Extra-Curricular Activities as an Important Factor for Developing Subject Qualities of Future Engineers

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We examine the need to develop the subjective qualities of students at technical universities based on the analysis of Russian and foreign research on future engineers' training. We consider the peculiarities of future engineers' educational process, based on the importance of extracurricular activities in the development of such qualities. The purpose of the study is to test the hypothesis about the effectiveness of developing the subjective qualities of future engineers by involving them in extracurricular activities that were formed at the initial stage. The paper describes a pedagogical experiment that includes three stages. The set of research methods includes analysis, synthesis, comparison, generalization, pedagogical observation, questionnaire survey, testing, conversation, expert assessments, and statistics. We present different directions and types of activities organized within the experimental work with pedagogical support. Besides, we give examples of extracurricular activities that contribute to the successful development and manifestation of the specified personal qualities in students. The paper contains evidence of the effectiveness of extracurricular student activities as a factor in developing subjective qualities.

Keywords: subject personality traits, student, extracurricular activities, pedagogical experiment, higher technical institution

INTRODUCTION

In today's competitive world, to obtain success, a future engineer must acquire many professional knowledge and skills and constantly develop the necessary personal qualities. Currently, specialists should be capable of a creative approach to professional activity, successfully act in unpredictable new situations, take the initiative, take responsibility for others, for a common cause. Therefore, the above will be useful not only during university studies but also in building their future professional careers (Kubrushko &

Kozlenkova, 2019; Lysenko & Nazarova, 2019; Solovyev, Petrova, Prikhodko & Makarenko, 2017). The training of such specialists is possible only if the subjective qualities of future engineers are developed.

The educational process in a higher technical institution has several features related to the goals, objectives, content, forms, and teaching methods. Professional training of students of engineering specialties aims to form professional, highly specialized technical knowledge, skills, and abilities since their future activity is associated with functioning in the human-technology system (Dobruskin, 1999). This priority was confirmed by analyzing the educational and qualification characteristics and educational and professional training programs for future engineers of bachelor and master's degrees in different areas of training in higher technical institutions.

However, the number of disciplines in the academic cycle and the amount of time allotted for the study in a technical institution are less than academic or economic universities. Besides, with the transition to new standards of higher education in Ukraine, the academic and socio-economic cycle disciplines are classified as selective, which puts them at risk in higher technical education. Let us consider such reasoning to be correct. There is every reason to search for ways and means of developing the subjective qualities of students at a technical university just outside the classroom, which, in turn, indicates the increasing role of extracurricular activities in this process.

Extracurricular activities are an essential component of the system of educational work of the university, aimed to form the professional and personal qualities of a future specialist. It makes it possible to create a favorable educational environment for the formation and development of the student's subjective qualities, stimulating his activity, independence, and creativity.

REVIEW OF LITERATURE

The students' ideas of higher technical institutions largely coincide with the above. Therefore, according to the monograph by O. Piralova (2009), this model (according to students) is primarily determined by the presence of professional skills (40%), and only then by certain personal qualities, such as communication skills (31%), purposefulness (29%), responsibility (25%), etc. (Piralova, 2009).

However, in numerous Russian and Ukrainian scientific studies of the requirements for graduates of higher technical institutions (HTI) (Ihnatiuk, 2009; Romanovskyi & Ponomariov, 2014; Saienko, 2012, etc.), and other countries (King, 2003; Yunus & Li, 2005; Mourshed, Farrell & Barton, 2012; Bairaktarova & Pilotte, 2020), the modern engineer is characterized in a slightly different way. Significantly, modern engineers are professional, but they also have a high level of general culture, intelligent engineers, effective managers with developed managerial, leadership, organizational, communicative qualities, and skills, who strive for self-realization self-development in personal and professional spheres.

