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Self-Regulation as a Basic Element of the Professional Culture of Engineers

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Abstract: This paper addresses the problem of the formation of the self-regulation of educational activities of students studying in a technical university. The purpose of this paper is to discuss the problem of the self-regulation of educational activities of students, presenting data from an experimental study of students' self-regulation. Special attention is paid to the distinction between the terms self-control and self-regulation. This paper presents data on the state of self-regulation among students studying technical specialties. The research methodology is based on the theoretical analysis of the results of scientific works, which present the main provisions on the formation of students' self-regulation. The research methods include questioning and a methodical experiment. The stages of the formation of students' self-regulation are highlighted, and the main directions of teachers' work on the formation of students' self-regulation are determined. The structure of self-regulation is described and the condition for its formation is justified using the technology of self-regulation formation. Based on the study, students' self-regulation is linked to the awareness of their professional and personal goals, as well as to the level of regulatory and reflective qualities. Personal and professional self-improvement in the process of vocational education depends on the level of the formation of regulatory and reflexive qualities.

Keywords: Self-regulation; self-control; independent activity of students; professional culture; learning activities; self-regulation technology

1. Introduction

In recent years, the problem of self-regulation has become the subject of psychological and pedagogical research [1–8]. This is due to the fact that self-regulation is one of the most important factors ensuring the independent activity of students. Its purpose is to prevent mistakes or detect ones already committed. It is most rational to begin with the formation of the regulation of the independent activity of students. The skill of self-regulation is the most poorly formed skill among students [9–12].

Authors who use the concept of self-regulation do not always understand this the same way.

According to Kuhl's theory of self-regulation, there are two basic modes of volition: self-regulation and self-control. Self-regulation is associated with positive emotions, whereas self-control is associated with negative ones. Self-regulators remember intentions better than self-controllers [13]. Self-regulation increases the success of training transfer, whereas self-control impedes the success of training transfer [14].

Self-regulation is conceptualized as a mode of volition in which learners form goals in accordance with their needs and preferences (self-determination) and flexibly resolve action-related conflicts oriented at self-maintenance. It is self-supportive and fosters an overview and integration of own multiple needs, wishes, preference, goals. Self-control, in contrast, is conceptualized as an "authoritarian" mode of volition in which individuals maintain a specific goal by suppressing any

tempting alternatives, even if these alternatives are self-congruent. It is self-suppressive, focused on goal maintenance and the perseverance of a single goal, self-discipline, and supported by high planning abilities for specific action steps.

Self-control is understood as the mental, motor and sensory components of the process of human activity, allowing a person, to monitor actions and the results of these actions on the basis of the set goals and plans and to consciously regulate them. Self-control refers to the alignment of thoughts, feelings, and actions with enduringly valued goals in the face of momentarily more alluring alternatives. The role of self-control can be examined in academic achievement [15]. The proper organization of self-control is important for the development of future specialists, because skills of independent activity will provide them with an invaluable service in the future and allow them to make the right decisions in difficult life situations. For example, sleep deprivation decreases individuals' self-control while increasing hostility, resulting in increased workplace deviance [16]. Self-assessment helps students to obtain information about educational activity, to mark mistakes and wrong decisions in order to analyze and correct them. The most important thing is to develop the right attitude to the academic discipline for the future specialist. It is necessary to develop the skills of the verification of work, to be able to direct students to search for errors. In addition, the teacher must convince students that they need not only to correct a mistake but also to be able to defend their point of view. This usually makes students take a more responsible approach to checking work.

Two self-regulatory capacities (self-control and mindfulness) can be compared with respect to their potential to help students deal with motivational conflicts in studying and leisure activities, by either promoting a selective, normatively-oriented versus open-minded, non-judgmental stance toward conflicting motivations. Self-control goes along with a preference for achievement-oriented over well-being-oriented values, which might explain the academic benefits associated with self-control. The total effects of self-control and mindfulness are differentially mediated via either activity preferences (self-control) or need satisfaction (mindfulness).

The research on self-regulation has largely focused on the idea of effortful self-control, which assumes that exerting willpower will lead to greater success. However, in recent years, research has challenged this perspective and instead proposes that effortless self-regulation is more adaptive for long-term goal pursuit [17].

Self-control is the ability to control one's impulses when faced with challengers or temptations and is robustly associated with psychological well-being. Self-control is heritable. The heritability of self-control did not vary across gender or age. The heritability did differ across informants with stronger heritability estimates based on parent report versus self-report or observations. When aiming to understand individual differences in self-control, one should take genetic factors into account [18].

Self-regulation is associated with the awareness, implementation, and regulation of their practical actions, with the containment of desires and the ability to manage their own actions and is aimed at achieving their goals. Self-regulation is one of the significant components of the conscious self-regulation of one's behavior, aimed at self-change, as well as personal and professional growth. In the process of self-regulation, self-observation, awareness and self-analysis of their actions takes place, accompanied by self-assessment and the correction of the results. The student constantly analyzes and evaluates the achieved results, correlating them with the goals set, and also plans ways of further self-development [19,20].

Thus, the student's self-regulation is understood as the subject's awareness of one's own actions, mental processes and states. All researchers suggest the need for self-regulation for the successful implementation of activities—in particular, the independent activity of students. They state that self-regulation should be trained specifically. In our study, the concept of the "self-regulation" of students is limited to the framework of the educational process. Based on the research tasks and analysis of the existing definitions, we define "students' self-regulation" as the ability to critically assess external behavior and mental activity under the guidance of teachers in the process of learning activities that develops on the basis of their natural inclinations. Self-regulation occupies an important

place among the universal competencies that students must master in the learning process. It has a great influence on the acquisition of educational skills and increases awareness of the performed actions; it also allows students to successfully organize their own activities, which improves not only the learning process, but also adaptation in society.

Currently, in the process of the formation of the modern society of Russia, the professional culture of a specialist is of great importance. Professional culture is necessary for building conflict-free situations and the sustainable and progressive development of the whole society. The basis of this experience is the cultural tradition, which serves as one of the dominants of the philosophy of culture. The systemic revival of all elements of cultural traditions and their use in education as basic cultural paradigms, norms and values are necessary to consolidate the ideals of democracy, freedom and the cultural development of each individual, nation and society as a whole. This is one of the key goals of modern education, which is based on the cultural tradition value. Maintaining a basic sample (the culture of a society) is maintaining or reproducing a cultural tradition, and the motivation to maintain a sample is the development and formation of personality. Consideration of the professional culture of a specialist from this point of view can be a starting point for the use of cultural traditions in the practice of modern education and upbringing and bringing them into the life of our society [21].

