

The Intelligent Platform of Autonomous Learning in Post-Secondary Education

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Abstract—The study aimed to develop and test an autonomous learning intelligent platform's effectiveness in post-secondary education. It was conducted based on the Institute of Dentistry named after E.V. Borovsky in I.M. Sechenov First Moscow State Medical University (Moscow, Russia) and Humanitarian and technical academy (Kokshetau, Kazakhstan). This research involved 59 teachers and 390 students, who comprised the total sample of 449 respondents. The experiment consisted of three stages – introductory, experimental, and final. The introductory stage included the distribution of enrolled students into the experimental and control groups. Besides, at the introductory stage, the development of questionnaires directed at identifying students' and teachers' readiness to implement autonomous learning was performed. Apart from this, the involved educators were required to fill the learning platform with predetermined training content. Programmers developed the considered intelligent learning platform by prior agreement with educational institutions under study. The experimental stage aimed to introduce the designed model of autonomous learning based on the created intelligent platform. The final stage implied surveying of all study participants according to the developed questionnaires. After introducing the created autonomous learning model, it was revealed that 51.5% of enrolled teachers were ready for self-directed education at a high level, 20.4% – at a satisfactory level, 18.4% – at a moderate, and 9.7% – at a low level. Among the students of Sechenov University, 21% of respondents had a high level of readiness for autonomous learning based on intelligent platforms, 27% of students had a sufficient level, 35% – moderate, and 17% – low. Among the Humanitarian and technical academy students, 29% had a high readiness for autonomous learning, 30%

were ready at a sufficient level, 25% at a moderate, and 16% at a low level. This study provided an opportunity to use the developed questionnaires and the model of autonomous learning in post-secondary education to research the implementation of self-directed training further.

Keywords—Post-secondary education, mobile learning, autonomous learning, intelligent platforms.

1 Introduction

In this day and age, the educational sector undergoes multiple transformations that lead to drastic changes in the teacher's and student's roles. In addition to active participation in the educational process, today's students can choose learning methods for their post-secondary education and manage their own educational trajectory, i.e., studying in the so-called autonomous mode. Though, for this process to be successful, several factors must be taken into consideration. In particular, the availability and accessibility of training materials and tools for obtaining knowledge can be provided by mobile learning and the presence of motivation for learning.

The formation of autonomous education requires both technological and pedagogical substantiation. The transition process is the most difficult and is best ensured if electronic devices are used in teaching already at the very early stages of education and school preparation [1].

Researchers agree that the teacher's role remains critical in autonomous learning, both in higher education and in secondary and post-secondary education [2,3]. Teacher training should include increased readiness for technological change and mastery of mobile devices and the management of unique applications for learning and knowledge of specific pedagogical techniques focused on e-learning and greater student autonomy [4,5].

The research is devoted to the problem of the transformation of teaching from the classroom to autonomous using an intelligent learning system. It is necessary to determine whether such a transition will increase the quality of teaching without significant preliminary training, education, and increased readiness of teachers and students, or they will increase their level of readiness for autonomy in using such a system. In most cases, technological innovations at a high rate in many developing countries provoke such a transition without preparation, immediately using special training applications [6]. Therefore, the problem under study is extremely relevant and has been little studied in the scientific literature.

The research is structured as follows: The Introduction briefly presents the background, issues, and reasons for the research, its goals, and innovation; The literature review reviews the most significant works devoted to the research problem and emphasizes the novelty and purpose of the work; Methods and Results provide data on the sample, research methods and the questionnaire used. The Results section is devoted to a detailed analysis of the results obtained during the survey. The discussion introduces the findings of the research into the general discourse of the problem with related works.

1.1 Literature review

Modern scientific works emphasize the trend towards an increase in students' ability to self-study, self-management, and self-assessment [7]. Research in this field is predominantly concentrated on the questions of equity and the social mobility of education seekers [8], positive relationship between virtual reality and satisfaction from learning, and situation-based education, oriented at the acquisition of the necessary skills, knowledge, or behavior due to the use of complex technologies [9]. Researchers note that the vector of influence in modern education is transferred from the teacher to the student, who is supposed to design a personal learning trajectory with the teacher's help [10]. Such autonomous training is referred to as a way to build a personality of a new level in the format and context of lifelong learning under the conditions of digitalization of education [11].