The European Center for the Development of Vocational Training in 2014 expressed employers' opinion who argued that the gap between the skills and qualities of graduates and the demand for a professional environment arises from inadequate training of graduates (European Center for the Development of Vocational Training [CEDEFOP], 2014). Graduates often lack organizational skills, adaptation, and the ability to express their subjective qualities in new circumstances (Bridgstock, 2009). There were doubts about the university and its role in developing the skills needed to lead a successful and responsible life (Cornali, 2018). Employers clearly distinguish between an engineer's professionally important and personal qualities while giving preference to personal qualities. One of the most acute problems is a certain discrepancy between the professional training of young engineers and the requirements of the current labor market.

The result of this discussion is the search for ways to overcome the problem, including the humanization and humanization of higher technical education. Moreover, there is a need for the upbringing of the student's creative personality and personal qualities.

The issues of personal formation and the development of students' subjective qualities are becoming more relevant in modern pedagogical science, particularly in the theory and methodology of vocational education (Osnitckii, 1996).

The formation and development of subjectivity, subjective position, and subjective personality traits attract many humanities that study it using various methods from different angles.

The subject in current sciences is considered in two ways – broad and narrow. In a broad sense, a subject is the creator of their own life, capable of turning the activity into an object of practical transformation, evaluating their activity methods, controlling and adjusting its course and results. In a narrow sense, a subject is an active, independent person, capable of carrying out specifically human forms of life. A person as a subject builds their activity, realizing the functions of analysis, assessment, goal setting, planning, and decision-making.

We consider it appropriate to interpret the subject as a bearer of object-oriented practical activity and cognition, an "active agent," a source of conscious, purposeful activity.

We consider the student's subjective qualities, which characterize them as subjects (activity, responsibility, initiative, independence, and creativity). The qualities we indicated are directly or indirectly present in many pedagogical studies. We consider it expedient to dwell on the interpretation of these subjective qualities.

We consider the activity as the ability of a person to consciously, purposefully transform the surrounding reality. We fully support the definition given by V. Gorshkova. The author defines the activity of the subject as a personality quality that allows to:

- Carry out goal setting in activities;
- Operate in a mobile way and carry out their constructive correction;
- Be proactive and critical to the advancement of new tasks that go beyond the given situation;
- Predict performance results creatively and variably (Gorshkova, 2004).

Thus, the student is an active participant in the process of their own education.

Responsibility and initiative can be considered as forms of activity. The peculiarity of the subject's initiative is that it occurs either before forming external requirements or as an alternative to these requirements. The initiative is a manifestation of the creative approach of the individual. It expresses the motives and desires of the student as a subject.

Responsibility as a form of activity lies in the fact that it arises when the subject realizes and accepts the external necessity. The subject determines the forms and boundaries of this need independently. Therefore, responsibility is a manifestation of independence, inner freedom. The presence of responsibility indicates the student's readiness to achieve the planned result independently. The value of student responsibility lies in predicting and being responsible for the results of their educational activities.

Independence acts as one of the personality traits expressed in the manifestation of the initiative, critical attitude, self-regulation, a sense of personal responsibility for oneself, and one's activities (Bezrukova, 2000). The subject is independent in choosing goals, behavior style, means of activity, and at the same time, is responsible for the decisions made and their consequences.

We understand creativity as a subjective quality that reflects the degree of a person's creative manifestation in everyday life, during communication, in professional and social activities, fully agreeing with V. Bezrukova (2000).

There is no consensus among scientists regarding the definition of the concept of "extracurricular activities." V. Koval (2009) interprets it as a part of the time allocated for life outside the audience. A. Sevastianova (2004) slightly expands the definition, which considers extracurricular activities as a single conglomerate of different activity types, outside the educational process. V. Ivanyushina and O. Zapletina (Ivaniushina & Zapletina, 2015) characterize this term differently, considering it a rich environment for the development of various subjective qualities at each stage of personality maturation.

Our work includes students in the extracurricular activities, a system of various, interrelated areas that are not related to the curriculum, carried out in an HTI outside it. They are conducted to create conditions for the personal development of future engineers and their self-realization. During the classroom training, the student's activities are directly supervised by the teacher during the extracurricular time. In that case, the student manages the process of mastering knowledge, forming skills and abilities, thus showing their subjective qualities. The system of extracurricular activities, in our opinion, contains the following areas:

research work; cultural and leisure activities; student council. In our study, we consider the independent work of students at a technical university as the basis for implementing the selected areas of students' extracurricular activities since it is a direct link and an important part of any of them.

