

USO DE FEEDBACK APRIMORADO EM UM CURSO DE APRENDIZAGEM ELETRÔNICA
"FUNDAMENTOS DE FÍSICA MOLECULAR E TERMODINÂMICA"USE OF ENHANCED FEEDBACK IN AN ELECTRONIC LEARNING COURSE
"FUNDAMENTALS OF MOLECULAR PHYSICS AND THERMODYNAMICS"ИСПОЛЬЗОВАНИЕ РАСШИРЕННОЙ ОБРАТНОЙ СВЯЗИ В ЭЛЕКТРОННОМ
УЧЕБНОМ КУРСЕ «ОСНОВЫ МОЛЕКУЛЯРНОЙ ФИЗИКИ И ТЕРМОДИНАМИКИ»OREKHOVA, Yelena Yurievna¹; SYSOEV, Sergey Mickhailovich²; ALEKSEEV, Maxim Mickhailovich³¹ Department of Foreign Languages, Surgut State University, Surgut, Russia^{2,3} Department of Experimental Physics, Surgut State University, Surgut, Russia* Correspondence author
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RESUMO

Introdução: Por ser uma parte essencial do processo educacional de aprendizado híbrido, ainda existem alguns problemas no que diz respeito à interação entre professores e alunos. Eles incluem uma diminuição no nível de conhecimento e no número de graduados, pois os alunos experimentam falta de comunicação ao vivo com o professor, falta de experiência suficiente de trabalho independente, falta de avaliação interativa. **Objetivo:** Este estudo teve como objetivo elaborar o modelo de feedback aprimorado em um curso de e-learning "Fundamentos de Física Molecular e Termodinâmica" para aumentar o desempenho educacional dos alunos. **Métodos:** A eficácia do modelo de feedback aprimorado no processo de aprendizagem foi medida com a metodologia de cálculo de indicadores estatísticos da qualidade da educação: qualidade do conhecimento, nível de proficiência dos alunos, progresso e nota média. Para medir a atitude emocional e avaliativa dos alunos em relação às atividades educacionais e a interação com o professor em um curso eletrônico, foi utilizado um questionário-teste de satisfação com a atividade de aprendizagem. **Resultados e Discussão:** os resultados do controle inicial e final dos indicadores estatísticos da qualidade da educação incluindo qualidade do conhecimento, nível de proficiência dos alunos, progresso e nota média dos alunos mostraram uma diferença significativa entre os grupos controle e experimental. No final do semestre, a diferença na qualidade do conhecimento era de 23%, nível de proficiência do aluno - 13%, progresso - 3,5%, nota média - 0,6 notas. A análise da satisfação dos alunos com o processo de aprendizagem também confirma um aumento no nível de satisfação com o processo de aprendizagem e com a interação com o docente. Assim, a metodologia experimental contribui para uma melhoria significativa nos resultados do processo de aprendizagem. **Conclusões:** O experimento demonstrou que substituir a avaliação formativa pelo modelo de feedback aprimorado aumenta as realizações educacionais dos alunos e compensa a falta de comunicação ao vivo com o professor.

Palavras-chave: *educação a distância, aprendizado híbrido, curso e-learning, feedback pedagógico, física.*

ABSTRACT

Background: Being an essential part of the educational process, blended learning still faces some problems concerning the interaction between teachers and students. They include a decrease in the level of knowledge and in the number of graduates as students experience a lack of live communication with the teacher, lack of sufficient experience of independent work, lack of interactive assessment. **Aim:** This study aimed to elaborate the model of enhanced feedback in an e-learning course, "Fundamentals of Molecular Physics and Thermodynamics," to increase student educational achievements. **Methods:** The effectiveness of the model of enhanced feedback in the learning process was measured with the methodology for calculating statistical indicators of the quality of education: knowledge quality, level of student proficiency, progress, and average grade. To measure the emotional and evaluative attitude of students to educational activities and interaction with the teacher in an electronic course, a test-questionnaire satisfaction with learning activity was employed. **Results and Discussion:** the results of the initial and final control of the statistical indicators of the quality of education including knowledge quality, level of student proficiency, progress, and average grade in students showed a significant difference between the control and the experimental groups. At the end of the semester, the difference

in knowledge quality was 23%, student proficiency level – 13%, progress – 3.5%, average grade – 0.6 scores. The analysis of student satisfaction with the learning process also confirms an increase in satisfaction with the learning process and with the interaction with the lecturer. Thus, the experimental methodology contributes to a significant improvement in the learning process results. **Conclusions:** The experiment demonstrated that replacing formative assessment with the model of enhanced feedback raises student educational achievements and compensates for lack of live communication with the teacher.