One of the actual pedagogical problems of the modern system of the Russian higher education is the study of factors and conditions affecting the process of professional development and self-development of future specialists. Dynamic versatile changes occurring in the modern educational sphere lead the student to adapt to new conditions. Particularly acute is the problem of the effective management of one's own educational activities, achievement of educational independence, initiative and responsibility, finding a rational approach, ensuring high accuracy of educational activities, its productivity, requiring competent implementation of the regulatory and controlling functions, mastering the actions of self-regulation [22–29]. The results of numerous studies in domestic and foreign studies confirm that the quality of the implementation of labor depends on the use of the profession and self-regulation skills of specialists in professional activities [25–28]. We consider the formation of positive motivation for self-regulation as one of the key factors. It can be achieved through mentoring; in the process of interaction with the teacher and other students (both in class and via distance learning). For that reason it is not only the selection of the content of educational material that is necessary but also the efforts of the mentor aimed at the development of self-regulation and the organization of work aimed at the development of self-regulation—in particular, the implementation of a program for diagnosing the level of the development of self-control in educational activities, particularly the independent activity of students. When forming a positive motivation for self-regulation among students, it is necessary to take into account the needs, abilities, and aspirations that induce them to learn. The training material should be based on past knowledge but at the same time contain information that allows not only to learn new things, but also to comprehend past knowledge and experience, to learn what is already known from the new side. The training material must be presented in such a way as to evoke an emotional response from the students. These ideas were implemented in the learning process in the form of classroom educational activities, distance learning and project work in the academic course of the English language.

Predictive self-regulation contributes to the optimal use of students' capabilities and acts as an indicator of the formation of their learning activities. The essential point in teaching students self-regulation is the understanding of the purpose of training activities and familiarization with the samples by which they will compare the methods used to perform the training work and results obtained. From the very beginning, it is very important, to give students comprehensive instructions on the correct implementation of the upcoming academic work and to acquaint them with samples for comparison. The formation of self-regulation is a long process that involves the constant presentation of certain requirements to students. One of the conditions for the development of self-regulation among students is the creation and implementation of a program for diagnosing the level of self-regulation development.

The analysis of educational and methodical literature has shown the insufficient development of this issue.

Reeve presents an overview of self-determination theory (SDT) in relation to education. The central concept in a SDT is students' autonomous self-regulation. It makes students self-initiating because the tasks they undertake are perceived as interesting or important to them. SDT suggests that learning goals differentiate in the degree to which they meet the psychological needs of students. It enables the teachers to predict both the quality of their engagement and the result of the learning [29]. Regulation of learner's behavior as a single system includes three sub-systems of regulation, namely, cognitive control [30,31], emotional regulation and volitional regulation [32], which are based on individuality resources. It is important for the future specialist as a professional subject to possess the skills of self-regulation, which allows achieving a high quality of work [33]. Emotion is easily typecast as the nemesis of self-regulation. Emotion and cognitive control are integrated, at times working in harmony. Emotional states can enhance high-level cognition and can modulate the neural mechanisms that support cognitive control. Such an integrated neural organization might be adaptive: emotional states could help resolve control dilemmas, facilitating the transition of the whole system into a more unified, situationally appropriate control state. This perspective is intriguing because control dilemmas are pervasive in human affairs [34]. Self-regulation allows professionals to flexibly adapt to the changing parameters of their professional activities. It is one of the resource regulatory tools of the individual: it provides a high precision of actions, their productivity, and a comparison of the results obtained with those previously planned [35–39]. The ultimate goal of the organization of a self-regulation system is the transfer of this function to the students themselves, so that self-regulation is initiated not by the "threat" of pedagogical control but becomes the norm of the learning process.

The urgency of the problem of the self-regulation of the educational activities of students is due to the existing contradiction between the requirements of the modern employer and the actual skills of young professionals, which determines the need for an experimental study of students' self-regulation. A modern student needs to be able to regulate his or her academic activities, monitor, establish and eliminate the causes of the difficulties that arise. Self-regulation is one of the main components of the modern student's learning activities, when the educational results obtained by the student are reflexively evaluated in relation to individually formulated goals. In contrast to the control exercised by the teacher in order to test knowledge and ideas about the possibility of the further study of educational material, self-regulation should be carried out during the formation of educational activities. Decisions learners make about self-regulation either promote or impede their achievement. Evidence suggests that productive self-regulated learning can be fostered through evidenced-based designs for learning activities and environments, by promoting particular beliefs among teachers, and helping learners discover value in education [40]. Studies conducted in order to evaluate whether reflection journal writing was effective in promoting self-reflection and learning, and whether students become better at self-reflection if they are engaged in this type of activity suggest that self-reflection does lead to improvements in academic performance [41].

The self-regulation of the performance of the action by the student is carried out using the feedback mechanism. Any information about the process or the result of an action is a feedback that regulates and controls. Zimmerman's cyclical model of self-regulated learning is described and analyzed as one of the most comprehensive. The model is grounded in social cognitive theory and is comprised of three phases (forethought, performance and self-reflection) with a special focus on the influences of motivation on self-regulation [42]. The control involves three links, representing the structure of the internal control of the subject of activity for its implementation: the image of the required, desired result of the action; the process of comparison of this image and real action; deciding whether to continue or correct the action. A criteria-referenced self-assessment (a process during which students collect information about their own performance or progress; compare it to stated standards; and revise accordingly) has been shown to promote achievement [43]. Self-regulation is conceptualized as an ability to effectively modulate one's behavior [44].

Barak suggests a model for self-regulated learning in technology education (SRLT) comprised of cognitive, metacognitive and motivational domains. The study demonstrates that self-regulatory behavior correlates with an individual's motivation to handle challenging assignments and individuals' belief in their ability to handle it. The SRLT model highlights the interrelationships between the cognitive, metacognitive and motivational aspects of learning, problem-solving and invention [45]. Empirical studies prove the learning value of a group assessment activity aimed at promoting first-year students' development of basic self-directed learning skills required for university study. It enhances students' capacity to ask appropriate questions, identify resources and tools, and draw links between different learning resources [46].