The value of extracurricular activities is since it is based not on forcing students to master certain educational or artistic information, but on the principles of voluntariness, freedom of choice, considering the interests, abilities, and aspirations of students. Extracurricular activities provide the student with the opportunity to freely choose the direction, content, methods, and forms of activity, expand the space of interaction with the world, learn about their uniqueness and originality, their capabilities, develop their abilities and personally significant qualities, enrich their subjective experience (Novikova, Alipichev, Kalugina, Esmurzaeva & Grigoryeva, 2018).

MATERIALS AND METHODS

At the initial work stage, there was a hypothesis that the development effectiveness of future engineers' subjective qualities will significantly increase in extracurricular activities with pedagogical support.

The need to provide pedagogical support is based on the data of the survey. As a result, it was found that the majority of HTI students (92% of 323 respondents) experience difficulties in the process of development and identification of subjective qualities in various educational and life situations, and therefore need support from teachers.

To test the hypothesis of the research, we organized a pedagogical experiment in the natural conditions of a technical university. The experiment was carried out in 2017–2019 based on the Kharkiv National Automobile and Highway University (automotive, mechanical faculties). Various experimental work types covered 108 students and 23 scientific, pedagogical, and pedagogical workers (including deputy deans for educational work, curators, teachers, heads of sections, etc.). The experiment included the stages traditional for pedagogical research: ascertaining, formative, and control.

In the experimental work, we used a set of such research methods:

- Theoretical-analysis, synthesis, comparison, generalization for the study of scientific sources in order to clarify the state of development of the specified problem, determination of the theoretical foundations and key concepts of the study;
- Empirical-pedagogical observation, questioning, testing, conversations, expert assessment, pedagogical experiment to test a hypothesis;
- Statistical methods of mathematical statistics for quantitative and qualitative analysis of empirical data.

RESULTS AND DISCUSSION

At the ascertaining stage, many tasks were solved. We analyzed the scientific literature, selected the main subjective qualities necessary for a future engineer, namely: activity, initiative, responsibility, independence, creativity.

We determined the character of their manifestation by students (stable, situational, rarely manifested) as an indicator of personal qualities development. To determine this indicator, the following methods were selected:

- Observation of the behavior of students and their interaction with each other and other participants in extracurricular activities;
- Method for analyzing the products of extracurricular activities of students;
- "Unfinished sentence" technique;
- Method of expert assessments;

Conversations with students, teachers, leaders of circles, curators in order to clarify the necessary experimental data.

We have identified three levels of development of the subjective qualities of HTI students: high, medium, low. Students with a high level demonstrate resilience in the manifestation of these personal qualities. The unevenness of their manifestation (some – frequently, some – situationally) is typical for students with an intermediate level. A low level is evidenced by the manifestation of subjective qualities rarely, in some cases.

Data on the nature of the identification by students of the above personal qualities in extracurricular activities are presented in Table 1.

TABLE 1
DATA ON THE CHARACTER MANIFESTATION OF THE SUBJECTIVE QUALITIES OF HTI STUDENTS

Subjective quality	Manifestation character		
	Frequent manifestation	Situational manifestation	Rare manifestation
Activity	9.8%	67.9%	22.3%
Initiative	6.7%	65.8%	27.5%
Responsibility	28%	52.8%	19.2%
Independence	20.7%	43%	36.3%
Creativity	17.6%	37.8%	44.6%

The experiment involved two academic groups of mechanical (M-21, M-22) and automotive departments (A-21, A-22). The diagnostic results were similar. Groups M-21 and A-21 (53 students) were experimental (E1 and E2, respectively), and groups M-22 and A-22 (55 students) were control (K1 and K2, respectively). The sample consisted of 108 students (the second and third years of study). First-year students were not involved in experimental work because they went through adaptation to new life conditions at a technical university. Involving fourth-year students directly into the pedagogical experiment was recognized as inappropriate since they devote the second semester of the academic year to graduate design, making it impossible for them to engage in the experiment fully. Consequently, it was decided to involve the second and third years of study at HTI in experimental work.

