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I P Varava[1], A P Bohinska[2], T A Vakaliuk[3,5] and I S Mintii[4,5]

[1] National Aviation University, 1 Liubomyr Huzar Ave., Kyiv, 03680, Ukraine

[2] College of Information Technologies and Land Management of the National Aviation University, 6 Druzhkivska Str., Kyiv, 03113, Ukraine

[3] Zhytomyr Polytechnic State University, 103 Chudnivsyka Str., Zhytomyr, 10005, Ukraine

[4] Kryvyi Rih State Pedagogical University, 54 Gagarin Ave., Kryvyi Rih, 50086, Ukraine

[4] Institute of Information Technologies and Learning Tools of the NAES of Ukraine, 9 M. Berlynskoho Str., Kyiv, 04060, Ukraine

E-mail: `varavairina8@gmail.com, bohinskaa@ukr.net, tetianavakaliuk@gmail.com, irina.mintiy@kdpu.edu.ua`

Abstract. The research work analyzes the problem of forming software engineering technicians' soft skills, approaches to defining the list, detail and the maturity level of software engineering technicians' soft skills and basic ways of their formation, in particular: development of new academic programs or individual innovative courses, the problem-oriented approach, the AGILE approach, gamification of learning, development of interdisciplinary courses, etc. The obtained data enable developing methodological recommendations to form software engineering technicians' soft skills when studying the humanities and social sciences and experimentally investigating their efficiency.

1. Introduction and analysis of relevant research

Total digitalization and, accordingly, rapid development of the IT industry are becoming defining features of today's being, this causing increased demand for IT professionals. Therefore, the question of determining qualities of future IT specialists is highly relevant. Among these qualities, there are distinguished technical (hard) and non-technical (soft) skills.

As for forming software engineering technicians' soft skills, researchers point out the following:

- Q. Brown, F. Lee, and S. Alejandre, consider that engineering education has evolved from forming students' hard skills only before studying courses encouraging soft ones [1];

- M. Rehman, A. K. Mahmood, and R. Salleh think that ". . . software development is a human activity (performed by humans)" and, therefore, investigations into soft skills of software engineering technicians need special attention [2];

- G. Matturro thinks that ". . . soft skills are as important as, or even more important than traditional qualifications and technical skills" [3];

- L. Fernando Capretz believes that ". . . soft skills enhance job satisfaction, improve efficiency" [4], these competences are necessary at all stages – from problem setting to ". . . successful completion of a software project" [4];

- D. González-Morales, L. M. Moreno De Antonio and J. L. Roda Garcia consider that students' soft skills should be developed from the first year of their study as they are not sufficiently attended to in early academic courses, though students have a comprehensive amount of theoretical and applied coursework [5];
- V. Thurner, A. Böttcher, A. Kämper think that first-year students have problems with developing the simplest software because of absent soft skills [6].

Based on research analysis, [7] notes "... a lack of understanding of what soft skills are necessary for development of complicated software projects", and for this purpose soft skills adaptation and specification are necessary for software engineering technicians.

Scientists determine the list, details and level of soft skills for IT specialists in various ways, namely by:

- analyzing job advertisements [8], [3] (in [8] based on analysis from over 500 sources, it is determined which soft skills are necessary and which are desirable);
- conducting surveys among software engineering practitioners from software companies [9];
- determining "the skill level expected by the job market" [6];
- developing specific modules to measure certain soft skills, in particular those for assessing team work [10];
- developing new tools that synthesize information about candidates' contributions on various sites (code placement, technical question-and-answer forums) to compare their competences [11].
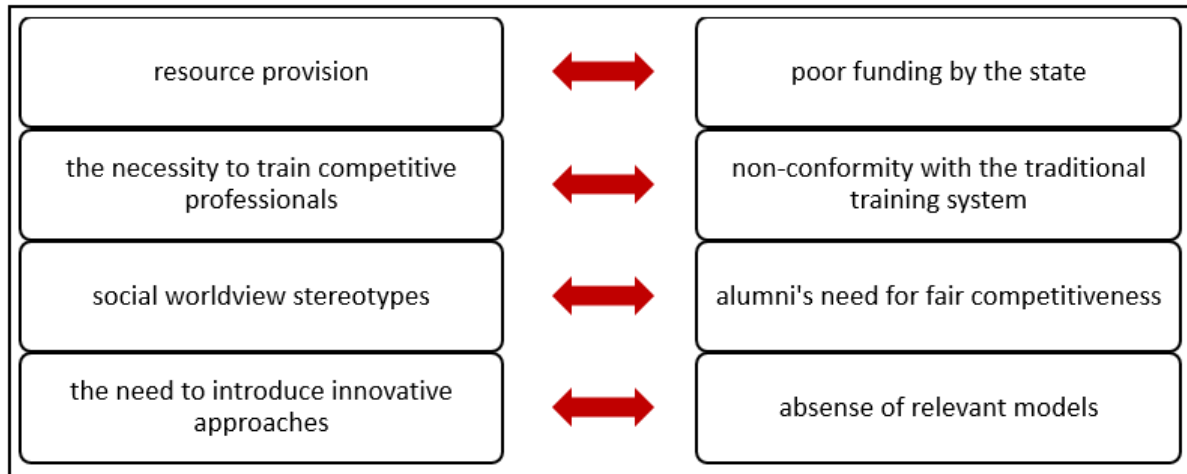
The problem of forming software engineering technicians' soft skills can be solved in the following ways:

- designing new educational software programmes (the service-learning educational programme called EPICS (Engineering Projects In Community Service) [12];
- introducing specialized courses aimed at forming soft skills [13];
- introducing innovative courses, in particular "... in supervision, project management, quality control and decision-making" [5];
- implementing problem-based learning [14] and the AGILE approach [15];
- gamification of learning [16];
- providing practical training disciplines with examples that contribute to soft skills formation, i.e. integration of soft skills into practical training [4];
- developing multidisciplinary courses [1], e.g. "... a course focused on interweaving software engineering practice, service learning, and development of "soft" professional skills" [17];
- studying the humanities and social sciences.

At the present stage, the task of vocational education in Ukraine is to train competent specialists. This is reflected in "The National Strategy for Education Development for 2012–2021" [18], the Decree of the President of Ukraine "On Goals of Sustainable Development of Ukraine until 2030" [19], which provide for enhancing the role of the humanities and social sciences in higher educational institutions.

At the same time, a number of contradictions arise hindering a full-scale educational process when training competitive software engineering technicians (figure 1).

The **aim** of this work is to highlight methodological recommendations for forming software engineering technicians' soft skills when studying the humanities and social sciences.

Figure 1. Contradictions in software engineering technicians' training.

2. Methodology

Being guided by analysis of researches into problems of formation of software engineering technicians' soft skills, employers' requirements to candidates for a certain position in an IT company, requirements to IT candidates on the example of Google (the representative office in Ukraine), practice of cooperation of vocational higher education institutions with IT companies, there are distinguished 13 soft skills [20, 21]. Let us consider their formation when studying the humanities and social sciences.

The ability for abstract thinking, analysis and synthesis. For a programmer, algorithmic and structural thinking, the ability to work simultaneously at different levels of abstraction and detail are important. Components of such thinking include reasoning and critical thinking, analytical skills, pursuit of excellence, research skills, reflection and self-knowledge, mega-perception, self-awareness, self-improvement, self-motivation, sensitivity to global social, economic, environmental, ethical and moral issues, entrepreneurship, sense of mission, adaptability, motivation, flexibility, openness and the ability for multi-tasking. This competence is formed when studying primarily the humanities and social sciences, and only then mathematical subjects. History, Philosophy, Political Science, Sociology and Law play an important role in forming this competence.

The ability to communicate in a native language. The level of verbal abilities is crucial for software engineering technicians. An IT specialist's professional and communicative qualities include the ability to organize communication, listen to opinions of others, the ability to discuss acute problems in a positive emotional mood and be an intermediary between conflicting individuals. This competence is closely related to working in a team, the ability to listen, persuade, negotiate, reach consensus and resolve conflicts. No doubt, this competence is formed primarily due to such basic humanities and social sciences as Ukrainian Language and Literature, History, Cultural Studies, Political Science, Sociology and Psychology.

The Ukrainian language is a tool and material for forming a person's personality, his/her intellect, will, feelings and a form of being. Language is a means of communicating between people, transferring one's own experience to others, and sharing it among others. It is a tool for building cross-cultural bridges and contributes much to formation of cultural competences. Language classes provide unlimited opportunities for shaping future software engineering technicians' worldview, their speech and general culture. Language means provide training of competent specialists, upright and educated people who combine a wide scientific worldview,

professional competence, the desire for self-improvement, the search for creative self-realization, universal values, and national self-awareness. These are individuals who are good at dealing with current historical, economic, and cultural situations. Taking care of students' literacy and speech culture, language teachers of higher technical educational institutions try to provide language and speech knowledge to develop general erudition and education. A specialist is to be fluent in written and oral forms of the national language, use his/her knowledge in professional activities and interpersonal communication.