Some scholars oppose autonomous learning to a blended learning model, representing the combination of traditional and e-learning educational approaches and allows one to manage the training process independently [12]. Mobile learning for these purposes may look most preferable due to mobile devices' total penetration into the social environment. At the same time, a broad range of literature is devoted to the study of mobile learning, which positively affects attendance and academic achievements [13], and flipped learning aimed at improving students' independence and involvement in the study process [14].

Scholars nowadays are pondering over the need to create, test, and implement autonomous learning intelligent platforms. MISNIS is considered one of the most promising platforms for education since its main idea lies in analyzing social networks' impact on society [15]. Vast attention has also been paid to the usefulness of borrowing intelligent platforms and their prototypes from other areas of human activity [16]. A strong opinion exists that the Moodle platform, which provides freedom of choice and extensive communication capabilities, can become a basis for developing autonomous learning intelligent platforms [17]. For such platforms, the natural integration of mobile access in implementing mobile learning becomes a regular part of the functionality [2].

The international practice provides numerous examples of the implementation of autonomous learning based on multimedia mobile and online platforms and technologies and a system of smart classrooms [3,18]. Several researchers have investigated English language teachers' perceptions of learner autonomy in terms of concept and practice in the higher education sector [19]. Scholars from the National Institute of Technology in Japan have thoroughly investigated autonomous learning and proposed an Advanced-Active Autonomous Learning System based on information and communication technology [20]. Great attention is also attached to augmented reality. It allows interactive and autonomous studying and the collaborative performance of laboratory practices with other students without a teacher's assistance [21]. Several researchers have also proposed an autonomous learning interaction model that involves both independent and direct training [22].

The most interesting studies of the process of introducing elements of an autonomous learning system and the use of mobile devices at the stage of preschool educa-

tion are given in many works [23]. Adequate transformation of the digital environment familiar in our era into a learning environment for children will become the key to their future accelerated development and academic success [1,5]. Researchers emphasize the importance and effectiveness of using special mobile applications for teaching preschoolers and schoolchildren and preparing teachers for them [24].

Autonomous learning is believed to stimulate students' initiative in training, promote cooperative and self-directed learning ability, and improve teaching levels [25]. An essential part of motivation for students is the rich technologies used in mobile and cloud-based platforms [26], for example, the ability to automatically find illustrations or images associated with a complicated search phrase [27]. The students' motivation to learn intelligent platforms supporting the voice chat to effectively inspire students' interest in training and improve their autonomous learning effect is highly emphasized. As an option, scholars propose creating the method to establish the autonomous learning intelligent platform as one of the variants of support services for distance post-secondary learners [28]. The academic community remains unanimous that the ability to learn autonomously becomes one of the overall qualities that university students should have and starts to be an indispensable capability in their life after graduation [29].

Teachers play a significant role in providing students with an autonomous learning environment and proper instruction [30]. For this reason, to enhance reflection and learning motivation, it is recommended to provide just-in-time feedback about performance on learning tasks and give students some freedom over the choice of learning tasks [31].

Particular consideration in scientific research is given to studying factors influencing the students' learning outcomes [32,33]. It is indicated that web-based and mobile autonomous learning, grounded in humanism and constructivism ideas, has combined self-directed training and Internet/mobile technology and opened up a new learning path [34]. A large number of specialists currently analyze the structure of autonomous learning, its basic principles, role, and significance [35]. Many of them focus on autonomous training's main approaches, its challenges, and prospects for its implementation [36].

The common point for all the above studies is recognizing the feasibility of introducing autonomous learning as one of the essential aspects of modern education. However, many scientific works have not described transparent algorithms for its introduction or even proposed useful and valid models for its organization. The problem of an intensive transition and rapid implementation of autonomous learning for students and teachers and the development of their readiness for such learning remains extremely little researched. There are no specific recommendations for using intelligent platforms in the educational field to support and implement such learning type.

1.2 Problem statement

The analyzed scientific sources actualize the need for the development, testing, implementation, and verification of autonomous learning intelligent platforms' effective-

ness in post-secondary education. It is necessary to establish a clear connection between the application of autonomous learning in higher educational institutions and students' academic achievements. Significant is the problem of the effectiveness of the transition to autonomous learning and the level of its effectiveness.