The importance of the role of self-regulation in the structure of activity, in particular, in the independent activity of students, is determined by the fact that it reveals the internal mechanism for the transition of teacher control and assessment into the actions of self-regulation and student self-assessment. The self-regulation of activity combines both motivational (intentions, goals, features of learning motivation, etc.) and executive (strategies, abilities and skills) blocks [47]. In the course of self-regulation, a student performs practical actions with attention to the conditions of academic work, fixing the state of the academic work performed, establishing its quality of performance, self-regulation of its progress, self-tracking of the quality of its performance, regulation, self-analysis, self-assessment, correction, point and timely self-response, and improvement of educational work.

There are four stages of the manifestation of self-regulation in relation to the assimilation of educational material in the independent activity of students. The first stage is characterized by the absence of any self-regulation. The student, who has not so far mastered the educational material, cannot control anything at this stage. The second stage is called complete self-control. At this stage, the student checks the completeness and correctness of the reproduction of the learned material. The third stage is characterized as a stage of selective self-regulation, in which the student regulates and checks only the most important questions. At the fourth stage, there is no visible self-regulation; it is carried out, as it is, on the basis of past experience, on the basis of some minor details.

The formation of self-regulation implies the ability of the learner to recognize and control their own actions and the situation. Self-control implies the existence of a standard and the possibility of obtaining information about the controlled actions and conditions [48]. Will-based regulation is based on the student's self-control as a component of self-regulation while, at the same time, self-control can be the object of volitional regulation, for example, in stressful situations.

Obviously self-regulation in the educational process, in particular, independent activity of students, is an issue of great importance. The objectives of this paper are:

- To create a model of the formation of self-regulation by defining the educational tasks and activities that can be used in the academic course of the English language;
- To select the content of educational materials used both in class and distance learning, in order to promote students' self-regulation;
- To organize the learning process based on the suggested model with the usage of chosen materials;
- To assess the change in students' self-regulation that took place in learning process.

2. Materials and Methods

Experimental research is based on the strategy of methodological triangulation, in accordance with which quantitative (diagnostic methods) and qualitative (conversation, observation) methods were used. To process the results of this study, content analysis methods and methods of mathematical statistics were used. The problems of the development of self-regulation were studied in works devoted to the psychological aspect by Russian [49–54] and foreign researchers [55–64]. Despite the fact that the study of pedagogical problems of self-regulation in the educational activities of students was given some attention, a proper solution in the context of the competence approach has not been received yet.

The purpose of the experiment was to identify and clarify the conditions under which a more rational use of technology for the formation of self-regulation is possible. The following tasks were planned: to study the activities of students in the audience and in the performance of independent work, in particular, in the distance learning system, to analyze students' opinion, to clarify the features of the use of technology of self-regulation, which can lead to a decrease in the quality of their training; to identify the requirements, the implementation of which will allow avoiding a reduction in the quality of training, delegating the function of self-regulation to students when performing educational tasks.

Analysis of the scientific and pedagogical literature and the state of the students' educational activity allowed us to discover the following contradictions between the growing importance of self-regulation in the educational activity, in particular, the independent activity of students and the insufficient development of the theoretical foundations of students' self-regulation in the context of the competence-based approach; awareness of the need for self-control in teaching students and the lack of scientific-based interaction of all subjects of education for its improvement; the need for the formation of a positive motivation of students to self-regulation and the lack of appropriate modern educational technology. These contradictions, insufficient scientific and methodological development of the problem of self-regulation among students and its importance in terms of the competence-based approach led to the relevance and allowed formulating the problem: to find pedagogical conditions for the development of self-regulation among students that affect the success of their learning activities.

The need to comply with global trends in the development of education stimulates an increase in the share of students' independent work, creating opportunities for their self-development. The leading goal of teaching foreign language to students of non-linguistic specialties is the formation of communicative competence, the most important indicator of which is the student's ability to self-monitor and self-assess his own speech activity [65,66].

We focus our attention on the practical and applied aspect of the process of learning self-regulation, the key point of which is the creation of special exercise systems and types of learning tasks aimed at mastering concrete practical strategies and skills for implementing the self-regulation of each type of foreign language speech activity, stimulating students' independent initiative, abstracting self-assessment and self-management of learning tasks, which should ideally go to autonomous student management of their educational activities. It is a well-known fact that self-regulatory skills (time-management, setting up learning goals, monitoring the learning progress, looking for help when it is needed) are essential for online learners. Self-regulation effects student achievement and performance. There is some evidence that providing scaffolding for monitoring performance, methods of learning, use of time, and motivation may be helpful to online language learners [67–71]. Studies show associations between self-regulated learning and academic achievement in online settings [72].

A system, proposed by Barolli, De Marco aims at increasing the e-learning completion rate by stimulating learners' motivation. The proposed system has three subsystems: the learning subsystem, learner support subsystem, and teacher support subsystem. They include a display of the learner's study history, change of interface color, encourage function, ranking function, self-determination of the study materials, and grouping of learners, etc. [73].

Massive Open Online Courses (MOOCs) are expanding the scope of online distance learning. Some modern researchers focus on studies of self-regulated learning skills profiles among learners enrolled in a Modular Object-Oriented Dynamic Learning Environment (Moodle) online course [74–77]. The analysis shows that online self-regulation and computer self-efficacy influences grades in a positive way. Others recommend implementing a networked self-regulated learning (SRL) platform enhanced with the Web 2.0 technology [78]. The Web 2.0-enforced SRL platform helps to achieve the goal of developing the learner's self-learning capability and potentials. Results indicated that students performed better at online self-regulated learning than online collaborative learning. These findings

indicated that a Personal Learning Space might be an effective means for improving both online self-regulated learning capability and online collaborative learning [79–83].