The main purpose of studying Literature at pre-higher educational institutions is to get students acquainted with the highest achievements of world literature and culture, universal and national spiritual values, develop students' aesthetic taste, high reading and general culture, and immunity against low-grade phenomena of mass culture. For this reason, literature is an integral part of forming future software engineering technicians' ability to preserve and enhance moral, cultural, scientific values and society achievements based on understanding of history and patterns of the subject area development, its place in the general system of knowledge about nature and society and social advance. Studying History, Philosophy, political Science, Law, Sociology and Cultural Studies is important when forming this competence.

The ability to communicate in a foreign language. This competence is equally important for software engineering technicians, the English language being here of particular importance. All algorithmic programming languages, with a few exceptions, are based on the structures of English, the level of proficiency of which depends on the speed of memorization and interpretation of programming structures. In other words, software engineering technicians' professional activity is English-speaking in its nature.

The main purpose of a foreign language as a subject area is to contribute to future software engineering technicians' mastering communication skills in oral and written forms in accordance with the motives, goals and social norms of speech behavior in typical areas and situations. Learning a foreign language is to form future IT specialists' communicative competence based on communication skills, which involve language knowledge and skills. Communicative competence development depends on sociocultural and sociolinguistic knowledge and skills that ensure the individual's entering another social medium and contribute to his/her socialization in a new society. The general cultural competence allows not only speaking fluently, but also feeling free in a multicultural space.

Analysis of academic programmes in foreign languages enables concluding about a very limited number of academic hours for language training, and this is despite the fact that future software engineering technicians are learning a profession-oriented language that takes more time to master terminology and a category apparatus. Due to the lack of academic hours, there is very little time left to present such language subsystems as scientific style, oral scientific language, lexical and grammatical features of the language of a particular speciality. The system of teaching a profession-oriented language to software engineering technicians should ensure qualitative acquisition of this subject and its effective use in their professional activity, if this system is based on a systematic approach and dialectical combination of invariant and profession-oriented content components of a foreign language course; the principle of professional orientation, its functions, requirements and rules; interaction of the principle of professional orientation with the following principles of learning: humanization, unity of training and upbringing, motivation of learning; a programme-target approach that ensures orientation of goals, content, forms, methods and tools of teaching a foreign language, teachers' and students' activities in the process of training for future professional activity.

The ability to learn and self-study. These competencies imply future software engineering technicians' understanding the importance of updating information and continuous monitoring of skills. The mentioned competence depends on the formed personal motivational readiness for professional self-improvement. It is formed mainly by the system of profession-oriented subjects

when studying the humanities and social sciences, in particular and history.

The ability to search, process and analyze information from various sources. This competence is based on the previous one. Research skills formation is realized through the ability to know and apply various software tools while searching for information, determine the most effective methods of collecting and processing information, produce their own algorithms for solving a problem, plan an experiment and process experimental data. Research skills are formed through studying such subjects as history, physics, and mathematics. This important competence is actively formed during teamwork when performing laboratory works and practical tasks in profession-oriented subjects and through students' practical activities in cooperation with stakeholders.

The teamwork skills. A programmer is a team person. This competence is developed through implementing complex group projects which are also a means of training students' teamwork skills, the ability to establish communication with colleagues, listen to other opinions, defend their own point of view, competently represent a project and their colleagues' contribution. The competence is formed through performing project activities and laboratory works, practical tasks in the classroom. History, Ukrainian language and literature and English play an important role in forming this competence.

The ability to act ethically. For software engineering technicians, it is important to form experience that reflects peculiarities of humanitarian-oriented professional activities based on the principles of the absolute value of human life and personality, human safety, ethics and social ecology. Basic humanities and social sciences (Ukrainian Literature, History, Philosophy, Political Science, Sociology, Psychology, Cultural Studies) form this competence.

The social competence expresses the ability to exercise rights and responsibilities of a person as a member of society and his/her need for sustainable development, the rule of law and human freedoms. Software engineering technicians do a variety of things that have ethical, social and political implications.

The course of History is aimed at revealing specific features of social development and socio-economic processes. The concept and structure of the course contributes to formation of a students' holistic vision of the studied era, both generally and in its individual phenomena and processes. It is unequivocal that the course of History is an ideal basis for forming the cultural competence because each topic contains information about a particular culture or a civilization to provide better understanding of the role of dialogue of cultures. As a subject, History expands cultural references and enhances understanding of the human state in the context of developing ideas. History interprets human life conditions. It is based on the theory of political science, economics and sociology, and as an interdisciplinary object, history can also be extremely contextual to the technical and scientific part of engineering programmes.

