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Analysis of Value-Semantic Sphere of Students in the Context of Studying Mathematics

Natalia V. Biryukova
Chair of mathematics and computer science
Trans-Uralian Tyumen State Agricultural University
Tyumen, Russia,
n.biriukova@bk.ru

Natalia V. Zybina
Chair of physics, mathematics, computer science and teaching method
Mendeleev Tobolsk State Pedagogical University
(a branch of TuySU)
Tyumen, Russia,
natalja_sybina@mail.ru

***Abstract*—The aim of the current paper is to provide the reason for the formation and development of personal senses and values which motivate students of non-core areas to study mathematics at university. This process is considered as an essential component in vocational education of future specialists giving students a completive advantage on the labour market. The methodologies and mechanisms to diagnose the formation of personal sense for studying mathematics have been selected and tested; motives and stimuli are determined for each level of formation.**

Keywords—professional competence; competitive specialist; intellectual resource; value-semantic competence; personal sense for learning mathematics.

I. INTRODUCTION

One of the components of the government programs is to prepare the graduate of the university for learning consciously such fundamental sciences as mathematics, physics and others which broaden their career opportunities and develop personal qualities. The importance of education in mathematics is reflected in Decree No.599 by the Russian President, of 7 May 2012 on “Measures to Implement State Policy in Sphere of Education and Science” where paragraph 1 states: “To develop and adopt the Concept of education in mathematics based on data on the existing situation at different levels of education, in December 2013” [1].

The importance of mathematics education goes beyond learning the key principles of mathematics and acquiring professional skills and values; students are introduced to mathematical culture as a part of a globalized culture which develops intelligence, humanitarian ideals and moral values [2].

Based on the curricular practices and pedagogical experience in teaching mathematics to students of non-core areas, it should be noted, that most students have never thought about mathematics as a valuable subject. They view mathematics as a foreign subject, mathematics as a meaningless subject in their self-assertion, not influencing their social status. Mathematics as a fundamental science is traditionally associated with scientific thinking. Thus, it does not provide a sharp focus on vocational activity. That is the reason why students of non-core areas do not understand a direct link between mathematical subjects and future occupation [3]. Therefore, the action of teaching, learning and curricular practices in mathematics has been severely affected by such views. In other words, it encourages difficulties in teaching mathematics at non-core faculties; the reason is that students do not understand the role and place of acquired knowledge, skills and competences in the process of their professional development. At the same time, most students have an aspiration to become highly skilled professionals. For instance, according to the results of the survey at Trans-Uralian SAU, work is a priority concern for most young people [4, 5].

Nowadays there is a wide range of studies on competence formation of students in vocational training; the questions of forming individual qualities in the process of studying mathematics are discussed. Nevertheless, the problem of value-semantic approach to mathematics for students of non-core areas is not supported by a theoretical study. There is no clear-cut idea about the meaning of studying mathematics, dynamics of its development; technologies, the system of means, methods and forms, fostering personal sense development for studying mathematics in the process of vocational training, have not been identified. This raises the question of actualizing the subject “Mathematics” potential to form professional competence of future specialists and create pedagogical conditions for integrating this subject into the integral process of development of a personality and value-semantic sphere of students at non-core faculties.

With this regard, there is a question about relationships between “sense” and other “sense reality” elements such as meaning, value and motive. Recent decades have seen different research perspectives on analyzing the problem of meaning: mechanisms of sense regulation of activity [6]; the system of personal senses [7]; sense formation in pedagogical interaction [8]; sense formation as a function of a person [9] and etc..