The objective of this work was to develop an intelligent platform for autonomous learning in post-secondary education. The achievement of this goal was possible after the solution of the following tasks:

- Analyze the state of knowledge regarding the use of autonomous learning intelligent platforms in post-secondary education
- Develop and test the model of autonomous learning in post-secondary education based on an intelligent platform
- Determine the relationship between the use of autonomous learning intelligent platforms in post-secondary education and students' academic achievements
- Compare the obtained data with the available foreign experience in the indicated direction and determine standard and distinctive features
- Conclude the effectiveness and further usefulness of autonomous learning intelligent platforms in post-secondary education.

The scientific novelty of this research lies in the development of the autonomous learning model in post-secondary education based on an intelligent platform and obtaining an assessment of the effectiveness of the transition to this type of education and an increase in the level of readiness for autonomous education among students and teachers in the case of using this system.

2 Materials and Methods

2.1 Research design and sample

This study was carried out at the Institute of Dentistry named after E.V. Borovsky in I.M. Sechenov First Moscow State Medical University (Moscow, Russia) and Humanitarian and technical academy (Kokshetau, Kazakhstan). The research sample consisted of 449 people (59 teachers and 390 students). The study involved students of different specialties and academic years with various levels of ideas about future professional activities to show their readiness for autonomous learning and responsibility for their educational results.

The research hypothesis assumed that intelligent platforms for autonomous learning in post-secondary education contribute to an increase in teachers' and students' readiness to work in autonomous learning mode.

The examination process consisted of three stages - introductory, experimental, and final. The introductory stage included dividing all students into experimental and control groups (EG and CG, respectively). Within this stage, the development of particular questionnaires aimed at determining students' and teachers' readiness to implement autonomous learning was also performed. The involved educators were required to fill the intelligent autonomous learning platform with pre-selected educa-

tional content. Programmers developed this intelligent platform by prior agreement with educational institutions under study. The second stage - experimental - was to introduce the autonomous learning model based on the created intelligent platform into the educational process of two selected universities. At the final stage, a survey of all study participants (students and teachers) was conducted according to the developed questionnaires. Each of them had 20 statements to which respondents were supposed to give a positive or negative answer (Yes/No). For each positive answer, a person was given 1 point. Correspondingly, for the negative answer, no points were awarded. Following the number of points scored, four levels of readiness for autonomous learning could be distinguished (Tables 1 and 2):

- High (18-20 points)
- Satisfactory (15-17 points)
- Moderate (11-14 points)
- Low (less than 10 points).

Table 1. Questionnaire on students’ readiness for autonomous learning

Statement	Answer	
	Yes	No
1. I know what knowledge, skills, and abilities a student of my specialty should master.		
2. I can easily build my daily study program for mastering a future specialty.		
3. Every day I create my own self-study plan and schedule.		
4. I can find and process any information related to my specialty from various sources.		
5. Preparing for classes, I compose questions and tasks to check my level of educational material assimilation.		
6. I pay maximum attention to the preparation for classes connected with my specialization – I find and process relevant information from the teacher’s sources.		
7. I often prepare presentations and projects based on independently selected materials.		
8. Among the teacher’s bunch of information, I easily find the most relevant for its additional investigation.		
9. When I receive a bad mark on a test, I figure out my knowledge gaps and improve my preparation methods.		
10. I have a positive experience with distance learning courses offered to me as part of the training.		
11. From time to time, I search and take interesting distance courses.		
12. I am proficient in information and communication technologies.		
13. I can work on an assignment together with my classmates according to a pre-defined plan.		
14. In the course of performing a collective assignment, I can give recommendations concerning the study process.		
15. I can work on creative and search assignments given by the teacher without external support.		
16. I can independently select or develop interesting creative projects and work on them without the teachers’ help.		
17. I have a positive experience in preparing materials for various types of lessons together with my teachers.		
18. I participated in a joint student-teacher discussion concerning the educational content of my training course.		
19. I took part in professional competitions offered at my educational institution.		
20. I took part in personally chosen competitions outside of my educational institution.		