Thus, humanitarian training is extremely important for software engineering technicians. It forms *the ability to evaluate and take into account economic, political, social, technological and environmental factors* influencing the field of professional activity. Forecasting and evaluating consequences of implementation of programme projects, their impact on environmental safety and society actualize the problem of forming future software engineering technicians' experience of humanitarian expert evaluation of programme projects. This competence is meant to be formed by social and humanitarian disciplines (primarily History, Philosophy, Political Science, Sociology and Cultural Studies) [20].

Such disciplines as Philosophy, Psychology, History, Foreign and Native Languages, Ukrainian and World Literature, Cultural Studies, Law, and Sociology "immerse" students in the world experience of modern existence, interaction, relations and communication of people. It is this "immersion" that enables active development of the consciousness and self-awareness of our future IT specialists.

Development of any activity strategy should be based on integrative, humanitarian-oriented

knowledge. Cultural Studies as a science and an academic discipline is the methodological basis of such knowledge. This is an important academic discipline in the system of humanitarian education of students of I-2 accreditation level educational institutions. It provides a holistic, totally new vision of human relations with the world, promotes formation of students' ideas about universal human values and national priorities, simulation of their behaviour in conditions of modern globalization of the information space.

Cultural education of future software engineering technicians is intended to ensure that they comprehend, first of all, cultural thinking, which is formed by human correlation with the social and natural environment within a certain national or historical system of cultural coordinates.

Future software engineering technicians should be ready to conduct professional activity in the multicultural world. Therefore, cultural education of students should be multicultural in its essence, reveal plurality of cultural systems, form experience of cultural activity aimed at determining the socio-functional role of software engineering technicians, and ways of their entry into the social practice, searching for culturally deterministic ways of solving personal and professional problems. Cultural Studies is on the list of mandatory academic disciplines of the State Educational Standard.

Studying economics is a necessary component of basic education. After all, in the system of economic relations, each of us acts as a full participant in economic life of the country and the world, both as a consumer and as a manufacturer of goods or services. Therefore, future software engineering technicians' knowledge of this science will help orient themselves in the world around us, make rational decisions, identify their strengths and weaknesses in the labour market, communicate equally with representatives of other countries and other cultures. Economy unites people of different countries, gives them a sense of confidence in communicating with others, and therefore is important for personality development and formation of the cultural competence.

The main purpose of the discipline "Law" is to shape systemic legal knowledge in future IT specialists, promote formation of their active public position, raise the level of legal culture. Knowledge of their rights and responsibilities contributes to confidence of a person in the current situation. A person's awareness of his/her rights contributes to understanding of his/her place in society, culture and thereby to formation of college students' general cultural competence.

In psychology, the aptitude for "self-determination" – the skill to "...decide for themselves..., and the decision for themselves always means forming themselves" (courtesy translation) [22] is decisive for personal growth, self-improvement of an individual. According to C. R. Rogers, the main driving force of a person's self-improvement is the combination of his/her real and ideal "self" which actualizes the constructive forces of growth and development of the personality, rather than personal complexes, protective mechanisms and non-adaptive behaviors. The combination of "real self" and "ideal self" gives rise to belief in the possibility of self-realization which becomes an internal stimulus of self-improvement of the person.

After analyzing the programmes of the humanities and social sciences, it can be concluded that they all aim to form and develop soft skills of software engineering technicians, help them in orientation in society and adaption to social changes, familiarize with the cultural heritage of humanity and self-affirmation.

The humanities and social sciences fulfill their main purpose – to form software engineering technicians' soft skills. At the same time, along with the above tasks, the humanities and social sciences should be integrated into the general system of vocational training and have close interdisciplinary relations with specialized disciplines. Thus, the concept of the contextual approach fully meets these requirements, awakens interest in the humanities and social sciences, and develops cognitive and professional motivation of future software engineering technicians.