The formative stage of the pedagogical experiment provided for students' active involvement from experimental groups in extracurricular activities to develop their subjective qualities with pedagogical support. In the control groups, a separate task for developing the subjective qualities of future engineers was not set. Therefore, this process took place spontaneously during traditional extracurricular activities.

At this stage of the experiment, a system of measures was implemented, which provided for active explanatory and informational work on the importance of subjective qualities for a future technical specialist and the possibilities of extracurricular activities for their development. During the curatorial hours, study sections, clubs attracted teachers, curators, and student government leaders.

Stimulation of positive-active motivation of students to develop and manifest subjective qualities was facilitated by conducting interactive mini-lectures, conversations ("My dreams, goals, actions," "Act or wait?", "How to achieve what you want?"), discussions ("The expediency of participation in a competition, conference / seminar / master-class "), debates ("Does everyone need to be a leader?", "An active person is active in everything?", "What qualities should a modern engineer show?", "Who is responsible for the quality of education?"), problematic lectures ("Not enough time," "Let us do it later"), lectures with case studies.

At the first mini-lecture, students of each of the experimental groups were asked to assess their own development level of subjective qualities (high, medium, low). The results are shown in Table 2.

TABLE 2
THE RESULTS OF STUDENTS' ASSESSMENT OF THE DEVELOPMENT LEVEL OF THEIR SUBJECTIVE QUALITIES

Group / Level	E1 (amount of students / %)	E2 (amount of students / %)
High	11 (38%)	9 (38%)
Medium	16 (55%)	14 (58%)
Low	2 (7%)	1 (4%)

After this survey, the students got the diagnostics results we carried out at the ascertaining stage of the experiment. Revealing the differences between self-esteem and the real picture of the development state and the manifestation of subjective qualities, on the one hand, was an incentive factor for students to intensify work on themselves. On the other hand, certain differences allowed them to understand better the existing gaps and extracurricular activities, which would help them fill these gaps.

Lectures played a special role in considering cases in the process of explanatory and informational work on the development and manifestation of future engineers' subjective qualities. These lectures were similar to lecture-discussions. However, the subject of discussion in them was not the questions illustrated by certain examples and situations, but the presented situations. Working with case studies created optimal conditions for developing critical thinking skills. We agree with the position of Kulamikhina (2018) that "by developing good critical thinking skills, our undergraduates would manage to improve language skills significantly together with their social abilities" (Kulamikhina, Birova, Alipichev, Vasbieva & Kalugina, 2018).

Since these events were interactive, students actively participated in the discussion, search, presentation, and illustration of information, exchange of views, joint progress to conclusions. When conducting a conversation on the "A successful person – a successful engineer" case, we asked students to name the characteristics and signs by which a person can be considered successful, give examples of successful people in their opinion, name their personal qualities and certain skills. It should be noted that among the main signs of a successful person, students named external manifestations (beautiful appearance, stylish and expensive clothes, jewelry, branded accessories, the presence of a prestigious car, phone, etc.), and as examples of successful people they pointed to mostly foreign representatives of show business or famous public figures.

However, with an emphasis on a successful person's personal qualities, students named such characteristics as the ability to communicate, independence and self-confidence, self-control, purposefulness, cunning, leadership qualities, and responsibility (characteristics are presented in order of importance from the most important). According to the students, when comparing these characteristics with those of a successful engineer, we found that they were very similar, and the ability to communicate was the most important. The difference between this list and the previous one was two new characteristics in the second and third places. So, students gave second place to those related to an engineer's professionalism (professionalism, a high level of knowledge, the ability to draw and work with technical documentation, the ability to work with certain computer programs, attentiveness, caution). The third place was by the skills and qualities of the organizer (leader).