Galperin draws a distinction between “sense” and “meaning”: “meaning” describes an object being related to other things, while “sense” characterizes the same object in terms of relationships with an individual. [10]. Petrov takes the same view that meaning is a complex of attributes, a kind of functional image; sense does not describe a thing on its own as it takes a person’s perception of an object and its characteristics [11]. Value is a meaning, importance,

usefulness of a thing or activity. With the respect to the position of a person as a subject of activity, sense has the meaning of a valuable and beneficial object for a person. The moral values have subject-objective relationships as they come from a person to values. The meaning values have object-subjective relationships, as they relate to a person and in the end become meaningful for an individual. "An object, being a valuable thing for a person, does not lose its value when it becomes senseless for the same subject" [10]. Need is the main incentive for motive and it is closely connected with the meaning. These connections can appear from outside. In this case, a person's activity might not be exactly the same as his/her needs. According to Leontiev, "the sense of this activity is disconnected from its purpose; objective and subjective contents of the activity do not correspond to each other. The process of getting knowledge serves as a means to achieve other goals: to get a good mark, certificate, diploma, scholarship, a teacher's appraisal, peers' approval and etc. The content of the subject does not appear meaningful to a person that is why it is considered to be «senseless» [10]. Leontiev comes to the conclusion that the same action, being motivated by different motives, obtains different meanings, takes a different form and develops in another way which leads to other consequences, taking a special place in a person's life. Unlike meaning, personal sense becomes relevant in a person's real-life situations. Personal sense is adopted by personality individual values based on his/her own experience. Thus, in the context of studying mathematics, the concept of personal sense can be described as follows. The personal meaning of studying mathematics by students of non-major areas is understood as a subjective reflection in the minds of students of the objective significance of this sphere of education for their professional and personal formation and development realized in an active creative position aimed at acquiring personal and professional experience, solving cognitive-practical problems on the basis of mastering the methods of algebra, geometry and mathematical analysis [12].

Thus, the category of sense makes it possible to approach the problem of value-semantic integrity of the subject of education from a modern perspective. The pedagogical aspect of the problem, where the value-semantic sphere of a person is considered as a base of personality integrity and sense as a result of a person's understating true social values, need to be reviewed and developed by specially selected methods.

II. Objects and methods

The diagnostic stage of the study includes:

- selection of diagnostic techniques allowing interpreting obtained data on the objective attitude of students of non-core areas to studying mathematics; use them as a means of efficiency and relevance of the chosen model in teaching mathematics;

-description and diagnosis the levels of formation of personal sense for studying mathematics in university students of non-core areas;

The experimental research has been made at Trans-Uralian Tyumen State Agricultural University. The respondents in this study comprise 88 First and Second Year students of different university areas. The experiment was conducted in the mathematics classroom.

III. Results

A. The selection of diagnostic techniques

The diagnosis of personal sense formation for learning mathematics is based on analyzing and comparing the results of various types of methods: direct and indirect

Observing students' behavior in the mathematical class belongs to the indirect methods of teaching process as follows:

- students' performance in the mathematical classroom-context (creative, active, situation related to active, passive);
- the desire to complete optional tasks (always, sometimes, never);
- the preferable selectivity of the individual stages of the lesson (the formulation of theoretical positions, the solution of problems on the model, the solution of problems of increased complexity);
- engagement, emotional rise in learning mathematics (positive emotions, passivity, negative emotions);
- knowledge level (excellent, good, satisfactory, unsatisfactory);
- the principle of defining the value of mathematics (egocentric, group-centric, prosocial);
- reflection of the learning mathematics experience (yes, no).

The direct methods of the study of the formation of personal sense levels would include those as follows:

- methodology for the study of motives of educational activities (according to Rein), adapted to the study of the students' sense of mathematics. The need to further develop research of motivation sphere for studying mathematics is based on the theoretical approach to the activity. According to Bratus, activity is an active attitude to reality in its integrity of motivational, valuable and emotional factors [13];
- methods of determining the levels of personal sense formation for learning a foreign language at high school (Novakova) adapted to mathematics. They include a questionnaire and responses matrix for an individual and group survey. There are seven evaluating criteria. Each diagnostic parameter has four meanings which refer to the levels of personnel sense formation: from formal attitude to mathematics to value-semantic one [14].