Keywords: *distance learning, blended learning, e-learning course, pedagogical feedback, physics.*

АННОТАЦИЯ

Введение: Являясь неотъемлемой частью образовательного процесса, смешанное обучение до сих пор сталкивается с некоторыми проблемами, касающимися взаимодействия между преподавателями и обучающимися. К ним относятся снижение уровня знаний и количества выпускников, так как студенты испытывают недостаток живого общения с преподавателем, отсутствие достаточного опыта самостоятельной работы, отсутствие интерактивного оценивания. **Цель:** данное исследование было направлено на разработку модели расширенной обратной связи в электронном учебном курсе "Основы молекулярной физики и термодинамики" для повышения образовательных достижений студентов. **Методы:** Эффективность модели усиленной обратной связи в учебном процессе измерялась с помощью методики расчета статистических показателей качества образования: качество знаний, уровень подготовки студентов, успеваемость, средний балл. Для измерения эмоционально-оценочного отношения студентов к учебной деятельности и взаимодействию с преподавателем в электронном курсе использовался тест-опросник удовлетворенности учебной деятельностью. **Результаты и обсуждение:** результаты исходного и итогового контроля статистических показателей качества образования, включая качество знаний, уровень подготовки студентов, успеваемость и средний балл студентов, показали значительную разницу между контрольной и экспериментальной группами. По итогам семестра разница в качестве знаний составила 23%, уровне знаний студентов - 13%, успеваемости - 3,5%, средней оценке - 0,6 балла. Анализ удовлетворенности студентов процессом обучения также подтверждает повышение уровня удовлетворенности процессом обучения и взаимодействием с преподавателем. Таким образом, экспериментальная методика способствует значительному улучшению результатов учебного процесса. **Выводы.** Эксперимент показал, что замена формального оценивания моделью с расширенной обратной связи повышает учебные достижения студентов и компенсирует отсутствие живого общения с учителем.

Ключевые слова: *онлайн-обучение, смешанное обучение, оценивание, педагогическая обратная связь, физики.*

1. INTRODUCTION:

In 2019 - 2020 Coronavirus crisis (COVID-19) affected peoples' lives in the whole world. It is not a secret that the education system was reorganized and modified to survive and provide students with the opportunity to master the learning material and get consulting support from teachers. In the territory of the Russian Federation in connection with the spread of new coronavirus infection, all educational institutions shifted to blended or distance learning to ensure continuity in teaching (Decree of the President of the Russian Federation of 02.04.2020 N 239 "On measures to ensure the sanitary and epidemiological well-being of the population). Therefore, the shift from traditional to blended or distance learning was necessary. Still, it was real due to digitalization as many educational institutions actively use modern information and communication technologies in teaching.

Over the last decade, distance learning has experienced many developments in the

teaching and learning process (Simonson, M., 2012). While these changes in distance education have taken place, different definitions of distance education have been put forward. According to R. Koper, distance education is the education given remotely using media tools (Koper, 2014). Researchers L.A. Schlosser and M. Simonson define distance education as an institution-based formal education in which educational resources and tutorials are brought together by using telecommunication tools of learners in different places (Schlosser, and Simonson, 2009). K. Lee describes distance education as bringing together students and teachers in separate spaces by using media (Lee, K., 2017). In B. Gökbulut's (2020) opinion, distance education is the teaching model where teaching is carried out in online environments through technology products; learners and teachers are not in the same environment.

In contrast to distance learning, blended learning is an instructional design structure that facilitates the benefits of technology, paired with

face-to-face instruction, to address the variance in student learning (Yang, S., Carter, R.A., Zhang, L., Hunt, T, 2021). According to K Berga, E Vadnais, J Nelson, R Hu, B Olaiya (2021), blended learning integrates face-to-face and online instructions. The researchers believe that there is no significant difference in knowledge between the blended online and face-to-face groups.

One of the most popular and widely used educational tools in the distance and blended education is an electronic learning resource (e-learning resource) or an electronic learning course (Makhmutova, Senicheva, Akimova, 2019).

An electronic learning course is an independent ready-made information product, which contains information in electronic form, information technologies are used to transform and store information used in the educational process to meet user requirements (Kurvaeva, Gavrilova, Mahmutova, Chichilanova, Povituhin, 2018). It should provide study, review, and reteaching of the educational material; self-examination using the assessment part (tests, final questions); carrying out intermediate control - passing the test. The structure of the electronic educational course includes training modules with theoretical material; practical tasks to complete; applications containing teaching materials; tests for monitoring; final tests (Chusavitina, Davletkireyeva, *et al.*, 2017).

Nevertheless, some students are not psychologically prepared for e-learning courses. They experience difficulties due to lack of live communication with the teacher, insufficient experience of independent work with educational material and self-organization; and low preparation for working in an electronic environment and mastering a new course. Furthermore, working at a distance, lecturers do not contact a student in person and cannot track his/her problems and difficulties arising in the course of learning (Gökbulut, 2020). Therefore, new approaches in organizing the effective interaction "lecturer - student" in the educational process within an electronic course are needed.

The issue of assessment and control in the distance and blended learning has been studied in different scientific and methodological works (Jacques, Ouahabi, Lequeu, 2021; Jiang, Wu, Cheng, Wang, Xie, Fitzgerald, 2021). According to A.A. Korenev, the main functions of control are evaluating and motivating, and, thus, the question of the effectiveness of assessment procedures arises. To achieve these goals, the teacher needs to communicate to the student information on the

assessment results. In contrast, in this case, the assessment means the final and intermediate and continuous control (Korenev, 2018).