Table 2. Questionnaire on teachers’ readiness for autonomous learning

Statement	Answer	
	Yes	No
1. I actively involve students in the development and updating of training materials.		
2. I support the involvement of students in the development of the course content.		
3. I regularly conduct surveys among students to identify their interests to take their opinion into account during the further development of training material.		
4. I take into account students' opinions when choosing forms of work in the class.		
5. When using advanced tasks or organizing project activities, I always allow students to choose experimentally and search activity areas.		
6. I believe that students should be allowed to adjust the content of the educational course at least partially.		
7. I believe that students can plan their academic day on their own		
8. I have a positive experience of collaborating with students while developing the content of the educational courses.		
9. Together with my students, I participate in filling our university's electronic resources with educational content.		
10. I am proficient in the use of information and communication technologies.		
11. I have episodic/systematic positive examples of the introduction of autonomous learning elements in higher education.		
12. I am experienced in using intelligent e-learning platforms.		
13. I took short-term advanced training courses (seminars, hands-on sessions, workshops) on implementing autonomous learning in higher education.		
14. I have already developed and tested a didactic toolkit for organizing autonomous student learning.		
15. In my opinion, autonomous learning is not only a requirement of the time or a tribute to fashion – it is a way of teaching 21st-century students.		
16. I believe that experimental methods of organizing autonomous learning in higher education are worth to be tested.		
17. I would like to take part in an experiment on the organization of autonomous learning in higher education.		
18. I believe that students are ready to implement autonomous learning and can work with electronic resources.		
19. I have already worked with intelligent autonomous learning platforms.		
20. I am sure that autonomous learning will provide a high level of motivation for productive educational and cognitive activities and high academic results.		

The validity of the tests used was checked by the method of re-passing the test by a group of 59 students from the sample used in the study, from the control and experimental groups in equal numbers, as well as by the same size group of students from those who did not take part in the study from the same universities (from the same general aggregate). The test was performed in two groups simultaneously and before the main study. The discrepancy between the pretest results did not exceed 1.84%, indicating the questionnaire's high validity.

The study uses simple descriptive statistics using a detailed division of participants into groups according to the quality of readiness to more accurately and directly highlight the presence or absence of changes in this studied indicator. Further studies of the factors of change in readiness and their correlation between groups of participants by age, gender, and other significant signs make sense if proposing a form of imple-

mentation of an intelligent autonomous learning system will show in this study a significant result of improving readiness.

2.2 Intervention

The examination process provided for a certain level of interference in the considered higher educational institutions' educational process. Though, the authors of the present study were given time to do research.

2.3 Ethical issues

All study participants were aware of the investigation purpose. They perceived it positively and had no objections. The administration of educational institutions agreed to assist the experiment participants and financed developing an intelligent platform for autonomous learning.

2.4 Statistical analysis

The investigation covered 390 students (192 from Sechenov University and 198 from Humanitarian and technical academy) and 59 teachers (30 from Sechenov University and 29 from Humanitarian and technical academy). The surveying process was carried out in the Google Forms application, while the processing of its results was performed in the Microsoft Excel spreadsheet. The survey outcomes are presented in Table 3 and Fig. 1.

3 Results

In contrast to the CGs, whose educational process remained unchanged, the EGs were engaged in autonomous learning based on the developed intelligent platform. This model included the functions of students, teachers, the intelligent platform itself, and provided an algorithm for autonomous training.

The students' functions covered the registration on the platform; choice of courses, amount of study time, forms of knowledge control and self-study; processing materials available on the platform for each topic, module, or block; passing tests; performing independent tasks; and familiarization with their study results.

Functions of teachers included the development of an educational plan, learning materials for lectures or seminars, practical assignments for independent work, and means of student's control; uploading all the developed materials to the intelligent platform; communication in the platform's online chat (help students if necessary); commenting on completed tasks on the forum, and familiarization with students' learning outcomes.

The intelligent platform was supposed to process and store data, generate unique logins and passwords, form individual course loads, and collect the study results.

The working algorithm was as follows:

1. Registration of a student on the autonomous learning platform: entering personal data, indicating his/her specialty, training duration, and the range of professional interests; generation of a unique login and password
2. Determination of training time and volume: students can choose the number of courses for a particular time period (for example, 3 or 4 courses per week, 5 or 6 lessons per day)
3. Students' choice of forms of control for each course or topic: test control, answers to questions, creative tasks, project activities
4. Students' choice of forms and topics for independent work (presentation, mini project, mind map, storytelling, video)
5. Generation by the platform of student's individual schedule
6. Implementation of autonomous learning: the student works on the materials available on the intelligent platform and undergoes knowledge control
7. Calculation by the platform of the final educational result for courses/modules.

At the last stage of the study, all participants were interviewed using the Methodology section's questionnaires. The results of this examination are presented in Table 3 and Fig. 1.