To examine the development of a personal sense of students in this area, one should follow the dynamics of the external parameters of the formation of a new personality quality according to the specified criteria. Based on the personal semantic sphere theory (Bratus), the degree of "acquired" sense (Bratus) and mechanisms of a person's behavior regulations (Leontiev), we can distinguish the following criteria of sense formation for learning mathematics:

- subjective understanding of the importance of studying mathematics;

-stability of a semantic position, the degree of "acquired" sense;

- "penetration" of sense for learning mathematics in various areas of self-assertion;

- formed a personal approach to learning mathematics; engagement in the learning process; the degree of activity in the mathematics classroom; the degree of mastering the subject;

- positive emotional experience of learning mathematics;

- expression of willingness and satisfaction from overcoming difficulties in this area [15].

B. Levels of formation of the personal meaning for studying mathematics

Each criterion corresponds to a certain level of personal sense formation for learning mathematics.

The first level demonstrates low parameters of a personal sense formation. It provides a formal attitude to the subject and is characterized by the lack of understanding of the social and personal significance of knowledge in mathematics (mathematical education is a waste of time as it is useless). As a result, the classroom lessons do not bring any emotional pleasure to students being obligatory. Students get a desire to master new knowledge in mathematics when their personal interests are influenced (pass credit). They demonstrate poor performance in the mathematical class and they are not interested in out-of-class activities. With regard to the behavior of the students from this group, it should be noted that the parameters of formation criteria at all levels are low: the students do not have an understanding of the role of mathematics for social life, occupation and personal development. The students have either low or high self-esteem of their mathematical knowledge as they lack a formed system of values. They demonstrate an egocentric approach to determining the relevance of mathematics. The importance of the subject is restricted by personal advantage, so it becomes valuable for students in terms of benefit (get a grand) and etc.

The second level presents the middle level of forming a personal sense of knowledge as positive and amorphous attitude to mathematics. The representatives of this level admit that knowledge of mathematics is widely used in the world but their positive attitude to mathematics is not confirmed in practice. They are aware of the value of mathematics and this awareness drives them to learn mathematics hard and achieve good results. The students demonstrate activity in the mathematical-related situations where they can achieve their personal aspirations (pass a credit, get a good mark and obtain the approval of the peers). In other cases, their interest does not develop into sense. It should be noted that the representatives of the second level do not have enough knowledge of mathematics to perform independent creative work. This includes a sense obtained in a mathematics-related situation and the value interpretation where the main priority is to meet the expectations of a social group. In this regard, group-centric interpretation of the importance of studying mathematics should be noted. The representatives of the second level demonstrate a personal sense of unstable character. Students do not demonstrate any efforts to cope with difficulties and persistence in learning the subject. Understanding the social value of mathematics and future job opportunities, students do not realize the importance of learning mathematics from a perspective of a personal development. The students from this group are passive in the classroom activities: they cannot make the choice of solving mathematical problems or just follow the model; refuse to solve complex tasks; avoid taking part in conferences and etc. While assessing their own work, they, first of all, rely on other peoples' opinion. Thus, the basic feature of this group is the formation of a situation-related sense for learning mathematics and group-centric interpretation of the importance of studying mathematics.

The third level presents the high level of a personal sense of knowledge when students are active in learning mathematics. The students representing this group highly value mathematics for both personal and professional development. They take an active part in the classroom and out-of-classroom activities. The students are characterized by the positive emotional rise, a stable interest and active work in groups. They have a good command of mathematical knowledge. Thus, these students demonstrate the elements of acquiring sense as they show a stable interest in studying mathematics; their level of knowledge is above the average. On the other hand, the students try to avoid the situations related to the independent search of information with the manifestation of creativity; it is typical for obtaining a situation-related sense. The representatives of the third level are aware of the value of knowledge and they are interested in learning mathematics but demonstrate unstable interest signs. The students are active in the classroom but if they are familiar with the material which does not present difficulties in learning. They have mass knowledge in mathematics; nevertheless, they do not express willingness to apply it in "out-of-classroom activities". So, the degree of sense obtained by this group is not clearly defined as its representatives demonstrate features of obtaining as a personal sense as well a situation-related one in studying mathematics.