One way to solve this problem is to use a model of enhanced feedback in e-learning regular university courses (Fishman, 1994; Mabrito, 2004; Hattie, Timperley, 2007). Thus the study aims to elaborate the model of enhanced feedback in an e-learning course, "Fundamentals of Molecular Physics and Thermodynamics," to increase student educational achievements.

2. MATERIALS AND METHODS:

The research hypothesis is that enhanced feedback in an e-learning course, "Fundamentals of Molecular Physics and Thermodynamics," increases student educational achievements.

2.1. Participants

This research was conducted at Surgut State University in Surgut, Khanty-Mansi Autonomous Okrug – Yugra, Russia. The study included 49 students (9 female and 40 male aged 19 - 23) of the three courses and the lecturers of the Department of Experimental Physics of the Polytechnic Institute of Surgut State University. The selection of the students and the lecturers was based on the initiative of the lecturers of the Department of Experimental Physics to elaborate the model, implement it in the ready-made e-learning course and analyze the results.

2.2. Study Design

The research design was carried out with an experimental study including three stages: the initial stage, the experimental stage, data collection, and the final stage.

2.3. Experimental procedures

The first stage was to search and select the relevant literature sources, analyze and compare different scientists' approaches to the concept of blended learning, electronic course, and pedagogical feedback; to generalize the ideas of researchers on the characteristics, types, criteria of effective feedback. The analysis of scientific articles was carried out in electronic databases Web of Science, Scopus, E-library. The selection of the researched articles was based on the theme and keywords identity. Over 100 articles were chosen for primary analysis, and 40 were selected for further analysis. Most studies were written in English and about 10 were written in Russian as

the problem of feedback has been of great interest to Russian researchers. The period of searching the articles included several stages: identifying the aim and the hypothesis of the research; developing study design; selecting the scientific articles by keywords, journal ranking, scientific novelty.

The second stage included a pedagogical experiment with steps carried out within the real educational process. The purpose of the experiment was to test, obtain the data required, analyze the results of the implementation of the model in student groups and confirm or reject the hypothesis. The study included experimental and control groups. The conditions and content of the educational program in both student groups were identical, except for using different post-lecture tasks.

The experiment was conducted during one semester. In the first two months, the student groups had no difference in the course elements (post-lecture tasks aimed to check the understanding of lecture material given in the e-learning course "Fundamentals of Molecular Physics and Thermodynamics"). In two months, in the middle of the experiment, both groups studied four lectures ("The basic equation of molecular-kinetic theory", "Maxwell distribution. Boltzmann distribution", "Transference phenomena", "First Beginning of Thermodynamics"), passed four tests and performed the lab works. After that, the statistical indicators of the quality of education (Simonov, 1999) such as knowledge quality, level of student proficiency, progress, average grade were measured. To study the emotional and evaluative attitude of students to educational activities and interaction with the teacher in an electronic course on the open-source learning management system (LMS) Moodle, a closed-ended questionnaire satisfaction with learning activity by L.V. Mishchenko was employed (Appendix 1) (2007).

The experimental group studying the electronic course did the post-lecture tasks with enhanced feedback in the next two months. Enhanced feedback showed the students both the results of their work and feedback about the task, processing of the task, and self-regulation (comments, recommendations, suggestive questions, explanations, references) answering three major questions of effective feedback: Where am I going? How am I going? Where to next? The results of the fulfillment of the tasks by the students of experimental and control groups

were analyzed and compared throughout the experiment.

In the second part of the experiment, the students of both groups studied four next lectures ("Second Beginning of Thermodynamics. Circular processes", "Real Gases", "States of matter", "Quantum statistics and their applications"), passed four tests and performed the lab works. At the end of the course (in 4 months), the statistical indicators of the quality of education and the emotional and evaluative attitude of students to educational activities and interaction with the teacher in an electronic course were measured for the second time.

2.4. Data Collection

To determine whether the model of enhanced feedback in the e-learning course "Fundamentals of Molecular Physics and Thermodynamics" was effective or not, the statistical indicators of the quality of education such as knowledge quality, level of student proficiency, progress, average grade were measured and analyzed.

To measure the emotional and evaluative attitude of students to educational activities and interaction with the teacher in an electronic course a closed-ended questionnaire by L.V. Mishchenko was used. The test included 26 emotional-evaluative statements and suggested answers. The research was conducted individually and anonymously. The student could either agree or reject the statement with varying degrees of confidence. The following forms of responses were proposed: "True"; "Perhaps it is true"; "Perhaps it is not true"; "Wrong".

2.5. Statistical Analysis

In this study, such methods of statistical analysis as statistical observation, summary, grouping, and analysis of data, presentation of statistical material were used. Calculation of the average value of the quality of knowledge, student proficiency, progress, and average grade was automatically carried out in the Excel program. To process the results of the Test-questionnaire satisfaction with learning activity, the key was used, which was compared with the answers of the examinee. Each answer was evaluated using a four-point system.