The scheme of soft skills formation in the process of studying the humanities and social sciences is shown in figure 2.
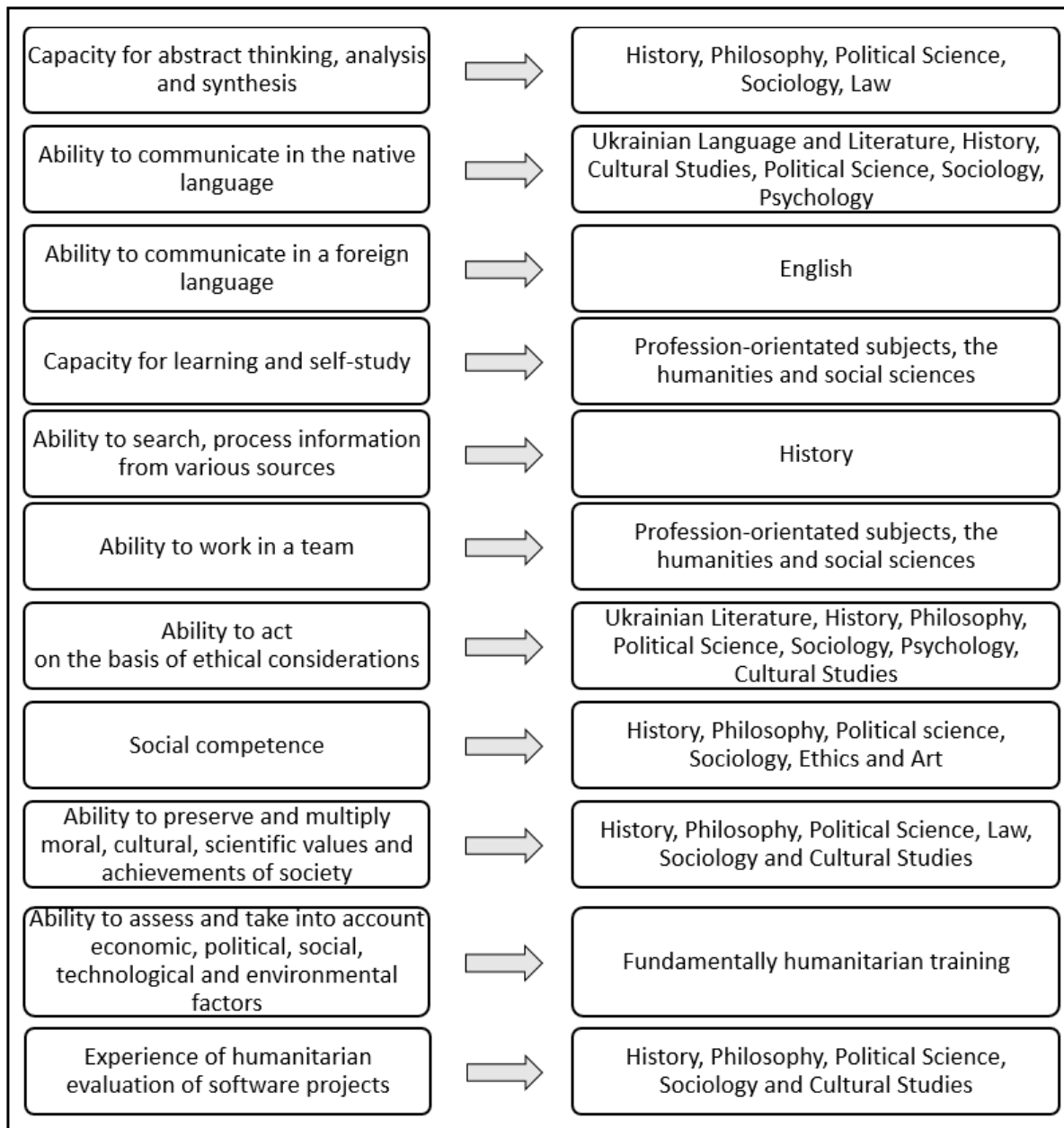
Figure 2. Soft skills formation in the process of studying the humanities and social sciences.

Introduction of innovative teaching methods into the modern educational and pedagogical process is of significant importance nowadays. It is the creation of training programmes, business games or role-playing and brainstorming sessions that are the driving forces provoking future IT specialists' interest in self-improvement and development. This means that now it is extremely important to master new methods of teaching history at institutions of pre-higher education that should be based on active methods and forms of education [23].

A teacher of any academic discipline at colleges should know that the system of requirements and social expectations is the source of self-improvement of the person, while contradictions between the requirements for the person and his/her real behaviour, between his/her existing

knowledge and educational standards, etc. are the driving forces of self-improvement. This obviously imposes obligations on teachers to organize classes in such a way so that they can use methods of training selected by them to not only form professional knowledge and skills, but also develop personal abilities in the context of the future profession, including the following skills:

- to independently set main goals of self-education activities;
- to search for and select sources of information – this will ensure success in designing;
- to find and apply specialized software tools using electronic resources to optimize the programme code;
- to independently compare the result in the form of the code of software modules and database objects with the set goals and tasks [24].

The job components of software engineering are defined in corresponding educational programmes developed by individual institutions of vocational pre-higher or higher education. Their analysis enables stating that software engineering technicians should have certain formed general-scientific, instrumental, socio-personal and general-professional competences that will ensure effective execution of their professional functions.

In the 21st century, humanitarian knowledge should be founded on an interdisciplinary complex involving close interrelations of the humanities with practical courses on the basis of combination of specially selected "blocks" of History, Philosophy, Cultural Studies, Sociology, Psychology concerning soft skills formation. First, it combines a significant theoretical layer with the following practical implementation. Secondly, the interdisciplinary approach clearly traces the tendency of creating a "block" of the humanities and natural sciences.