The fourth level of personal sense development is the highest one. It presents a value-semantic attitude to mathematics as the students demonstrate deep knowledge; they appreciate mathematics as a way for self-development. They use the acquired knowledge to solve independently creative tasks in mathematics; the classroom is organized and active; the students demonstrate engagement and a stable interest in learning the subject. The representatives of the level are distinguished by a prosocial interpretation of the subject value and there are indicators referring to all diagnostic criteria.

C. *Diagnosing levels of the formation of the personal meaning of studying mathematics*

The findings of this study show that among 88 First and Second Year respondents of "Land development and Cadastres", "Agriculture", "Agrochemical products and soil

science", "Environmental Management" only 19% of students demonstrate value-semantic attitude to mathematics (Figure 1). They are motivated to learn mathematics but the majority of them do not have enough "energy" to study it for the personality and career development (only 4% of respondents demonstrate aspiration to raise their educational level in mathematics).

According to the results, 16 % of students have a positive and active attitude to learning the subject in terms of a situation (for example, only 5% of students attend mathematics classes with pleasure, take part in scientific conferences, competitions and contests).

About 35% of young people are neutral to learning mathematics as they are reluctant to overcome difficulties in learning the subject (for example, about 50% students do not show any interest and 50% of students are diligent in doing their home tasks); 30% of students have a formal attitude to mathematics; 48% of respondents agree on the item "I am motivated to study mathematics because I want to get credit".

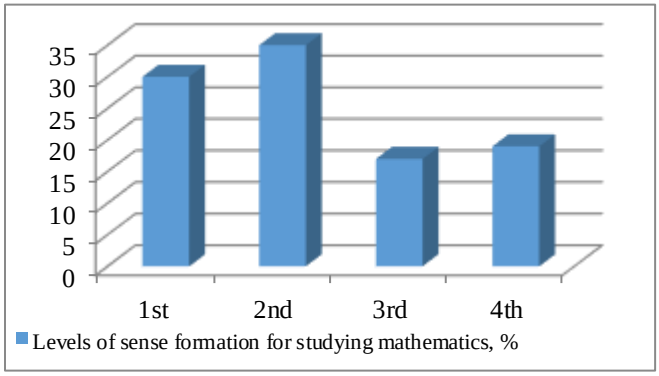

Fig. 1. Results of diagnosing levels of the personal sense formation of knowledge

Figure 2 presents the criteria structure depicting the levels of personal sense formation for studying mathematics in students of non-core areas

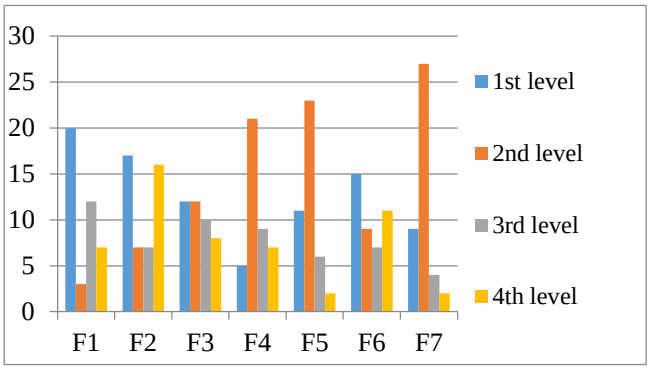

Fig. 2. Criteria structure of the levels of personal sense formation

F_1 – the level of subjective understanding of the importance of studying mathematics;

F_2 – the level of sense position stability, the degree of sense;

F_3 – the level of involvement in learning mathematics;