3. RESULTS AND DISCUSSION:

3.1. Literature review

3.1.1 Feedback

In science, the feedback has been attracting the attention of many foreign and Russian researchers (Thorndike, 1931; Skinner, 1961; Fishman, 1994; Besspalko, 2002). K. A. Bessonov considers feedback to be one of the leading mechanisms in the process of the formation of personality self-awareness. It is a means that provides an individual with the opportunity to build a relationship with himself, relying on ideas about himself from others. For example, in organizations, people constantly communicate and therefore provide feedback (Bessonov, 2016).

Scientific research confirms that feedback is an essential prerequisite for an effective learning process (Korenev, 2018). Therefore, the role of feedback in education, particularly in distance and blended learning, cannot be underestimated as it promotes student learning (Black, Lee, Harrison, Marshall, 2004).

According to O. D. Luk'yanenko (2007), feedback is a message to teachers about what of their work did help them to achieve certain standards, and what, on the contrary, did not help. Feedback helps make a plan to prevent repeating mistakes and stimulate progress. If someone has not reached the standard, this is not a reason for criticism. It is necessary to understand the reasons and understand what a student needs to do to complete the task correctly. Thus, learning and development can take place through feedback.

In J. Hattie and H. Timperley's opinion (2007), feedback is a gift. The teacher/lecturer who gives feedback should be happy because he provides the recipient with a chance to get better. A British scientist Reg Revans (2011) wrote that people could not learn from actions as they are. An orderly feedback system is needed.

In pedagogy, feedback has traditionally been associated primarily with the processes of assessment and control. However, at present in the works of foreign authors (Black, Lee, Harrison, Marshall, 2004) the term "assessment for learning" is often used, which, according to A.A. Korenev, can be contrasted with the traditional "assessment of learning". "Assessment for learning" includes increased attention to the teaching function of control, attention to non-standardized forms of control, detailed study of the external validity of assessment procedures, and the positive and negative effects that assessment can have on learning (feedback effect of assessment) (Korenev, 2018). Of course, in this regard, much attention is paid to student understanding of the structure, goals, format, and criteria of

assessment and the pedagogical feedback they receive in the process and as a result of control.

The importance of quick and informative feedback is discussed in the issue "On Formative Control and Informative Feedback in Course Design" (Maksimenkova, Neznanov, Podbelsky 2014). The authors consider feedback in the context of the teacher's professional and communicative competencies related to monitoring, improving the quality of education, and assessment.

The analysis of the Russian regulatory documents, professional standard "Educator" in particular, showed that providing high-quality pedagogical feedback is not reflected in the documents. In the professional standard "Educator" (Order of the Ministry of Labor of Russia of 10/18/2013 N 544n, 2014) "On the approval of the professional standard "Educator" among the target skills, one can see the ability to "objectively assess the knowledge of students based on testing and other control methods following the real educational abilities of children" and "to carry out control and evaluation activities in the educational process", but there is no information about how the data obtained in the course of this control and evaluation activity should be communicated to students and used to improve the effectiveness of the educational process. Thus, there is a serious shift in focus in the assessment process from the student personality to the formal assessment of the quality of the educational process and about the insufficient reflection of the teaching and motivating control functions.

3.1.2 Pedagogical feedback

In science, understanding of the concept "feedback" is associated from the outset with the biological and psychological foundations of pedagogy and appeared in the era of behaviorism at the beginning of the 20th century.

John Broadus Watson (1914) was one of the first to use the concept of feedback in its biological sense in 1914. The scientist identified two forms of feedback: punishment or satisfaction of a need.

After that in 1931, Edward Lee Thorndike (1931) studied feedback through the prism of the "Law of Effect". According to the researcher, when the reaction is followed by a reward or a state of satisfaction, its recurrence rate increases, and when a reaction causes harmful or unpleasant consequences, its recurrence rate decreases. In E. Thorndike's opinion, positive feedback has the

strongest stimulating potential, negative feedback has less stimulating potential, and the absence of feedback has the least stimulating potential.

Subsequently, the behavioristic understanding of feedback was developed in the works of Burrhus Frederic Skinner (1961). The researcher wrote that behavior was influenced by the consequences depending on the result and introduced the terms "positive" and "negative" reinforcement. He also wrote about the need for an "urgency of reinforcement," which must occur synchronously with the desired behavior.

W.C. Estes (1967) highlighted the motivational and informational components of reinforcement. The motivational component refers to the source of support and its perception as bringing joy or suffering. In contrast, the informational component is aimed to determine the correctness or incorrectness of the answer.

J. Bruner (1961) linked the concept of "feedback" with assessment and control. He considered assessment to be one of the three aspects of learning. The scientist understood the feedback as input information that informs the student about how adequately his understanding reflects the world around him.

Scientists B. Eaves and P. Shafto (2012) note that a sincere, substantive, and open dialogue allows one to achieve a high level of epistemic trust between a teacher and a student. It is possible when two important parameters of the informant are fulfilled: truthful knowledge about the subject (or about the world) and the ability to be useful to the informed student.

Based on some of the opinions mentioned above, it can be concluded that pedagogical feedback is an integral part of pedagogical communication, which affects the student awareness of their educational achievements and mistakes, the student relationship with the teacher, and motivation for learning. It is effective due to the teacher's professional competence and desire to be useful to the student.