In modern conditions, the traditional understanding of vocational education as acquisition of a certain amount of knowledge based on teaching fixed subjects is clearly insufficient. Education today should focus on ways of thinking and activity, worldviews, stable moral and aesthetic ideals, personality culture rather than educational subjects. Disciplines of the humanitarian cycle of vocational education institutions accumulate the system of universal human values and ideals and can serve as a content of spiritual development, humanization of the person. Strengthening the role of social and humanitarian disciplines in higher technical education should be based on the following principles: orientation of the technical education system to create conditions for spiritual, ethical and cultural self-development of the person; deep fundamental and methodological training of students in the field of humanitarian knowledge, spiritual life of man and society; students' mastery of the methodology of cognition and creativity, practical activity, a person's social behavior and self-development as preconditions for achieving success on the way of life; creation of prerequisites for organic involvement of students in the economic, social and cultural processes of the world civilization development; organic connection of the educational process with extracurricular work, students' leisure and recreation.

The general model of software engineering technicians' soft skills formation is shown in figure 3.

To check the proposed methodological recommendations, an experiment was conducted which involved students of speciality 121 "Software Engineering" (field of knowledge "Information Technologies", specialization "Software Development") at Kyiv Professional College of Information Technology and Economics of the National Aviation University.

Thus, the control group (CG) comprised 46 students (year of graduation – 2018), and the experimental group (EG) – 52 students (year of graduation – 2020). Students were offered a questionnaire:

1. How often were active methods (games, trainings, case methods, discussions, etc.) used in the training process?
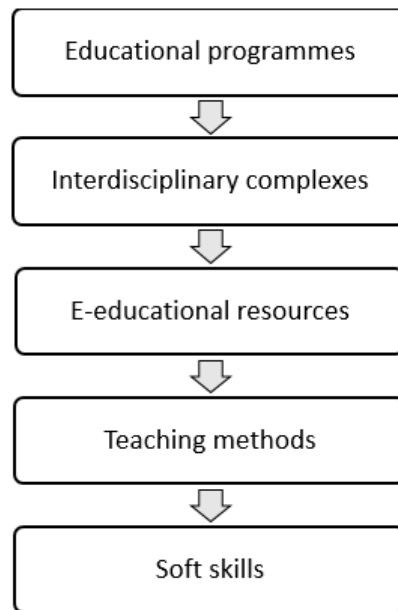
Figure 3. Soft skills development model.

- constantly;
- periodically;
- very rarely;
- almost never.

2. How often were E-educational resources used in the training process?
   - constantly;
   - periodically;
   - very rarely;
   - almost never.

3. Evaluate your level of corresponding soft skills as high, sufficient, medium or low:
   - the capacity for abstract thinking, analysis and synthesis;
   - the ability to communicate in the native language;
   - the ability to communicate in a foreign language;
   - the capacity for learning and self-study;
   - the ability to search, process information from various sources;
   - the ability to work in a team;
   - the ability to act on the basis of ethical considerations;
   - the social competence;
   - the ability to preserve and multiply moral, cultural, scientific values and achievements of society;
   - the ability to assess and take into account economic, political, social, technological and environmental factors;
   - the experience of humanitarian evaluation of software projects;

The percentage results of answers to the first question is shown in figure 4.

The percentage results of answers to the second question is shown in figure 5.