Table 3. Students' survey results

Readiness levels/number of respondents				
<i>High</i>	<i>Satisfactory</i>	<i>Moderate</i>	<i>Low</i>	<i>Total respondents</i>
Sechenov University				
<i>1st year (EG)</i>				
4	6	10	5	25
<i>1st year (CG)</i>				
0	2	6	14	22
<i>2nd year (EG)</i>				
5	3	10	7	25
<i>2nd year (CG)</i>				
2	4	12	7	25
<i>3rd year (EG)</i>				
6	9	8	3	26
<i>3rd year (CG)</i>				
2	5	8	10	26
<i>4th year (EG)</i>				
6	8	7	0	21
<i>4th year (CG)</i>				
3	4	9	6	22
Humanitarian and Technical Academy				
<i>1st year (EG)</i>				
8	8	4	5	25
<i>1st year (CG)</i>				
3	3	6	13	25
<i>2nd year (EG)</i>				

7	6	8	3	24
<i>2nd year (CG)</i>				
4	4	4	12	24
<i>3rd year (EG)</i>				
9	9	7	2	27
<i>3rd year (CG)</i>				
4	4	6	12	26
<i>4th year (EG)</i>				
5	7	6	5	23
<i>4th year (CG)</i>				
3	4	7	10	24

As shown in Table 3, EG respondents demonstrate higher readiness for the implementation of autonomous learning based on intelligent platforms than those from CGs. Thus, it was revealed that among the first-year students of Sechenov University allocated to the EG were 16% more individuals with a high level of readiness for autonomous learning than in the CG, in which such highly prepared students were not identified at all. A satisfactory level of readiness was inherent to 24% of Sechenov University newcomers, and a moderate – to 40%. Among second-year students of Sechenov University who belonged to the EG, 20%, 12%, and 40% were ready for autonomous learning at high, satisfactory, and moderate levels. Data for students of the third year of study from the EG indicate that only 24% of them were highly prepared for such learning mode, while 36% and 32% of third-years appeared to be ready at satisfactory and moderate levels. As of the fourth-year students of Sechenov University distributed to the EG, 24%, 36%, and 28% were ready for autonomous learning at high, satisfactory, and moderate levels. In general, among the respondents of Sechenov University EG, 21% had a high readiness for autonomous learning implementation, 27% – satisfactory, 35% – moderate, and 17% – low (Fig. 1).

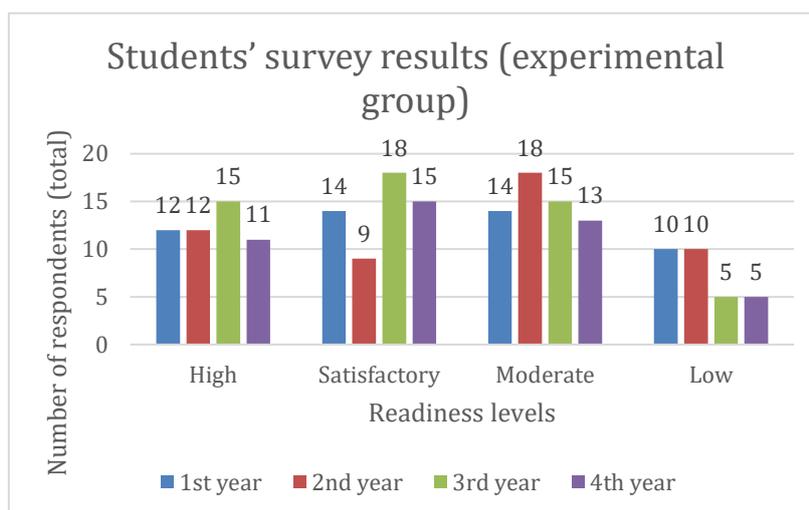


Fig. 1. Students' survey results (experimental group) for both universities

The results of CGs were somehow worse (Fig. 2). A high level was noted among 3.6% of learners, satisfactory among 7.8%, moderate among 18.2%, and low among 70.4% of enrolled students.