3.1.3 Typology of pedagogical feedback

The analysis of the number of studies related to the typology of pedagogical feedback in the works of foreign and Russian authors (Kulik, Kulik, 1988; Hattie, Timperley, 2007; Lukyanenko 2007; Eaves, Shafto, 2012; Korenev, 2018) resulted in grouping various types of feedback in the unified typology of pedagogical feedback. Thus, based on Table 1, the typology of pedagogical feedback includes eight classification

characteristics that classify feedback in several types.

Table 1. Typology of pedagogical feedback

An electronic regular university resource, being a part of the main course in blended learning, is expected to include feedback elements in all course assessment tasks. According to the data presented in Table 1, the following types of pedagogical feedback are typical for electronic courses: before/after the lesson feedback; feedback to the student; external/internal feedback; written feedback; personal/indirect feedback; short/expanded feedback; delayed feedback; positive/instructive feedback. However, based on data from the interviews with the students of the three courses of the Polytechnic Institute of Surgut State University, 1) the assessment methods that teachers use are not always effective in promoting good learning, 2) grading practices tend to emphasize control and competition rather - than personal improvement, and 3) assessment feedback sometimes needs positive impact, particularly on low-achieving students.

3.1.4 Criteria of effective feedback

An assessment can show if lecturers and their students are given relevant information that can be used as feedback in self-assessment assessing each other; and in altering the teaching and learning activities lecturers and learners are engaged in (Black, Lee, Harrison, Marshall, 2004).

P.J. Black, C. Lee, Ch. Harrison, and B. Marshall believe that an optimal education environment or best practices occur when both teachers and learners try to find answers to the three major questions of effective feedback: "Where am I going? How am I going? Where to next? These questions correspond to notions of feed up, feedback, and feedforward". Thus, the purpose of effective feedback is to reduce discrepancies between current understandings and performance and a goal (Black, Lee, Harrison, Marshall, 2004).

1). Where am I going? (What are the goals?). Goals may relate to specific achievements or understandings or different qualities of experience. Goals typically involve two dimensions: challenge and commitment. Challenging goals relate to feedback in two major ways. First, they inform students what type or level of performance they should strive for activity and achievements. Second, reasonable goals are set

through feedback, and progress towards achieving them is tracked (Hattie and Timperley, 2007, p. 87).

Secondly, having received feedback, students (and/or their lecturers) can set the next complex tasks when the previous ones are achieved, creating the conditions for ongoing studying.

2). How am I going? (What progress is being made toward the goal?). A teacher provides information relative to a task or performance goal, often about some expected standard, prior performance, and/ progress or lack of progress in some part of the assignment. The effectiveness of feedback is determined by two factors: whether it provides a student with information about his/her progress and/or about what should be done for improvement.

3). What should I do next? Recommendations or guidelines are often sequential: teachers provide information, tasks, or learning intentions; students attempt tasks; and so on. Feedback can provide learners with information about a concrete question as well as give information helping to perform challenging tasks. J. Hattie and H. Timperley (2007) discriminate four levels of feedback: the task, the processing, the regulatory, and the self-levels. Effective feedback at the task, process and self-regulatory levels is interrelated. In the opinion of researchers, the feedback's status influences the effectiveness of reducing the gap between current understandings and performance and a goal.

The effectiveness of feedback in the terms of marks or written comments was also investigated. According to Black and Wiliam (1998); Crooks, (1988), providing written comments (feedback about the task) is more effective than providing grades. In one of the early studies, Page (1958) wrote the test performance of students was significantly improved by short written comments than by grades. Researcher R. Butler admitted (1988) that providing comments alone led to an increase in achievement, while grades or comments with marks or praise did not increase achievement.

The effectiveness of the timing of feedback, particularly contrasting immediate and delayed feedback, has always been of interest to researchers. Most studies have been conducted without considering different levels of feedback. For instance, correcting student mistakes immediately during task performance (task feedback) helps learners acquire the material better. If errors are corrected during fluency

building, it can distract students from learning automaticity and related learning strategies (task processing feedback). Similarly, Kulik and Kulik (1988) admitted that at the task level (i.e., testing situations), some delay is beneficial, but at the process level (i.e., engaging in processing classroom activities), immediate feedback is beneficial

The issue of setting the criteria of effective feedback was studied in different scientific works (Kluger, DeNisi, 1996; Black, Lee, Harrison, Marshall, 2004; Hattie, Timperley, 2007; Korenev, 2018). The results of the study and generalization of the scientific approaches to the criteria of effective feedback are presented in Table 2.

Table 2. *The criteria of effective feedback*

Overall the main ideas for effective feedback in an electronic course can be summarized as follows:

Specific goals are more effective than general or nonspecific ones because they focus student attention, and feedback can be more task-oriented. In addition, it provides learners with information about the ways and criteria of achieving specific intermediate, not general goals.

Assistance by clarifying goals and enhancing commitment through feedback makes the goals clearer and more manageable. Assessment tasks are expected to assess student proficiency levels, show and explain the difference between the present level and the learning objectives at the task, the processing, and the self-levels. When the assignment is difficult, it requires more processing about the task, and delayed feedback is preferable. However, in comparison with challenging tasks, easy ones need not lengthy processing. Thus delay is unnecessary.