The Learning Management Systems Modular Object-Oriented Dynamic Learning Environment (LMS MOODLE) system is an open education information learning environment. This environment is able to integrate various informational training systems across the university, department, specialty, and a consortium of universities [84]. In the universities of the Russian Federation, LMS MOODLE is widely used, and its use does not require any special knowledge and skills from the user [85]. The system is a software environment designed for the development and deployment of an educational–methodical complex on the Internet, conducting an educational process through data from an educational–methodical complex. The LMS MOODLE system has a large number of tools aimed at creating various interactive courses.

In training engineers in the areas of preparation "Software Engineering", "System Analysis and Management", "Information Systems and Technologies", "Software Engineering" in 2019 in the federal state autonomous educational institution of higher education "Peter the Great St. Petersburg Polytechnic University" study of the discipline "Foreign Language. The basic course" as an experiment was conducted using the technology of self-regulation formation. In our case, of interest was the fact that during the lessons, both the advantages and disadvantages of this technology were discussed—its use was analyzed both from the position of a teacher and from the position of a student.

Supervision over educational groups was conducted during one semester. During the experiment, various diagnostic procedures were used (questionnaires, interviews, surveys, observation, and study of the products of students' creative activity). In 2019, we conducted a staging experiment, in which we identified the peculiarities of self-regulation among students studying at Peter the Great St. Petersburg Polytechnic University, a federal state autonomous educational institution of higher education. In total, 157 students (1st-Year and 2nd-Year students) took part in the experiment. Two experimental groups and two control groups were formed: one control group and one experimental group made up of 1st-Year students and one control group and one experimental group made up of 2nd-Year students.

We present the main types of educational tasks that ensure the formation of a strategy for self-regulation. Basically, we can divide the educational tasks that were used in the learning process into two categories. The first one comprises the task students performed during the educational year in the form of a MOOC course designed specifically for the university academic program. Each of the 12 modules consisted of the following sections: use of English, vocabulary, listening, writing, and reading. The second category is the tasks that were done in classes in cooperation with a teacher, so that the teacher performed the role of a mentor, demonstrating the ways of working with vocabulary and grammar-based tasks and promoting the idea of self-regulation. In classes, how to improve learner's skills, plan educational activities and work in collaboration with other students was discussed. These tasks were used in organizing students' project work in groups, preparation of speaking tasks and presentations. They were also helpful in preparing the written assessments and the analysis of the texts used in reading classes.

Both categories include the following types of exercises.

I. Exercises aimed at the formation of a strategy of self-regulation of lexical skills.

The means of the self-regulation of lexical skills is a close-test, in which controlled lexical units are selectively skipped. Students fill in the gaps with the words that they find necessary to restore the content of the text, and then compare the resulting version of the text with the original one. The correctness indicates an accurate understanding of the text, as well as possession of the necessary lexical material.

The compilation of the associative map schemes on various educational topics is aimed at enhancing lexical material and the self-regulation of mastery. Students are invited to independently select and group lexical units in the framework of one academic theme or speech situation, using semantic, figurative or situational associations. In carrying out this exercise, students regulate how effectively

they have mastered the relevant lexical material. In drawing up maps, non-linear structures are used, which make it possible to more clearly structure the existing lexical knowledge. Such an exercise contributes to the formation of a sustainable semantic field in the context of studying one topic, and also provides invaluable assistance during the planning and preparation stages of oral and written assignments.

II. Exercises aimed at the formation of strategies for the self-regulation of grammatical skills

A comparison of a written text with the original. The function of this type of exercise is to compare the results with a given sample. The need for the formation of this type of self-regulation is to facilitate the formation of procedural, or step-by-step, operational self-regulation.

The exercise for self-editing is built on the material of educational texts (monologues) containing language errors. Students are encouraged to emphasize errors and indicate their type. They are numbered, making a list of missing language units (Basic, Advanced, Linkers) in the original form (nouns, verbs in the form of infinitives). Then, it is recommended to postpone the exercise for a while. Returning to the exercise, students fill in the blanks, compare the resulting text with the teacher's model text and, if errors are found, to correct them themselves, and repeat the corresponding grammatical material. Diagnostic stage. The purpose of this stage is to determine the initial level of self-regulation among students. Diagnostic tasks are presented in the questionnaire "Self-regulation as a stimulus to student learning activities" (Table 1). This kind of questionnaire, as experience shows, helps students to think about how and what they learn, to realize the importance of self-regulation, without which it is impossible to organize full feedback. Formal and informal regulation by the teacher is more significant for the teacher himself. Students often passively expect marks and, having received which, they hardly think about what has been done, why they did it well or badly. Only self-regulation gives them the opportunity to reflect on their own progress and problems and find ways to change, adapt and improve. For example, if students are encouraged to check their own written work, they will achieve better results than when only the teacher checks and corrects mistakes. The questionnaire was compiled on the basis of a widely used questionnaire in the Russian pedagogical system that is used to identify the severity of self-regulation in the emotional sphere, activity and behavior (id est social self-regulation). The technique was developed by Nikiforov, Vasiliev, Firsovoy [86]. The questionnaire "Self-regulation as a stimulus to student learning activities" includes questions that reveal a tendency to self-regulation in activities (Table 1).

The severity of the tendency to self-regulation (by type and total) is determined by the number of collected points (in accordance with the scores for each answer ranging from 0 to 2). Depending on the score the respondents obtain, their level of tendency to self-regulation can be regarded as: null (from 0 to 5 points), low (from 6 to 10 points), average (from 11 to 15 points), or high (from 16 to 24 points). The criteria referring to the mentioned levels are reflected in Table 2.

Self-regulation can be carried out by keeping a diary, in which the students keep track of what was done in the lesson, what educational material was studied, and what the problems were. Based on these records, students make written reports—the information from which along with the control of academic achievement can be used for individual consultations and as an additional source to compile a general picture of the student's progress, study his needs, adjustments to the goals, content and other components of the training system. Self-editing techniques can be mentioned among self-checking techniques. However, as practice shows, it is advisable to first ask students to assess each other's work and correct mistakes in them. At the same time, they will not only learn to help fellow students, but will also return to their own essays with greater interest and begin to edit them carefully. Students also learn how to edit their own work, responding to the signals of a special code left in the margins after the teacher checks, indicating errors of one kind or another.

Table 1. The questionnaire "Self-regulation as a stimulus to student learning activities". Instructions: Read statements 1–12 and express your attitude to each of them by crossing out one of the letters.

