DESCRIPTIVE GEOMETRY COMPETENCE IN RURAL ENGINEERING SCIENCE

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Abstract. In this research, criteria of descriptive geometry competence were determined: knowledge of descriptive geometry study course, technical drawing skills of graphic constructions applied in the descriptive geometry study course (depiction and transformation of space objects), spatial thinking and attitude. Within the framework of the research, the author calls descriptive geometry competence (as a criterion of graphical competence) as a certain amount of knowledge of the descriptive geometry study course (knowledge about regularities of space objects) which is necessary for improvement of graphical skills (skills of object depiction and transformation) being based on developed spatial thinking (abilities to operate with spatial images), and interest in regularities dealt with in the descriptive geometry study course.

Keywords: descriptive geometry, knowledge, skills, spatial thinking, attitude.

Introduction

Students should be competent to imagine and implement their imagination results in particular constructions and depict them both as a spatial model, using modern computer technologies, and also technically drawing, sketching or drawing on paper. Therefore, it is necessary to develop students' descriptive geometry competence, which is an ability to understand, interpret and analyze information given in the form of graphics that, in its turn, is an integrated part of engineer's creative activity. Competence is means of achieving more profound understanding [1], but its essence is being ready for life activities [2].

On the basis of theoretical studies, the following system of elements was determined based on the analyzed structure of competences: knowledge of the descriptive geometry, skills within the extent of the descriptive geometry knowledge, development of spatial thinking (cognitive capability) and attitude.

Materials and methods

The research was carried out as a qualitative one, and the nominal measurement scale complies with it. In total, eleven members of the academic staff, experts of the investigated field, participated in the research from the Latvia University of Agriculture, Riga Technical University, Daugavpils University and Rezekne Higher Education Institution.

On the basis of theoretical studies, several questions were formulated for the experts about the parameters of knowledge, skills, spatial thinking, and attitude criteria.

Using a questionnaire method, the experts' opinion was found out about the significance of the parameters of the criteria of graphical competence in the course of descriptive geometry.

Results and discussion

Level of knowledge. P. Pidkasisty has determined the following parameters of knowledge: knowledge of concepts, knowledge of facts, knowledge of scientific problems, knowledge of theory, knowledge of regularities and law, knowledge of methods and techniques [3].

On the basis of the analyzed pedagogical literature and survey of the specialists of the Latvian universities, four levels were determined. The following main graphic knowledge of descriptive geometry studies was accepted as indicators of these levels: knowledge of the terms, concepts, techniques, and regularities.

Figure 1 presents the summarized study results of the parameters of the knowledge criteria.

Level of skills. Savicka has distinguished the following basic criteria for the skills at solving graphic tasks:

- knowledge of operations and skills to carry them out;
- acquisition of operation contents;
- transfer of the acquired skills to solving tasks of creative and research character;

- application of the acquired skills to form new objects, solving construction tasks.

In association with these criteria, the skill formation level of carrying out graphic tasks may be determined and each level characterized:

- on the first level, acquisition of operations and their contents takes place;
- the second level is characterized by acquisition of the body of operations performing simple graphic activities, analysis of a technical project or process;
- on the third level, a complete acquisition of activity content takes place (acquaintance with the tasks, drawing up an action plan and carrying it out, and its analysis);
- the fourth level is characterized by abilities to transfer skills in carrying out graphic tasks to technical, special and engineering knowledge [4].