Both positive and negative feedback constructive in nature can be beneficial to learning. However, the effectiveness of feedback is more dependent on the level it focuses on and processed than on whether it is negative or positive. In particular, negative feedback is more effective at self-esteem, but both types of feedback can be effective as feedback about self as a person.

To be effective, feedback needs to compare with students' prior knowledge and provide logical connections. It also needs to prompt active information processing on the part of learners.

3.2 A model of enhanced feedback

Table 3 shows a framework in which assessment tasks with enhanced feedback can be used as an element of e-learning regular university courses. The model can replace face-to-face consultations making the discipline more interesting for students, increasing their educational achievements and motivation to study electronic courses.

Table 3. *A model of enhanced feedback*

Based on the analysis of the results of the initial and final control of the statistical indicators of the quality of education including knowledge quality, level of student proficiency, progress, and average grade in student groups of the 3 course of the Polytechnic Institute of Surgut State University, there are differences in the results of achievement tests in the control and experimental groups at the final control (See Table 4).

Table 4. *The results of the pedagogical experiment*

At the first stage of the experiment, the student groups had no difference in the course's assessment elements. Thus, the results of the initial test did not show a considerable difference. However, it should be mentioned that four statistical indicators of the quality of education are below the average, for instance, knowledge quantity. According to the criteria for assessing learning indicators, knowledge quantity below 33% is "critical", from 33% - 49% is accepted, from 50% - 74% is optimal, from 75% - 100% is high. In the first part of the experiment, this indicator is at the "accepted" level. The average grade in both groups is 2.9 – 3, which can be explained by the fact that the students had never studied electronic regular university courses before.

At the second stage of the experiment, according to the data presented in Table 4, the quality indicators of education, including knowledge quality, level of student proficiency, progress, and average grade, show a significant difference between the control and the experimental groups. At the end of the semester, the difference in knowledge quality was 23%, student proficiency level was 13%, progress was 3.5%, and the average grade was 0.6 scores. The inconsiderable difference in indicator of progress can be explained by the fact that it includes the number of students who have mastered the educational program with no difference in the score. All those mentioned above allow the

authors to conclude that the experimental methodology significantly improves the learning process results.

The emotional and evaluative attitude of students to educational activities and interaction with the teacher in an electronic course was studied with a closed-ended questionnaire by L.V. Mishchenko. The results of the test questionnaire are presented in Table 5.

Table 5. *The results of the test-questionnaire*

The closed-ended questionnaire showed that the student satisfaction with the learning process was characterized as "accepted" (from 2.6 – 3.5 points). The statements: "The learning process is structured so that I actively develop analytical, predictive and constructive skills" and "The teacher uses various teaching methods and forms" were often rejected. At the end of the course, there was an increase in satisfaction with the learning process and the interaction with the lecturer in both groups. However, still, there is a difference in the levels of the control and the experimental group. The level of satisfaction in the control group is 3.1 ("normal"), whereas the level of satisfaction in the experimental group – 3.5 ("high"). This proves the pedagogical effectiveness of the proposed model of enhanced feedback in increasing student educational results in an electronic regular university course.

Summing up the data obtained, the advantages of using the proposed model in developing an electronic regular university course are:

- it can be implemented in all forms of education: traditional, blended, and distance education;
- it can be used in most academic disciplines, including lectures and practical studies;
- the use of enhanced feedback serves several goals: to assess, to improve, to support, to promote self-regulation, and to increase student learning achievements;
- lack of live communication with the teacher is compensated by enhanced pedagogical feedback,
- it meets the criteria of effective feedback in an electronic regular university resource.

4. CONCLUSIONS:

The given paper analyzed the problems concerning the interaction between teachers and students in blended learning. Lack of live communication with the teacher, lack of sufficient

experience of independent work, and lack of interactive assessment can decrease the level of knowledge and the number of graduates.

Literature sources review and the analysis of the experimental research made it possible to conclude the following:

1) The issue of feedback and control in the distance and blended learning has been studied in different scientific and methodological works due to its immediacy and significance. The role of feedback in education, particularly in distance and blended learning, cannot be underestimated as it promotes student learning.

2) In pedagogy, the feedback has traditionally been associated primarily with the processes of assessment for learning and control; pedagogical feedback is an integral part of pedagogical communication, which affects the student awareness of their educational achievements and mistakes, the student relationship with the teacher, and motivation for learning.

3) An electronic regular university resource is expected to include feedback elements in all course assessment tasks. The following types of pedagogical feedback are typical for electronic courses: before/after the lesson feedback; external/internal feedback; written feedback; personal/indirect feedback; short/expanded feedback; delayed feedback; positive/instructive feedback.

4) The educational setting serves the purpose of promoting student learning when both teachers and students seek answers to the three major questions of effective feedback: Where am I going? How am I going? Where to next? The purpose of effective feedback is to reduce discrepancies between current understandings and performance and a goal.