1. If in the Received Task Something Remains Incomprehensible to Me, I:
(a) I always clarify all ambiguities before performing the task (2); (b) I do it sometimes (1); (c) I clarify the ambiguities along the way (0).
2. I check my actions while working:
(a) constantly (2); (b) from case to case (1); (c) rarely (0).
3. I like work that requires faith and precise skills:
(a) yes (2); (b) something in between (1); (c) no (0).
4. In the process of work, I try to check the correctness of its implementation:
(a) always (2); (b) from case to case (1); (c) only when I am sure that I made mistakes (0).
5. If I have doubts about whether I understood the meaning of the read text correctly, then I:
(a) once again, I reread an unclear place in the text (2); (b) I do it sometimes (1); (c) I don't attach any importance to this, move on to the next stage of work (0).
6. At the end of the work I bring my workplace in order, prepare it for the next working day:
(a) usually (2); (b) sometimes (1); (c) rarely (0).
7. I am quite a demanding person and always insist that everything is done, if possible, correctly:
(a) yes (2); (b) something in between (1); (c) no (0).
8. If, while reading the instructions, I encounter any ambiguities, then I:
(a) I do not pay attention to them, I continue to read further (0); (b) I do it sometimes (1); (c) I try to understand them (2).
9. Errors in the work performed should be corrected:
(a) only in cases if someone indicates (0) on them; (b) something in between (1); (c) I do not wait until others point to them (2).
10. When I plan my activities, I envisage time to check the work done:
(a) always (2); (b) sometimes (1); (c) rarely (0).
11. In carrying out the assignment, I am satisfied only when due attention is paid to all the details:
(a) correctly (2); (b) not sure (1); (c) wrong (0).
12. I do not start work until I am convinced that everything necessary for this is already in place:
(a) usually (2); (b) sometimes (1); (c) rarely (0).

Table 2. Criterion-level scale for determining the tendency to self-regulation.

Level	Tendency to Self-Regulation
Null	No understanding of the importance of self-regulation. Lack of ability to plan actions, program activities and behavior.
Low	Extremely limited self-regulation awareness, ability to plan activities and program behavior.
Average	Understands the importance of self-regulation, knows some constructive ways of self-regulation but cannot apply them.
High	High general level of the individual system of conscious self-regulation. Flexible and adequate response to changes in conditions and situations. Conscious nomination and goal achievement.

Questionnaires as a method of self-regulation can be aimed at identifying student-specific problems and preferences, what causes more difficulties in learning the academic discipline and what is easy, how they learn, how much time they spend studying what they can do and what they cannot do according to the academic subject being studied. Such information is necessary for them to set realistic tasks and plan their educational work. One of the possible ways to implement a systematic self-regulation and integrate it into the learning process at a higher education institution is to use a portfolio that allows you to obtain a dynamic picture of students' academic achievement. The focus is that students can produce or recall, as is usually the case with formal control (testing or passing an exam).

This stage is advisable to implement at the beginning of study. It is especially important to diagnose the level of self-regulation in the first year. Preparatory stage: The main objective of this stage is to ensure a smooth transition from the implementation of one type of regulation to another. The goal is realized with the help of the gradual complication of educational material on which the regulation action is carried out: the full mastery of educational skills.

Stage of external regulation: The purpose of this stage is to prepare for the independent implementation of one or another type of regulation, since external regulation contributes to the transition of the action of regulation from the external to the internal plan. The main tools at this stage are: checking the neighbor's notebook and joint checking with the teacher. The stage of comparison with the standard: The goal of this stage is to develop a student's ability to analyze a sample and compare his work with it and the ability to work according to the algorithm, as well as develop an abstracted attitude to his own work. The goal is achieved by the following means and methods: sequential comparison with a sample, the use of a reminder algorithm, verification of the work of a neighbor, and familiarity with the evaluation criteria.

Stage of final regulation: The goal is to teach students to check the answer/result and increase their motivation for self-regulation. The means to achieve the goal requires the introduction of the preparatory stage for the implementation of this type of regulation, the use of external regulation of the result, and joint verification with the teacher. Stage of regulation: The goal is to teach students to check not only the answer but also to monitor the progress of the learning task, and to check the individual learning activities. The means to achieve the goal are: the introduction of the preparatory phase. Stage consolidation: The goal of this stage is to automate the acquired skills. This goal is achieved through the implementation of self-regulation in all academic disciplines, as well as the continuous implementation of self-regulation on the learned educational material.

The result of the diagnosis is to determine the level of the development of self-regulation among students and its influence on the success of educational activities, which was determined by a special method (Tables 3–5).

Table 3. Criterion-level scale for determining the level of need for self-regulation.

Level	**Having a Need for Self-Test**
Striving for Self-Assessment	**Relationship to External Regulation**
Null	Self-testing is carried out only at the request of the teacher. Easily refuse their opinion.
Low	Check at the request of the teacher, sometimes on their own. Indifferent attitude.
Average	Feel the need for self-regulation, self-testing on their own initiative. Waiting for external regulation as a confirmation (rebuttal).
High	Self-check on their own initiative critical perception of the results of external regulation, the desire to understand, realize.

Table 4. Criterion-level scale for determining the level of students mastering the techniques of final, operational and predictive self-regulation.

Levels	**Mastering the Techniques of the Final, Operational and Predictive Self-Regulation**
Parameters of the Level	**Ability to Act on a Given Pattern Ability to Adhere to a Plan of Verification**
Null	Partial reproduction of the sample. The randomness of actions, impulsivity, the verification plan is carried out formally. Erroneous following of instructions. Reproduction, in which there is only a similarity of individual elements, the planning is partial.
Low	The entered action schemes are recognized; The desire to adhere to the verification plan. Reproduction with several errors (more than 1–2 mistakes), an attempt to follow the instructions in the new conditions independently. The planning is incomplete, the elements of planning are interleaved with the implementation of individual decision steps with the help of a teacher.
Average	Proper reproduction of the sample. Fully adhere to a predetermined verification plan. Reproduction with 1–2 mistakes, independent following of the instruction in new conditions. Independent item planning.
High	Actions relate to the sample.
	The plan is fully implemented. It contains its individually valid points, derived from the analysis of previous errors.
	Exact reproduction, independent following of the instruction in new conditions.
	Detailed, holistic planning.