The answers to the third question of the questionnaire clearly showed the positive shift of soft skills levels in all components (figures 6, 7).
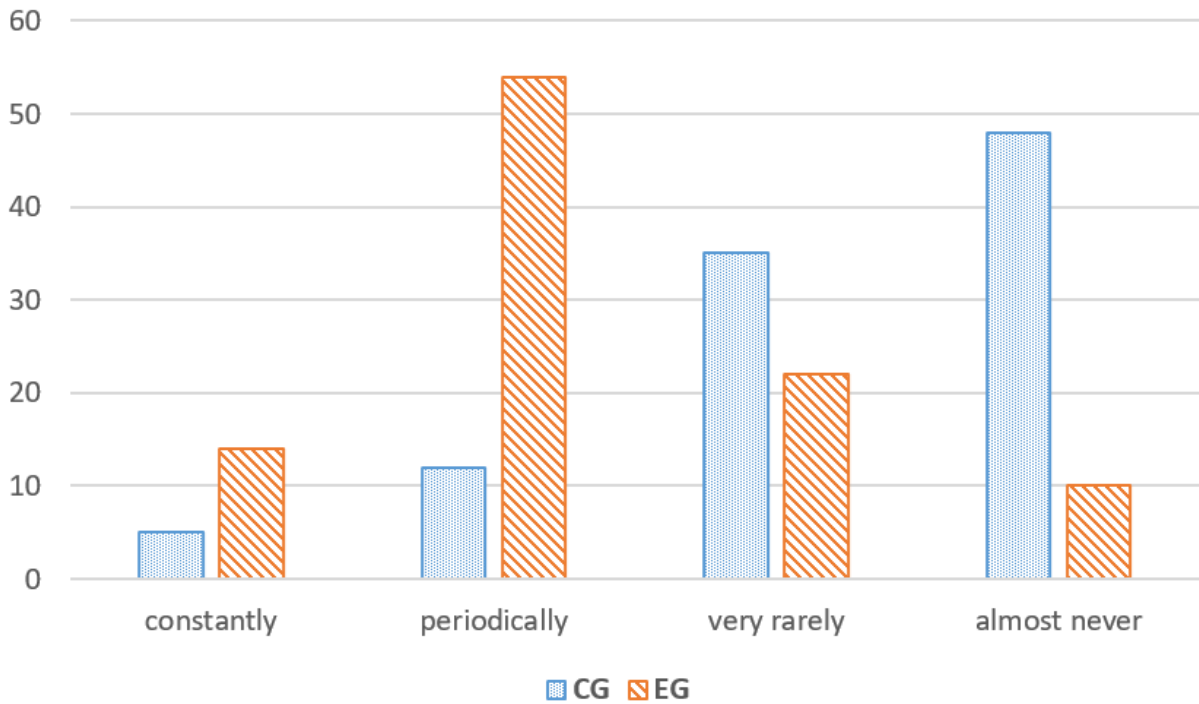
Figure 4. How often were active and interactive methods used in the training process?
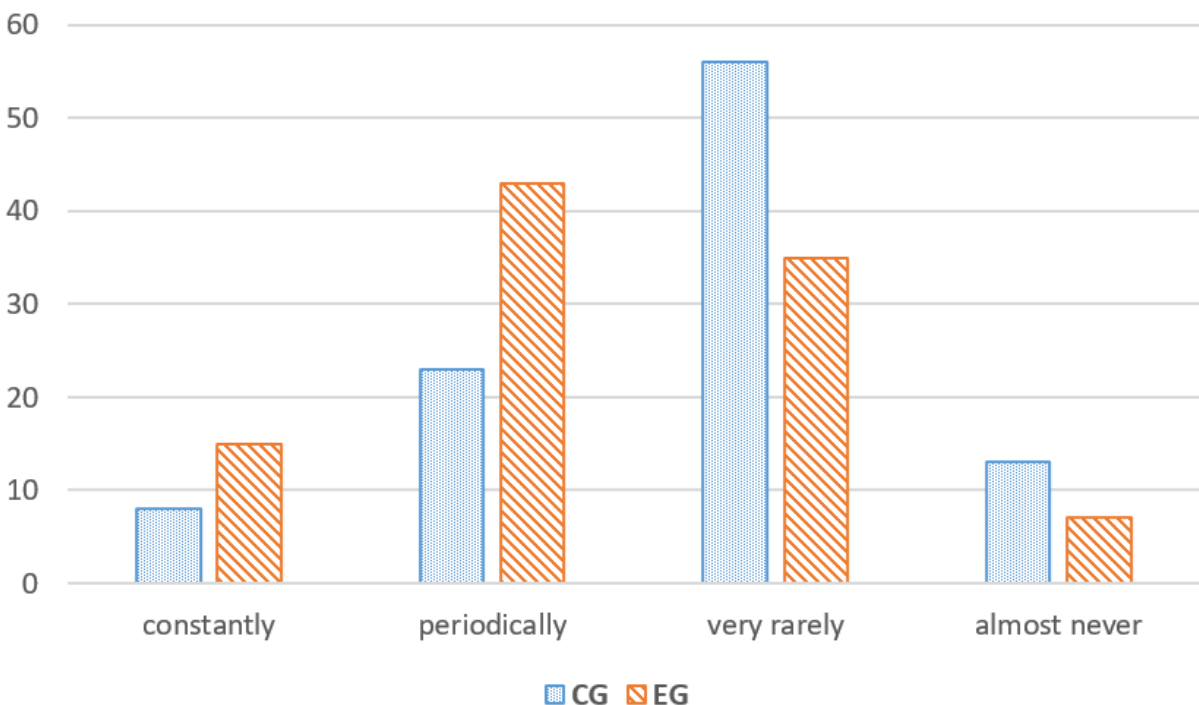
Figure 5. How often were E-educational resources used in the training process?