5) Pedagogical feedback is provided at four levels: the task, the processing, the regulatory, and the self-levels. The criteria of effective feedback include clear goal, specificity, constructability, balance, personification, comparability, interactivity, interactivity, hierarchy. The use of the model of enhanced feedback in e-learning regular university resources increases student motivation to master new material, level of acquisition of knowledge, and thus results in student educational achievements.

5. DECLARATIONS:

5.1. Study Limitations

No limitations were known at the time of the study.

5.2. Funding source

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5.3. Competing Interests

No conflict of interest exists in this publication.

5.4. Open Access

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6. HUMAN STUDIES:

The Head of the Polytechnic Institute and the Scientific Department of Surgut State University have approved this research.

6.1. Ethical Approval

Ethical approval for this study was provided by the Head of the Polytechnic Institute of Surgut State University, Surgut, Khanty-Mansi Autonomous Okrug-Yugra, Russia on 15.01.2021.

6.2. Informed Consent

The participants have agreed to participate in and consented to the research.

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Appendix 1. A closed-ended questionnaire by L.V. Mishchenko

Statements

1. I often feel deep pleasure not only from the results of my studies but also from the process of learning.
2. Studying at the university contributes to the development of my creative, intellectual potential.
3. I believe that the knowledge, skills, and abilities obtained at the university will be able to ensure success in future professional activities.
4. Usually I am so addicted to doing study assignment that I do not notice how time passes.
5. Educational activity at the university allows me to form important and necessary professional quality.
6. Studying at the university requires a lot of my intellectual tension, and I like it.
7. In the process of learning, I develop a striving for search and rationalization.
8. Training is structured in such a way that I have active development of analytical predictive and constructive skills.
9. I am actively involved in student research work.
10. Forms of education at my faculty successfully form my professional and communicative competence, increasing my cognitive activity.
11. Homework allows me to lead self-study actively and develop independence.
12. Forms of educational activity at the university develop my ability to self-study.
13. I like mental work and get intellectual satisfaction from my studies at the university.
14. I feel confident in seminars and practical training.
15. I like that most teachers use a rich arsenal of methods, forms and teaching methods combined with high methodicality.
16. My institute has every opportunity to learn and to live successfully in this society, become a contemporary of this era, and a successful peer of my generation.
17. At my institute, all conditions have been created for personal growth.
18. Educational work at the faculty and the university allows me to form and develop socially important qualities.
19. An atmosphere of benevolence and mutual assistance is created at the institute, which allows me to form the ability to see the problems of modern life and solve them to the best of my strength and capabilities.
20. I believe that the activities carried out at the university and the institute, bring up a person with an active life position, able to work on himself, create a promising specialist model.
21. I like that the university organizes many activities that contribute to the development of warmth, compassion, love for one's neighbor, kindness, and mercy.
22. Extracurricular work at the faculty helps instill a love for your profession, educate a true professional.
23. My institute conducts successful educational activities that promote the implementation of the adaptation tasks of freshmen, assisting young families, preventing offenses, fighting against smoking, alcoholism, drug addiction, HIV infections in the student environment.
24. I like that my institute leadership develops self-governance by involving students into active management activities.
25. Educational activities unobtrusively shape the need for students to influence life at the university, country.
26. Most of the activities at the university contribute to the active education of high moral, civic, and patriotic qualities.

Table 1. Typology of pedagogical feedback.
Source: the author

Nº	Classification characteristics	Types	Peculiarities
1.	Place (conditions feedback is provided in)	classroom feedback	given in response to specific learning activities, behaviors, and outcomes of these learning activities, spontaneous and time-limited
		feedback before the lesson	provided through a pre-or post-lesson communication between teacher and student, commentary on written work, or a student progress report
		feedback after the lesson	
2.	Primary addressee	student himself	transmits (or does not transmit) a message to the student in an adapted form
		parent or administrator	
3.	Knowledge control	external feedback	methods of recording and evaluating the results of student learning used by a teacher
		internal feedback	information about the learning results obtained by students themselves in the process of self-control and self-examination in various forms
4.	Form of feedback	oral feedback	characteristics of oral pedagogical feedback are similar to the characteristics of oral speech (redundancy, brevity, spontaneity, facial expressions, gestures, the emotional component, direct communication)
		written feedback	characteristic of written pedagogical feedback is similar to the characteristics of written speech (conciseness, structuredness, constant character)
5.	Communication of feedback	personal feedback	transmitted personally to the addressee using some features of oral speech in written comments, questions
		indirect feedback	written comments, audio recording
6.	Volume of feedback	short feedback	for example, reinforcement or praise
		expanded feedback	for example, comment
7.	Timing of feedback	immediate	more typical for communication situations in the classroom or during breaks; more effective for simple assignments
		delayed	more common when grading student work; in a classroom communication situation, delayed feedback is more useful when the outcome of the task is most important, while immediate feedback is more useful in drawing attention to the task itself; is more effective for complex tasks because students need more time to process information
8.	Impact of feedback	positive	reinforcing
		negative	limiting
		constructive	giving instructions