For another event, students had to explain and illustrate the subjective qualities of a person in a certain way. The students approached the task creatively, and some of the presentation-illustrations were bright, found response in other students. For example, one of the subgroups of students illustrated the subjective qualities with modern songs or fragments of songs. They provided their opinion that the subjective qualities of a personality were a requirement of modernity. The second subgroup of students emphasized that activity, responsibility, hard work, purposefulness, and the need to learn to belong to the "eternal" ones, and they cited folk sayings and proverbs. The third subgroup prepared short stories-presentations about people whose actions, life stories, success, or failure can illustrate the manifestation of the subjective personality traits.

To increase future engineers' positive active motivation to develop their subjective qualities and stimulate their manifestation, we organized meetings – seminars of students with interesting people. Thus, meetings were held with foreign guests who talked about the higher education system in their country, about their own education, requirements for students, the choice of training courses, and the like. The main idea of such meetings was to show students that it is the student responsible for the quality of education abroad. An interesting fact for our students was the need to participate in an educational institution's extracurricular activities with the fixation on positive results, duties performed, achievements, and the like.

It is worth noting that when engaging future engineers in any extracurricular event within the framework of experimental work, they were explained that the interaction of participants in extracurricular activities on the principles of cooperation involves: joint determination of the goals of activities, joint planning of future work, the joint distribution of responsibilities, resources, funds, following the capabilities of each participant, joint control and adjustment of activities, assessment of work results, and then forecasting new goals and objectives.

The attention of the students of the experimental groups was focused on the fact that participation in extracurricular activities is voluntary. At the same time, inviting students to take part, to organize the extracurricular event, students were told about how it could be interesting and useful for them, about the opportunities that this event provides for the development of their skills and qualities, they invited others (teachers, coaches, other students, representatives of organizations) for the presentation of the event, that is, to a certain extent, they advertised it.

Experimental group students were invited to participate in student competitions and conferences, write articles, essays. Such events are related to research work. Students' reflexive analysis of their participation in certain events, positive results, reasons for failures, and the search for ways to overcome problems also occurred with pedagogical support.

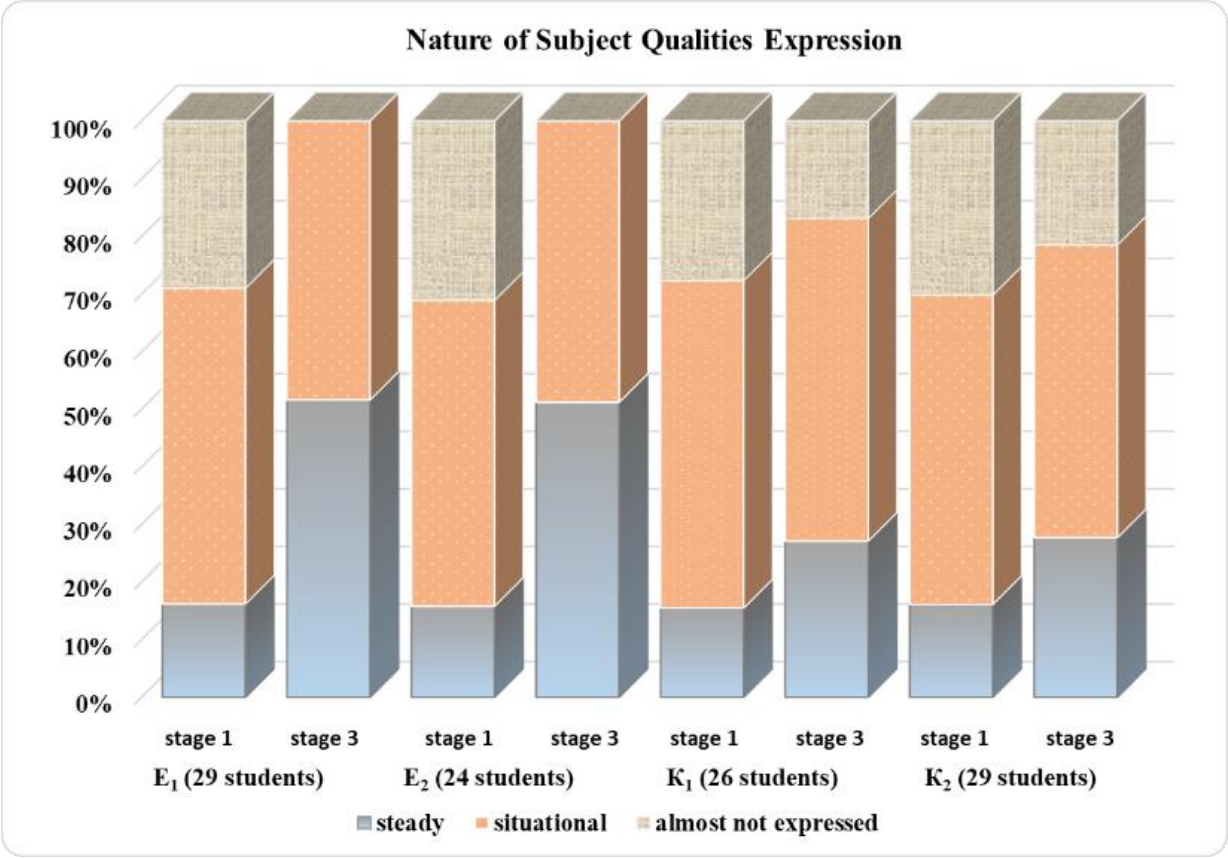
Students also received or independently selected assignments of different nature and content. These instructions provided for participation in councils of faculties, departments, student government bodies at various levels, and public organizations; in planning cultural and leisure activities of the group, organizing extracurricular activities in various directions. We will note such events of experimental groups as a group trip to auto races, participation in a bicycle race, organization of a support group (fans) of classmates at sports competitions (the Ukrainian kick-boxing championship, Muay Thai competitions, "work-out"), participation in city sports events and Science Nights as volunteers, attendance at master classes in 3d modeling.