Since teaching the humanities and social sciences in the experimental group was conducted in blocks (as proposed in the methodological recommendations), teachers (according to the results
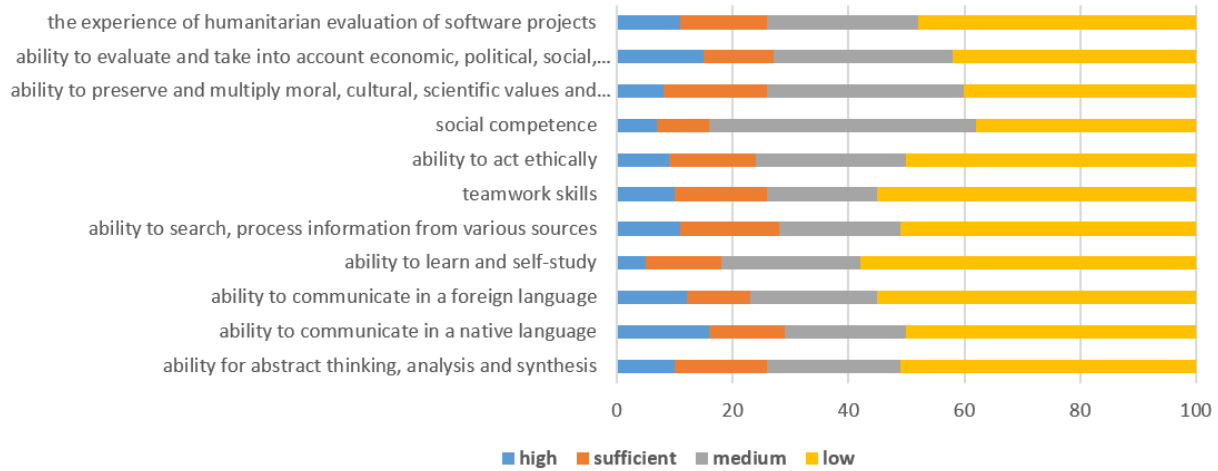
Figure 6. Software engineering technicians soft skills self-assessment (before experiment).
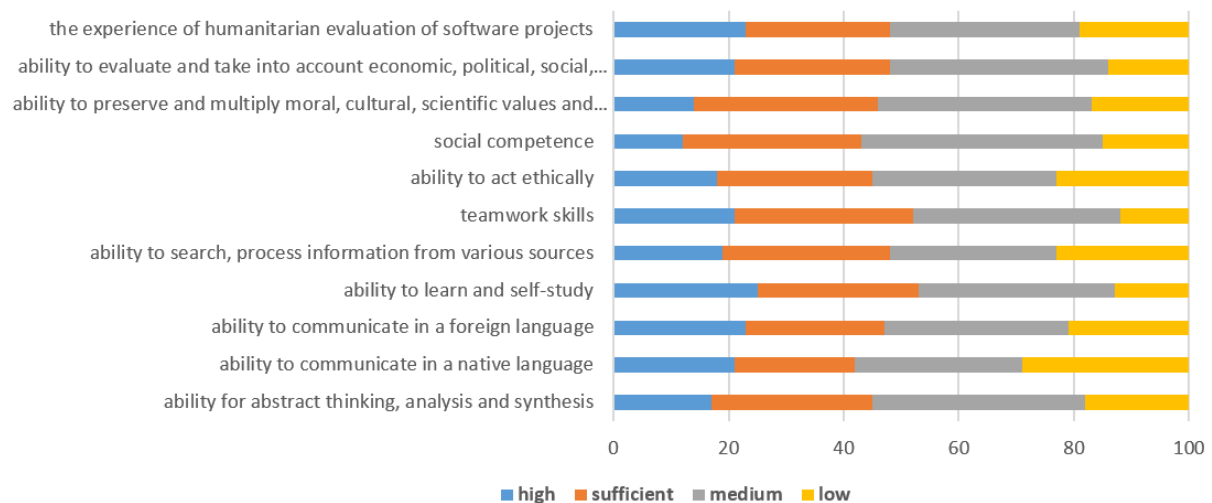

Figure 7. Software engineering technicians soft skills self-assessment (after experiment).

of the questionnaire) more often used E-educational resources and active teaching methods, we can assume that this was an increase in the level of soft skills maturity.

3. Conclusions and prospects for further research

1. Based on the analysis of sources and curricula for training software engineering technicians in institutions of vocational pre-higher education, there has been established a link between soft skills of software engineering technicians and the humanities and social sciences (figure 2) and there has been developed a model of soft skills formation (figure 3).

2. The results of the experimental work (figure 7) have confirmed effectiveness of the proposed guidelines for forming software engineering technicians' soft skills.

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