Table 2. Criteria of effective feedback
Source: the author

Nº	Criterion	Description
1.	Clear goal	Learners are more likely to try harder when the goal they want to achieve is particular, and when there is great belief that it will be a success at the end" (Kluger, DeNisi, 1996).
2.	Specificity	The educator must address a specific fact or action. Feedback is about what was said, done, and how, but not why. Guessing someone's motives creates an atmosphere of mistrust and hostility (Hattie, Timperley, 2007).
3.	Constructability	Pointing out the drawbacks or praise without a proposal for improving and consolidating progress can hardly lead to learning efficiency, and the motivating potential will be limited. Accordingly, pedagogical feedback instructions for further action are important and needed. So, checking written works must include both: correction of mistakes and suggestion of different tasks to practice problematic skills and abilities to overcome the same mistakes in the future (Black, Lee, Harrison, Marshall, 2004).
4.	Balance	The student should feel that the feedback helps him learn. If it is too critical, the student may internally reject it, if too glowing, then this can be perceived as guardianship, which can also cause some negative feelings. Feedback should be a mix of highlighting positive and negative points, each having educational value (Hattie, Timperley, 2007).
5.	Personification	When feedback is personalized and targeted to a particular learner or a group of learners it is perceived as sincere. The basic rule for providing feedback communication is the use of student names (Korenev, 2018).
6.	Comparability	Progress is made if the learner can compare the way he performed the exercise with his previous attempts. Therefore, if the teacher at the last session criticized the student ability to ask open questions, then he must show how this skill has changed after the exercise (Hattie, Timperley, 2007).
7.	Interactivity	The learner should not remain a passive listener. He must be actively involved in the process of changing his behavior to achieve certain goals. To make the feedback more interactive, it is useful to ask the student himself to comment on his behavior, knowledge, skills (Korenev, 2018).
8.	Sufficiency	While doing exercises, a person makes efforts, tries. Therefore, if he receives only fleeting feedback (especially in the case of a long-awaited achievement), he may feel that his efforts go unnoticed, which can lead to demotivation ((Kluger, DeNisi, 1996).
9.	Hierarchy	Typically, the learner can effectively take up 3-4 criticisms. The teacher may be too late to pay attention to an important point. Therefore, feedback points should be placed strictly in order of importance: firstly, more important, then less important (Hattie, Timperley, 2007).

Table 3. *A model of enhanced feedback*
 Source: the author

Aim	<ul style="list-style-type: none"> to increase student educational achievements and motivation to study an electronic resource.
Efficiency of an electronic course can be achieved by	<p>Teachers:</p> <ul style="list-style-type: none"> giving constructive feedback on specific goals, comparing the current results with prior student knowledge, providing an interactive educational process. devising assessment tasks aimed to assess student levels of proficiency and to supply information and explanations about the difference between present status and the learning aims at three levels: about tasks, about the processes or activities to realize the tasks, and about the adjustment, participation, and assurance in getting more learning-oriented;
Learning Environment	at the Learning Platform LMS MOODLE
Assessment tasks	<p>Task 1.</p> <p>Teachers: In each unit of an electronic course some video lectures/presentations/references are provided by the lecturer/tutor of the course. Each unit includes information about the content of the learning material, number of sections.</p> <p>Students: After studying the learning material, a student must set a question for each section of the learning material. The question should be formulated in a test form and have four possible answers. Students should indicate the correct answer among the proposed options, explaining why this answer is correct. Answers and questions may contain images, formulas, etc.).</p>
Enhanced Feedback	<p>Results: provided by the teacher at the Learning Platform LMS MOODLE</p> <ul style="list-style-type: none"> feed up and feedback about the task, processing of the task, and self-regulation (comments, recommendations, suggestive questions, explanations, references). <p>Task 2.</p> <p>Teachers: having analyzed the results of student works in terms of assessing their level of knowledge acquisition and having provided students with feedback, lecturers select appropriate and interesting questions devised by students to include in the second assessment task (test). The number of questions in a test – 10. One right answer – 1 score. The passing grade - 5.</p> <p>Students: After being given the results of Task 1 and the teacher’s feedback, students take a test and can send answers an unlimited number of times. Each time a new trial is taken, the questions in the test change randomly.</p>
Enhanced Feedback	<p>Results: at the Learning Platform MOODLE</p> <ul style="list-style-type: none"> feedback and feedforward about the processing of the task and self-regulation (comments, recommendations).

Table 4. *The results of the pedagogical experiment**Source: the author*

Test	Type of group	Number of students	Knowledge Quality	Level of student proficiency	Progress	Average grade
After two months period						
Initial test	control	25	48 %	46 %	72 %	3
	experimental	24	46 %	44 %	71 %	2,9
At the end of the semester						
Final test	control	25	60 %	60 %	84 %	3,7
	experimental	24	83 %	73 %	87,5 %	4,3

Table 5. *The results of the test-questionnaire**Source: the author*

Test-questionnaire	Type of group	Number of students	Satisfaction with the learning process	Satisfaction with the interaction with the teacher
After two months period				
Initial test	control	25	2,7	2,4
	experimental	24	2,8	2,6
At the end of the semester				
Final test	control	25	3,1	3
	experimental	24	3,5	3,6