Table 5. Criterion-level scale for determining the level of voluntary self-regulation.

Parameters of This Level Levels of Self-Regulation	**Acceptance of a Learning Task, Preservation of a Learning Task, Autonomy Concentration, Inclusion**
Null	The instruction does not assimilate. Short time is allotted when performing one task with constant guidance from an adult. Cannot concentrate. Needs external promptings.
Low	After repeated explanations. Only in a separate part of educational tasks. With frequent access to the teacher.
Average	After additional reminders. Most learning assignments. With occasional recourse to the teacher.
High	Execution from the first time. Throughout the execution of the training task. Performing without the help of a teacher.

Since the interpretation of the results of the questionnaire is a whole part of creation-level scales, we present all the scales (Tables 2–5) within one unified table. Based on the criteria given in Tables 2–5,

it is possible to determine the unified levels of self-regulation and to define the criteria and indicators (Table 6).

Table 6. Unified levels of self-regulation and their criteria.

Levels of Self-Regulation	Criteria
Null	No understanding of the importance of self-regulation. Lack of ability to plan actions and program activities and behavior. Self-testing at the request of the teacher. Erroneous following of instructions. Need for external promptings.
Low	Limited self-regulation awareness and ability of planning activities. Little self-testing on their own. Planning is incomplete. Limited following of instructions independently. Need for repeated explanations.
Average	Modest awareness of the importance of self-regulation and basic knowledge of some constructive ways of self-regulation. Necessity of external regulation for confirmation (rebuttal). Competent independent planning and following of the instruction in new conditions. Need for additional reminders from a teacher.
High	High general level of the individual system of conscious self-regulation. Independent self-check critical perception of the results of external regulation. Very good planning skills derived from the analysis of previous errors. Independent following of the instruction in new conditions. Performing without the help of a teacher.

As can be seen from the unified table, we differentiate four levels of self-regulation (from Null to High). Null level learners essentially have no ability to regulate the learning process independently. Students with low levels of self-regulation have extremely limited abilities of self-regulation. Average level of self-regulation refers to those who are quite competent in self-regulation. High level of self-regulation describes a very good ability of conscious self-regulation.

The following methods were used for expert data processing: methods of mathematical statistics and the Microsoft Office Excel program.

We note the positive dynamics of the formation of self-regulation among students of experimental groups in comparison with students of control groups. The result of our experimental study was the determination of the level of student performance. To determine this, we used the method of expert evaluation. The experts were teachers who worked in the control and experimental groups. They proposed a scheme for assessing the success of academic activities in an academic discipline. Experts evaluated each student according to the proposed scheme. We have divided the levels of success in the educational activities of students at the end of the academic semester in two levels: low and high. When processing the experimental data, we used two parameters: student self-regulation and academic performance. Applying the F-test, we found that there is a significant difference in experimental groups between the level of self-regulation at the initial stage and final stage of the experiment for 1st-Year and 2nd-Year students.

Thus, the data obtained indicate a more significant formation of self-regulation in experimental groups than in control groups, and an increase in the level of success of educational activities. The higher the level of self-regulation development of a student, the higher the level of success of his educational activity. This fact proves the effectiveness of the formulated pedagogical conditions for the development of self-regulation among students in terms of the competence-based approach. The experimental work carried out by us confirmed the initially put forward assumption and showed the general didactic significance of the implementation of the results into practical activity. However, it does not exhaust the entirety of the problem under study.

3. Results

The result of the implementation of the learning experiment and the model of the formation of self-regulation among students was the methodological development of the technology of self-regulation of students. The main objectives of the technology are: shaping the needs of students in the implementation of self-regulation through tracking their learning activities and their results; enrichment of knowledge about self-regulation; training on the implementation of testing on the finished sample; the development of the ability of students to detect errors in the actions of their comrades, the development of independence and self-organization; increased cognitive interest.

The results of oral and written surveys for each student were determined on the basis of an expert assessment of teachers, by a methodologist according to previously established indicators, and entered into the observation map in the form of an equivalent level: zero, low, medium, high. Based on individual observation cards that were filled during the academic semester, summary maps of the level of self-regulation development were compiled. The assessment of the level of self-regulation development in each student was carried out according to three criteria: the need for self-control; possession of methods of final, operational and predictive self-control; arbitrary self-control.

The initial part of determining the level of development of self-regulation among students was carried out at the beginning of the first semester of the first year and the second year of study. In the first semester *of the first year and the second year of study, respectively, intermediate and final sections were made.* The state of the level of self-regulation at the beginning, in the middle and at the end of the experiment is presented in Tables 7–9.

Table 7. Comparative dynamics of changes in the level of the formation of self-regulation among students (in % of the total number of students). (Initial Stage of the Experiment, Control and Experimental Group).

	Initial Stage of the Experiment		
	Low Level of Self-Regulation	**Average Level of Self-Regulation**	**High Level of Self-Regulation**
Control Group			
1st-Year Students	**14%**	**77%**	**9%**
2nd-Year Students	**7%**	**75%**	**18%**
Experimental Group			
1st-Year Students	**26%**	**67.5%**	**6.5%**
2nd-Year Students	**23%**	**64%**	**13%**

Table 8. Comparative dynamics of changes in the level of the formation of self-regulation among students (in% of the total number of students). (Intermediate Stage of the Experiment, Control and Experimental Group).

	Intermediate Stage of the Experiment		
	Low Level of Self-Regulation	**Average Level of Self-Regulation**	**High Level of Self-Regulation**
Control Group			
1st-Year Students	**10%**	**77%**	**13%**
2nd-Year Students	**4%**	**76%**	**20%**
Experimental Group			
1st-Year Students	**16%**	**66.5%**	**17.5%**
2nd-Year Students	**7%**	**74%**	**19%**

Table 9. Comparative dynamics of changes in the level of formation of self-regulation among students (in% of the total number of students). (Final Stage of the Experiment, Control and Experimental Group).

