				0.837			
In demand/ Useless	0.677				0.798			
Interesting/ Boring	0.645				0.844			
Active/ Passive	0.545				0.713			
Colorful/Plain	0.515				0.791			
Beneficial/ Worthless	0.509				0.545			
Chaotic/ Organized		0.791				0.537		
Classical/ Innovative		0.705				0.912		
Dull/ Creative		0.666				0.632		
Tense/Relaxed		0.558				0.886		
Unvaried/ Multiform		-0.508				0.833		
Pleasant/ Unpleasant			0.828				0.526	
Satisfying/ Frustrating			0.787				0.894	
Disgusting/ Attractive			-0.784				-0.776	
Hostile/ Friendly			-0.505				-0.877	
Complicated/Simple				0.823				0.819
Theoretical/ Practical				0.729				0.795
Physical/ Intellectual				-0.548				-0.521

Original table based on the factor analysis results, obtained by SPSS Statistics questionnaire data processing.

Taking into account the structure of interconnections in every factor, we have defined them as follows. Factor 1 - «Interest and Utility», Factor 2 - «Personal Attitude», Factor 3 - «Emotional Satisfaction», Factor 4 - «Intellectual Accessibility». The labels of the factors attempt to capture the theme represented by the antonyms loading strongly on each factor. Factors 1 and 2, for example, reflected the attitude toward the subject of "Chemistry" and comprised behavioral and partially emotional and cognitive components. Factor 3 was an affective-evaluative component, and Factor 4 was the cognitive component of the attitude. These 4 factors yielded 58.0-65.0% of the total variance which was an acceptable value for the explained variance.

The analysis of the mentioned factors shows that first-year students differentiated the attitude to Chemistry as a particular field of knowledge (Factor 1) and Attitude to the subject of "Chemistry" (Factor 2). While the values were mostly positive on Factor 1, where learners, especially students, emphasized the interest in Chemistry, its importance and opportunities to utilize it in future educational purposes like developing characters. However, the attitude toward the subject of Chemistry, towards the process of studying was negative. It suggests that students do not associate the knowledge obtained in General Chemistry classes with what they will need in their professional and practical applications. The subject seems to be too classic, boring, monotonous and tense, and the acquired knowledge does not make up the solid clear system. High factor values on antonyms "Complicated" and "Theoretical" (Factor 4), given by both the students and cadets prove that chemistry causes big difficulties for first-year students and is not intellectually easily accessible.

Factor 3 determines emotional satisfaction with Chemistry studying. The high factor values of variables included in this group were unexpected for the authors and can be explained both by satisfaction with the subject studying progress and by the positive attitude toward the teachers holding the classes.

The data of the study suggests that the attitude of cadets and students to the subject and the motivation for studying was largely determined by the emotional state of learners. Changing conditions of life, disappointment for the chosen profession, lack of incentives to study, and failing to understand the acquired knowledge importance

causes loss of interest in the subject, and, therefore, reduces the quality of education in general. This is especially true for basic disciplines.

The teacher's responsibility in these conditions is to create motivation for learning, using tools of pedagogical diagnosis. Taking into account the characteristics specific to different groups of learners, and to persuade the first-year cadets and students, it was not possible to become a specialist without the proper command of general physics and chemistry laws, or the ability to apply a mathematical apparatus for assessing the phenomena occurring in a fire. It is important to let the students understand that a professional is one who can assess the danger of an emergency situation, understand the dynamics of its development, and provide quick and accurate recommendations for its prevention and elimination.

7. CONCLUSION AND RECOMMENDATIONS

There are several conclusions of this study:

1. Lack of motivation for acquiring knowledge is connected with insufficient basic training in the subject. Students are also less motivated due to a lack of understanding of the importance of basic disciplines as prerequisites for the subsequent development of special disciplines. This results in a decline in their academic performance and worsens the quality of training. Results of data analysis of the current study obtained by the semantic differential analysis demonstrate that a teacher's task was to create motivation for studying the personal peculiarities of groups and individual students. It is recommended that there should be a change in the attitude toward the subject, in order to make it more intellectual accessible, and to bring together the first-year students' view of Chemistry as a field of science. The increase in students' interest in the subject can be achieved through actively studying integration and involving students in scientific research activities. The creation of interdisciplinary interaction and practical training would further motivate learners to study basic disciplines. The study also showed that the creation of blended groups should also be an incentive to increase motivation.

2. The method of semantic differential makes it possible to qualitatively and quantitatively evaluate the life experience based on emotional attitude of a person to the objectives of research. It enables to conduct a pedagogical diagnosis and get an unbiased idea of the emotional attitude of the respondent to these objectives. This method is especially relevant for conducting a survey in higher education institutions of Security, Defense and Law Enforcement Agencies, where the "supervisor-subordinate" organization of the educational process does not contribute to achievement of objectives.

3. The data obtained using the method of mathematical statistics was, in general, consistent with the results of graphical processing of the semantic differential survey forms, which proves the applicability of this method for small groups of respondents analysis, where factor analysis is not accurate and appropriate enough.

4. The semantic differential method in combination with graphical and mathematical statistics method is recommended for pedagogical diagnostics in order to reveal negative tendencies that appear in the course of study, to identify and consider individual peculiarities of learners. Curriculum development and teaching practices that improve students' attitudes may also eliminate the decline in the motivation level of learning.

5. It seems interesting to correlate the present research results with those that can be obtained from a similar survey conducted among senior cadets and students who have already completed the study of Chemistry. Similarly, further studies can be carried out to compare the full-time students' results with those of the students undergoing correspondence course.

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