The teacher's task was not to insist, not to force students to choose certain events, but to provide information, explanations, guide students to reflection, informed their own choice with the help of leading questions such as "Why do you want (or don't want) to take part in this event? "," What form of participation do you choose (individual, pair, mass)? Why?", "What can you (want) learn by taking part in it?" "What results do you plan to achieve?". The teacher helped the students decide for themselves in the direction of development and manifestation of subjective qualities in extracurricular activities, acting as facilitators.

The control stage of the experiment provided for repeated diagnostics of the levels of development of students' subjective qualities in the experimental and control groups after the end of the experimental work, as well as processing, analysis, and generalization of the results of the experiment.

The generalized data on diagnostics of the character of manifestation of these qualities in extracurricular activities by students of the experimental and control groups are shown in Fig. 1 (for each group, data were submitted at the ascertaining stage (stage 1) and the control stage (stage 3)).

FIGURE 1
DATA ON THE NATURE OF STUDENTS' MANIFESTATION OF SUBJECTIVE QUALITIES



Analysis of diagnostic data indicates significant positive shifts in the character of revealing these qualities by students of the experimental groups. The proportion of persons identifying these qualities is stably increased in the experimental groups by an average of 35.4%, in the control groups – by 11.6%.

In extracurricular activities, it is important to organize such interaction of participants, in which their communication is based on the principles of dialogue, and joint activity is cooperation. As a result of such interaction, students' efforts are activated, understanding the personal meaning of extracurricular activities, the development and self-development of the individual are stimulated, the formation of certain skills (intellectual, communicative, organizational, reflexive) and personal qualities (activity, initiative, independence, responsibility, creativity) in students is ensured.

CONCLUSIONS

All of the above data is to say that a more intense positive dynamics is observed in the character of revealing subjective qualities than in the students of the control groups as a result of the implementation of the formative stage in the experimental groups.

Thus, we can draw a general conclusion about the correctness of the hypothesis in the study that extracurricular activities with pedagogical support are indeed an important factor that increases the efficiency of the development process and the manifestation of future engineers' subjective qualities.

Extracurricular activities do not exhaust themselves with the indicated activities. Therefore, in the future, we want to identify the means of forming and developing other skills and abilities necessary for future engineers in educational and professional activities.

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