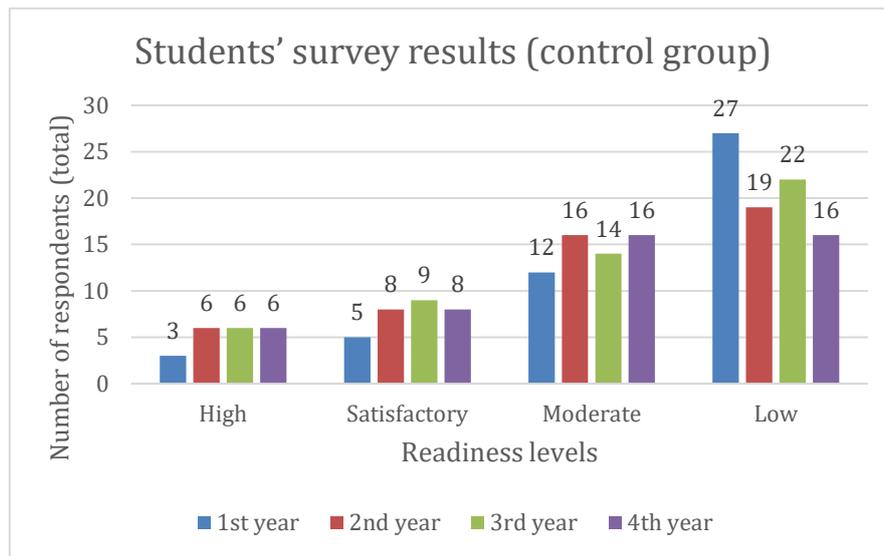


Fig. 2. Students' survey results (control group) for both universities

Among the EG students of the first year of study at the Humanitarian and technical academy, high and satisfactory readiness levels amounted to 32% each, while moderate made up 16% of all freshmen. The readiness of Humanitarian and technical academy EG sophomores for autonomous learning at a high level was inherent to 29% of individuals, at a satisfactory level – to 25%, and at a moderate level – 33%. Among the third-year students, only 33% were ready for autonomous learning at a high and satisfactory level, while 26% had a moderate readiness level. Among EG students of the Humanitarian and technical academy's final course, 22% were ready for autonomous learning at a high level, 30% – at satisfactory, and 26% – at moderate. On average, 29% of EG respondents had a high level of readiness for autonomous learning using intelligent platforms, 30% had a satisfactory level, 25% – moderate, and 16% – low. In parallel, only 7% of students of CGs demonstrated a high level of readiness, 7.6% had a satisfactory level, 11.6% – moderate, and 73.8% – low. Given the obtained data, the effectiveness of the implementation of the proposed autonomous learning model was proven.

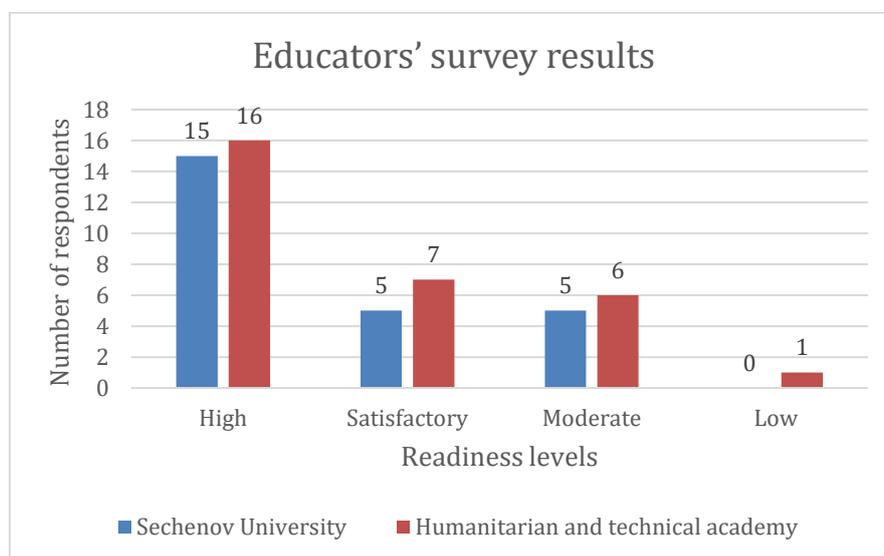


Fig. 3. Educators' survey results

As can be seen from Fig. 3, fifteen teachers (50%) of Sechenov University are ready to introduce autonomous learning through intelligent platforms at a high level. Five educators each (16.7%) have satisfactory and average readiness levels. None of the involved instructors from Sechenov University showed a low level of readiness. Among the teachers of Humanitarian and technical academy, sixteen people (53%) were ready to implement and practice autonomous learning at a high level, seven (24%) and six (20%) had satisfactory and average levels of readiness, respectively, and only one (3%) showed a low readiness level. In general, 51.5% of educators appeared to be highly prepared to introduce autonomous learning, 20.4% had a satisfactory level of readiness, 18.4% – moderate, and 9.7% – low.