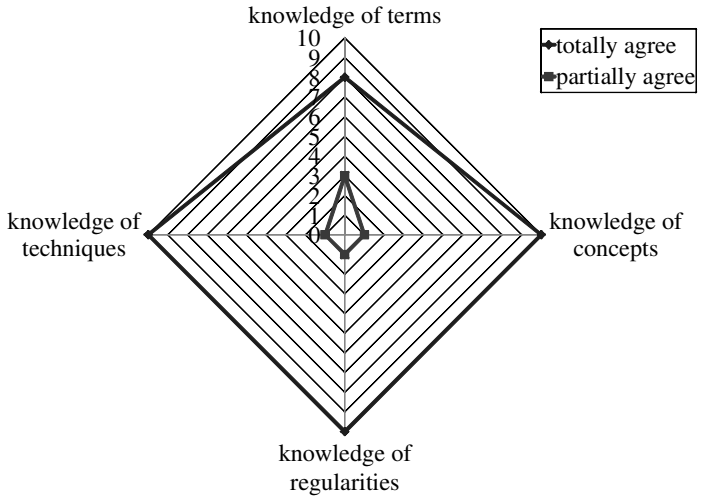

Fig. 1. **Summary of parameters of knowledge criteria**

On the basis of the analyzed pedagogical literature and survey of the specialists of Latvian universities, four levels were determined. The following main skills of descriptive geometry studies were accepted: skill to analyze and predict, skill to operate with acquired knowledge, skill of high quality activities, and skill of creative activities.

Figure 2 presents the summarized study results of the parameters of the skill criteria.

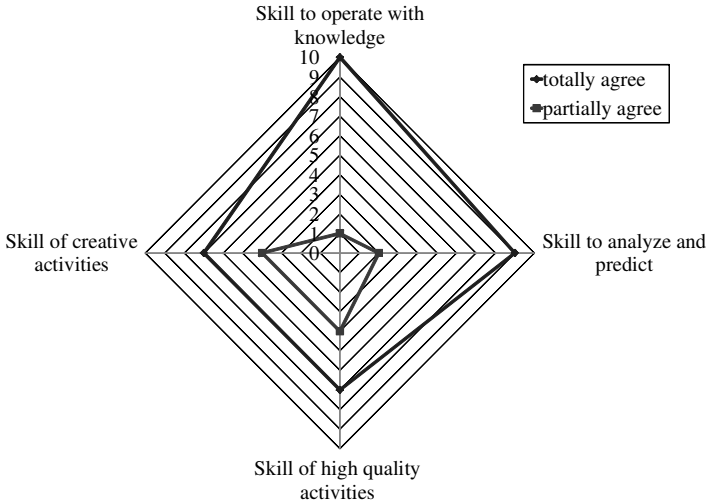

Fig. 2. **Summary of parameters of skill criteria**

Level of spatial thinking. The most complete is a three level thinking development scheme which comprises visually active thinking, visually figurative thinking, verbal and logical reasoning [5].

A principal difference of verbal and logical reasoning from visually active thinking and figurative thinking is that there it is possible to operate with an ideal object determined by the historical experience of society or real object models [5].

Acquiring knowledge about modern science, different theoretical and practical activities are associated with operations of spatial objects. Notions, which are formed based on the technical drawing, have a different psychological character that those which are formed based on particular object images. Images which appear operating with graphical models are similar rather to concepts than certain notions. Any graphical model is a flat image according to which it is necessary to renew a spatial position of a real technical object. Graphical models, used for acquisition of technical knowledge, more often represent correlation and relationships typical for a wide range of objects and phenomena.

On the basis of literature analysis and the experts' survey of the Latvian universities, the levels of spatial thinking development and their parameters were determined. The following main skills of descriptive geometry studies were accepted: ability to operate with objects based on real objects, operation with images based on 3D objects, ability to operate with images that is based on the object projections and change of image location.

Figure 3 presents the summarized study results of the parameters of the spatial thinking criteria.