F_4 –the level of emotional satisfaction in learning mathematics;

F_5 – the degree of activity in the classroom;

F_6 –the degree of sense penetration in different areas of self-assertion;

F_7 – the level of mastering the subject

The results of the study show that the students with the first level of personal sense formation suit to the criteria as follows: personal understanding of mathematics value (F_1); stability of a semantic position, the degree of "acquired" sense (F_2); "penetration" of sense for learning mathematics for self-assertion (F_6). It means that the majority of respondents do not have any aspiration to learn mathematics or they are reluctant to do it; ignore out-of-class activities in mathematics and optional tasks; personal sense formation tends to be situation-related. According to the level of emotional satisfaction in learning mathematics (F_4), knowledge of the subject (F_7) and the degree of classroom activity (F_5), the students of the second level presents a sufficient majority being personally motivated for learning mathematics. Their criteria parameters are as follows: a situation-related activity in the mathematical classroom; a "model" way of solving tasks"; the lack of willingness to overcome challenges in learning mathematics; the students seldom have positive emotions about the subject; they have enough mathematical knowledge to get a good mark. The level of engagement in the process of studying mathematics is equally shared among the members of the group.

Results of diagnostic motivation analysis according to Rein (Figure 3).

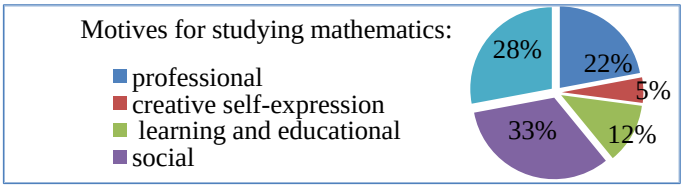

Fig. 3. Diagnostic motivation analysis according to Rein

Based on the findings, it is possible to determine motives for studying mathematics in students with a different attitude to mathematics (formal, positive, active and learning, value-semantic).

The representatives with the low personal sense formation for studying mathematics and formal attitude want to pass the exam successfully, not to be behind the curriculum and get a mark for the diploma. The external factors, "motive-stimuli", serve an encouraging force for these students to study (28%). The second group of students with positive and amorphous attitude to mathematics gives the following answers: to get a mark for the diploma, not to fall behind the groupmates, to

follow the pedagogical requirements. Some representatives of this group demonstrate such senses as follows: be good at studying mathematics and became a qualified specialist. In other words, social and learning motives explain their desire to study mathematics (45%). The criterion for regulation in this group is to meet the expectations of a particular socially significant group. The representatives with the high level of sense formation (active and learning to mathematics) demonstrate awareness of mathematics significance for personal and professional development (17%). They have the logic of social norms as well as an understanding of the role of mathematics for self-development. The representatives of the high level consider such senses as to become a highly developed personality and highly qualified specialist (22%).

IV. Conclusion

Thus, the results of the study involving students of non-core faculties at Tyumen State Agricultural University demonstrate that most respondents do not have a formed personal sense for studying mathematics. About two-thirds of students have formally expressed meanings for studying mathematics; these meanings do not influence a student to be consciously engaged in studying mathematics.

It is confirmed that as a person develops and forms, the relationships between motive and sense are changing; sense becomes more important from the psychological point of view and influences the person in his/her choice of motives. Sense serves a motivation for an activity, in this case for studying mathematics.

The presented analysis of value-semantic sphere of students in the context of studying mathematics gives us an opportunity to establish the following hypothesis. The process of studying mathematics aimed at developing a personal sense of knowledge will be possible and efficient if the psychological mechanisms of sense formation (reflective-assessment experiences) and stages of development based on these mechanisms are introduced into the model of mathematics teaching process [15].

In conclusion, the relevance of the formation of personal sense for studying mathematics as a part of the competence approach to vocational education must be emphasized. It is necessary to create pedagogical conditions for integrating this subject into the integral process of development of a personal value-semantic sphere [16].

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