	Final Stage of the Experiment		
	Low Level of Self-Regulation	**Average Level of Self-Regulation**	**High Level of Self-Regulation**
Control Group			
1st-Year Students	**7%**	**78%**	**15%**
2nd-Year Students	**3%**	**76%**	**21%**
Experimental Group			
1st-Year Students	**5%**	**71.5%**	**23.5%**
2nd-Year Students	**4%**	**71%**	**25%**

The features of students' self-regulation in modern conditions of educational activity (emotional and volitional components) are determined. In subjects, the indicators for exercising regulation over one's own emotional state (state of health, activity, mood) in conditions of monotony and time constraints decrease. The willful component of students' self-regulation is characterized by weak attentional stability, deterioration of speed and quality of actions. The students recorded a low incidence of self-regulation actions aimed at achieving productive learning outcomes. However, most of the students believe that self-regulation skills play a vital role or are extremely important in the job of an engineer.

For the interpretation of the results of the questionnaire identifying the level of self-regulation, the maximum number of points is 24. Criteria for the interpretation of questionnaire results: 1–10 points (0–40%)—low level of self-regulation in activities; 11–19 points (41–80%)—the average level of self-regulation in activities; 20–24 points (81–100%)—a high level of self-regulation in activities. The average values of the level of self-regulation in activities: 1st-year students—15.1 points; 2nd-year students—15.9 points. The average level of self-regulation indicates a moderate tendency to clarify ambiguities before performing any task and to check the correctness of their actions in the process of work, as well as after its completion.

At the initial stage of the experiment, the percentage of 1st-Year students with a low level of self-regulation was 14% in the control group and 26% in the experimental group. The percentage of 2nd-Year students with a low level of self-regulation was 7% in the control group and 23% in the experimental group. The percentage of 1st-Year students with an average level of self-regulation was 77% in the control group and 67.5% in the experimental group. The percentage of 2nd-Year students with an average level of self-regulation was 75% in the control group and 64% in the experimental group. The percentage of 1st-Year students with a high level of self-regulation was 9% in the control group and 6.5% in the experimental group. The percentage of 2nd-Year students with a high level of self-regulation was 18% in the control group and 13% in the experimental group. Data are presented in Table 7.

At the intermediate stage of the experiment, the level of student self-regulation increased compared to the initial stage. The percentage of 1st-Year students with a low level of self-regulation was 10% in the control group and 16% in the experimental group. The percentage of 2nd-Year students with a low level of self-regulation was 4% in the control group and 7% in the experimental group. The percentage of 1st-Year students with an average level of self-regulation was 77% in the control group and 66.5% in the experimental group. The percentage of 2nd-Year students with an average level of self-regulation was 76% in the control group and 74% in the experimental group. The percentage of 1st-Year students with a high level of self-regulation was 13% in the control group and 17.5% in the experimental group. The percentage of 2nd-Year students with a high level of self-regulation was 20% in the control group and 19% in the experimental group. Data are presented in Table 8.

At the final stage of the experiment, the level of student self-regulation increased compared to the intermediate stage. The percentage of 1st-Year students with a low level of self-regulation was 7% in the control group and 5% in the experimental group. The percentage of 2nd-Year students with a low

level of self-regulation was 3% in the control group and 4% in the experimental group. The percentage of 1st-Year students with an average level of self-regulation was 78% in the control group and 71.5% in the experimental group. The percentage of 2nd-Year students with an average level of self-regulation was 76% in the control group and 71% in the experimental group. The percentage of 1st-Year students with a high level of self-regulation was 15% in the control group and 23.5% in the experimental group. The percentage of 2nd-Year students with a high level of self-regulation was 21% in the control group and 25% in the experimental group. Data are presented in Table 9.

During the experiment, there was an increase in the number of students who reached a high level of self-regulation, with an average of 4% in the control groups and 14% in the experimental groups. The number of students with a low level of self-regulation decreased on average by 5% of the total number in the control groups and by 20% in the experimental groups. The number of students who reached the average level increased on average by 1% of the total number in the control groups and by 5% in the experimental groups. Comparing the data obtained, we note the positive dynamics of the development of self-regulation among students of experimental groups in comparison with students of control groups.

The F-test was performed to determine whether the data meet the analytic criteria. In the control groups, there is no significant difference between the level of self-regulation at the initial stage and final stage of the experiment for 1st-Year students ($\phi^* = 1.55$, $a = 0.01$) and 2nd-Year students ($\phi^* = 0.27$, $a = 0.01$). There is significant difference in experimental groups between the level of self-regulation at the initial stage and final stage of the experiment for 1st-Year students ($\phi^* = 2.44$, $a = 0.01$) and 2nd-Year students ($\phi^* = 2.39$, $a = 0.01$).

4. Discussion

The self-regulation of a student is manifested in his action by comparing, correlating his own ideas about the upcoming action—the action being performed with the preliminary algorithm (preliminary sample). It consists of a comparison, a correlation of the actions performed with the sample, and with the requirements. According to the data of the experiment, the students demonstrated the following features of self-regulation: low motivation for its implementation; low rates of self-regulation; violation of all components of self-regulation (external regulation, benchmarking, final and step-by-step regulation); the impossibility of self-mastery of self-regulation. In addition to these features, it should be noted that as the training tasks become more complex, students' self-regulation moves independently to a qualitatively higher level. Thus, carrying out the regulation actions on the learned material, students can independently apply them in solving new educational problems.

Both checking and self-checking should be carried out according to a certain system. Even a careful general inspection and analysis does not allow identifying all errors and systematizing them. To speed up the self-examination of work in the classroom, under the guidance of a teacher, an algorithm is developed for checking the work, using which students find and eliminate errors in their work. The algorithm makes it possible for each student to think about the result of his activity and is designed to systematize independent cognitive activities to verify educational work, so that students have a well-structured structure that will help not only to verify educational work, but also to make correct, rational decisions during their execution.

For the development of independent activities, it is necessary to take into account not only the psychological climate in the classroom, but also the psychological impact of the audit of students' educational work. It is very important to tactfully comment on students' work. It is important to point out not only poorly performed work and to talk about shortcomings, but also to note the successes of poorly performing students, to instill in them confidence in their abilities, and also to skillfully use praise for good performance. Moral support is a stimulating factor for achieving positive results in the academic discipline. The operation verification algorithm is compiled for each section separately, noting the control positions that should be checked.