4 Discussion

Similar to the present research is the experiment on the smart classroom system - a ubiquitous network access environment, where wireless terminals can carry out group discussions and cooperative education in alignment with students' learning needs. It is a widely held view that such a system can better stimulate students' interest and participation in training and make independent learning possible [18]. However, the principal difference of this study from the present one is its narrow profile. It focuses only on learning a foreign language, whereas the current work proposes implementing autonomous learning in various disciplines and courses.

Certain correlations with the conducted experiment can be noted in Indonesian research to study teachers' and students' perceptions concerning autonomous learning. This study argues that even though both teachers and students held positive tenets on

autonomous learning, they still had an inadequate understanding of autonomous learning concepts [37].

Since the proposed autonomous learning model is network-based, it is appropriate to mention a study that proves the effectiveness of the combination of web-based education and autonomous learning through the introduction of mobile and individual training methods. It is noteworthy that this research was carried out precisely in the post-secondary education system, which encourages widespread mobile and individual teaching methods [34].

Large-scale research conducted at one of Ecuador universities to establish a relationship between the incentive to study and the attitude to learning a foreign language has revealed a strong link between motivation and frequency of occurrence of autonomous learning activities [38]. This suggests that autonomous learning is a time requirement and a key priority for the educational community. Accordingly, a conclusion can be drawn on the advisability of applying an autonomous learning model based on an intelligent platform. As our research shows, the implementation of such systems can be fast and increases the participants' readiness in the learning process for autonomy.

Most scientific works on autonomous learning emphasize that such training positively affects learning, cognitive activity, students' motivation, and academic results. The present investigation confirmed the hypothesis that using an autonomous learning intelligent platform in post-secondary education contributes to an increase in the readiness of teachers and students to work in a self-directed learning mode. Furthermore, this study contributed to the expansion of the understanding of autonomous learning possibilities. It also confirmed the assumption that all participants in the educational process should be ready to study autonomously.

5 Conclusion

This research aimed to develop and test the effectiveness of the autonomous learning intelligent platform in post-secondary education. The study hypothesis assumed that intelligent platforms for self-directed training in post-secondary education contribute to the enhancement of teachers' and students' readiness to work autonomously.

The study provided the creation of the autonomous learning model implemented in the study process based on a specially developed intelligent platform. After its introduction, through the use of the survey method, it was revealed that 51.5% of enrolled teachers were ready for autonomous learning at a high level, 20.4% – at a satisfactory level, 18.4% – at a moderate level, and 9.7% – at a low level. Among the students of Sechenov University, 21% of respondents had a high level of readiness for autonomous learning based on intelligent platforms, 27% of students had a sufficient level, 35% – moderate, and 17% – low. Among the Humanitarian and technical academy students, 29% appeared to be highly prepared for autonomous learning, 30% were ready at a sufficient level, 25% – at moderate, and 16% – at low. The results demonstrate a qualitative increase in the readiness for independent, autonomous work of

both students and teachers and conclude that implementing an intelligent autonomous learning system contributes to this process.

The practical significance of research findings is in using the developed questionnaires and the model of autonomous learning in post-secondary education. This study's scientific value is that it lays the foundations for numerous scientific discussions on the feasibility of autonomous learning intelligent platforms in post-secondary education. Besides, the performed examination opens new prospects for exploring novel approaches to organizing autonomous learning and promotes the development of best teaching practices in self-directed education.

5.1 Recommendations

The study results allow us to recommend at the level of post-secondary education to implement and independently create intelligent systems of autonomous learning at the level of educational institutions or to attract ready-made online learning platforms for their implementation. With the transition to autonomous learning, the willingness to use it grows for both teachers and students, and academic performance remains stable.

5.2 Research limitation

The research participants' age ranged from 18 to 25 for students and from 32 to 55 for educators. The examination was conducted within the educational process and was limited in time. During the study course, the experimental group of students practiced only autonomous learning based on the created intelligent platform.

The study uses descriptive statistics to demonstrate a measurable benefit in improving participants' preparedness; more detailed research is required using correlation and factor analysis to elucidate the significant success factors of intelligent autonomous learning systems. The study also used data from only two universities and should be extrapolated with caution to institutions using other curricula.

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