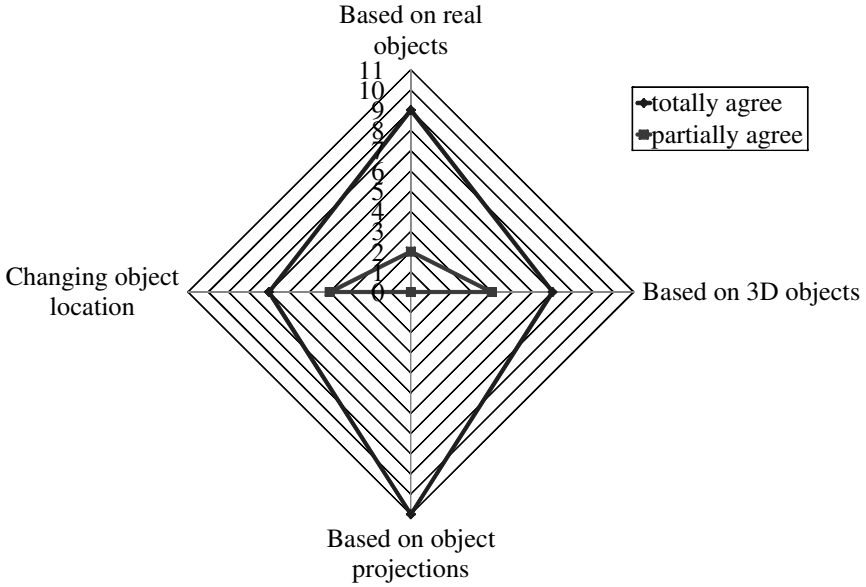

Fig. 3. **Summary of parameters of spatial thinking criteria**

Level of attitude. In the context of education, attitude is most closely associated with such components as inquisitiveness, motivation, creative abilities, skepticism, honesty, enthusiasm, self-esteem, reliability, responsibility, initiative and insistence [6].

Development of students' attitude to the teacher and the study course is affected by a social context that is why a favourable surrounding is created for engineering students providing a positive attitude towards teachers and various teaching aids and e-learning opportunities.

On the basis of the analyzed pedagogical literature and the survey of the specialists of Latvian universities, four levels of attitude were determined. As parameters of these levels, the following main attitude parameters in the descriptive geometry studies were accepted: participation in group work, timeliness, participation in the study process and responsibility.

Figure 4 presents the summarized study results of the parameters of the attitude criteria.

The obtained results allow concluding that the parameters of knowledge, skills, spatial thinking, and attitude criteria are supported positively by the experts' opinion. Frequency of responses of *totally agree* is 79 %; *partially agree* responses are 21 %. None of the experts responding to the questions about the parameters of knowledge, skills, spatial thinking, and attitude criteria chose the response *partially disagree* or *disagree.*

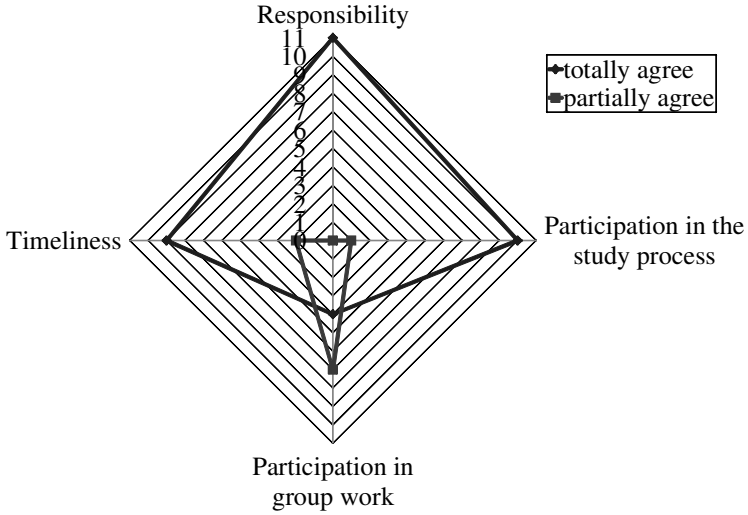

Fig. 4. **Summary of parameters of attitude criteria**

Conclusions

Analyzing pedagogical literature, the parameters of knowledge, skills, spatial thinking and attitude were obtained, the value of which was found out by using a questionnaire method. The experts of the descriptive geometry field and the author consider that it is most important to know regularities, be able to operate with one's knowledge, be able to change a spatial image (imagined object) location (position) and to perform any of the activities with the sense of responsibility.

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