The results of the experiment show a low level of the development of self-regulation among a large number of students. Even among the students completing training in the first year, a small number of students with a high level of self-regulation in learning activities were identified. We see the reason for this phenomenon in that regulation as a component of learning activities is carried out by the teacher, and the student is largely freed from the need to independently regulate and evaluate due to lack of motivation. Studies indicate that teachers play a crucial role in promoting self-regulated learning (SRL), as teachers' own self-regulatory competences is seen as a critical determinant of SRL implementation. Self-regulated teachers attune their instructional approach to their own SRL skills, better understand SRL processes and become more effective in SRL promotion [87]. The study proves the need for purposeful formation of self-regulation among students, taking into account the modern social and educational order. Consequently, there is an acute problem of developing the technology of the formation of self-regulation in the educational process among students.

The results of the experiment determined the need for purposeful work on the development of self-regulation among students in the process of learning at the university. The organization of experimental work was based on the psychological and pedagogical features of the development of students' self-regulation. In accordance with this, we have identified the following main areas of the learning experiment: the training of teachers to implement the conditions for the development of self-regulation among students; the rationale for students of the need to develop self-regulation as a factor in the success of learning activities; the formation of a positive motivation for self-regulation among students. To implement the chosen direction of work, the course "Developing self-regulation among students in the learning process" was developed and conducted. The objectives of this course were: the formation of a holistic view of the essence and psychological characteristics of students' self-regulation as a property of the subject; creation of pedagogical conditions for the development of self-regulation. The work took place simultaneously on three levels: theoretical, practical and technological.

According to the results obtained on the basis of two series of training tasks (the first aimed at determining the state of ability to compare with the standard, the second aimed at determining the level of formation of the skill of the final and step-by-step regulation), it can be concluded that the state of students' learning skills improved due to the use of self-regulation technology. Students have become more consistent in the performance of educational tasks; they paid more attention not only to the result, but also to intermediate actions. In addition, students with less difficulty carried out a sample analysis and successfully compared their work with it. The need to assist the teacher in performing assignments has decreased, students have become more independent not only when checking, but also when performing exercises. As a result of the use of the technology of the formation of self-regulation, students have increased their motivation to exercise self-regulation. It should be noted that the students in the process of applying the technology carried out the transfer of learned methods and techniques of regulation to new situations (they checked their readiness for class and a classmate, etc.). Thus, the data obtained in the course of the regulation experiment represent significant differences in the ability to exercise self-regulation by students after conducting experimental training.

We imply that it is necessary, firstly, to make self-regulation an integral part of the educational process, including through integration with the tasks performed in the classroom; secondly, to prepare students for its systematic implementation and to link with other types of control; thirdly, to refuse to make their own marks and thus eliminate unhealthy competition between them, to help students concentrate on their own activities and personal progress. The latter is of particular relevance for groups of students with varying degrees of learning a foreign language.

5. Limitations of the Present Study and Suggestions for Future Research

The key characteristics of the pedagogical experiment are its reliability and validity. We based our research on scientific literature [88–90] that formulates general recommendations to ensure the necessity and sufficiency of the sample: (1) when comparing the two groups of research subjects,

their total number should be at least 50 people; (2) to reduce the statistical error in the processing of data, the number of participants in each group should range from 30 to 35; (3) the number of subjects in the groups should be approximately the same; (4) the higher the variability of the investigated property, the larger the sample size should be. If the use of correlation analysis is planned for the processing of empirical data, the sample size should be at least 30–35 people. The larger the sample size, the lower the value of the correlation coefficient, which is considered reliable. Significance at the level of reliability 95% ($p = 0.05$) correlation coefficient can be considered when the sample size is of more than 35 people. The Glivenko–Cantelli theorem holds true for the sample size: the sample distribution function converges to its theoretical counterpart when the sample size increases; that is, the larger the sample size, the more accurate the results. The question of sufficient sample size is solved by determining the totality of all possible subjects to which the results of the pedagogical experiment are potentially applicable. Methods of sample size calculation include: arbitrary method—200–500 subjects; classical method—the sample size at the level of 2–10 % of the totality; statistical method—the sample is representative if it describes the characteristics of the population with the minimum allowable error.

The subject of our study, hypotheses and short deadlines make it reasonable to use a quota sample. Its essence is to build a micromodel of the object, showing the signs that are included in the subject of our analysis. To determine the opinions and moods of all the five hundred people we are interested in, we can examine one-half, one-third, one-fourth, and even only 10% of them. However, it is necessary that the level of training of the interviewed students represents and adequately expresses the level of the majority. In our study, the sample is random. The experiment was conducted in the first two courses with the example of the foreign language discipline. In similar studies, the sample is 21 [91]. In studies that involve 200+ people in a larger-scale experiment [92], students are usually from different universities or represent all the students from the same university, studied in the context of different disciplines. Our future research will be aimed at the study of the formation of self-regulation within the groups of students studying different disciplines. We will also focus on the implementation of the research findings into the learning programs of other humanitarian disciplines.

6. Conclusions

On the basis of the study, it is concluded that students in modern educational conditions experience difficulties in exercising emotional and volitional self-regulation. The results obtained are of practical importance for psychologists and teachers in the development and implementation of programs for the psychological support of students in the higher education system, the definition and testing of technologies for the formation of self-regulation. Further areas of study of the problem of self-regulation are associated with the identification of methods of the formation of self-regulation among students in an educational process using computer technology. It was also concluded that the formation of students' self-regulation should be carried out purposefully, in stages, taking into account an integrated approach, since self-regulation is a universal competence. The study showed that the content-structural mechanism of the self-regulation of students includes the presence of a motive, a plan; execution (realization) of educational actions, self-diagnostics of personal qualities achieved by them; assessment, turning into self-esteem; manifestations of will, autonomy and initiative in the performance of academic duties; control, turning into self-control; self-understanding of temporal relations, sequence, duration, pace and rhythm of academic work, self-assessment of the temporal characteristics of various processes and events, preferences in their organization; constant self-observation of their behavior in educational communication and training activities, as well as self-reports on what has been done, what has been achieved, self-correction and the definition of boundaries for future development. Thus, the proposed technology of self-regulation and the complex of training tasks have a positive effect on the formation of students' self-regulation and have a corrective effect on students' learning activities.

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