THE INFLUENCE OF THE PROCTORING SYSTEM ON THE RESULTS OF ONLINE TESTS IN THE CONDITIONS OF DISTANCE LEARNING

[a]ANARGUL SHAUSHENOVA, [b]ZHANDOS ZULPYKHAR, [c]SAMAL ZHUMASSEITOVA, [d]MARAL ONGARBAYEVA, [e]SHYNAR AKHMETZHANOVA, [f]ZHAZIRA MUTALOVA, [g]SHAKIZADA NIYAZBEKOVA, [h]ANNA ZUEVA

[a,b,c]S. Seifullin Kazakh Agrotechnical University, Zhenis avenue 62, Kazakhstan
[d]International Taraz Innovative Institute, Zheltoksan avenue 69B, Kazakhstan
[e]M. Kh. Dulaty Taraz Regional University, Suleymenov avenue 7, Kazakhstan
[f]Zhangir Khan West Kazakhstan Agrarian Technical University, Zhangir khan avenue 51, Kazakhstan
[g]Financial University under the Government of the Russian Federation, Moscow Witte University, 2nd Kozhukhovsky proezd, 12, building 1, Russian Federation
[h]Lomonosov Moscow State University, GSP-1, 1 Leninskiye Gory, Russian Federation
email: [a]a.shaushenova@kazatu.kz, [b]zh.zulpykhar@kazatu.kz, [c]samaljumaseitova@mail.ru, [d]ongarbaevam@mail.ru, [e]shina_70@mail.ru, [f]zhazira77@mail.ru, [g]shakizada.niyazbekova@gmail.com, [h]dgastin@mail.ru

Acknowledgement: This research was supported by project No. AP09259657 Research and development of an automated proctoring system for monitoring students' knowledge in the context of distance learning.

Abstract: Covid–19 has made significant adjustments to all spheres of Kazakhstan's society, the education sector was no exception, and therefore all educational organizations were forced to urgently activate distance learning. Of course, organizations of higher and postgraduate education used a distance learning format before the pandemic. Kazakh schools experienced difficulties with the distance learning format. One of the problems of distance education is that academic honesty in relation to online tests is dangerous because of deception, which artificially gives a high score. To solve these problems, an online proctoring system was used, designed to eliminate and prevent academic dishonesty. The purpose of this study was to compare the results of online tests with proctoring and online tests without proctoring. The test results of 220 students studying in different groups of the online course were compared using linear models of mixed effects, some students did not use a proctoring system, and the rest were forced to use online proctoring software. Students scored an average of 11 points less and spent less time on online tests that used proctoring software compared to tests without a proctoring system. A significant difference in grades and different use of time was in different exams, both for sections of the same course, and in the fact that some students used software for testing, while others were absent. The necessity of introducing the use of a proctoring program for online learning and distance education is justified. The necessity of using innovative tools in the field of education, in particular in online learning, is actualized. The introduction of proctoring systems increases the reliability of the assessment of educational results in the online mode. It is necessary to further develop the capabilities of proctoring technology and its wide implementation in all universities of the country. The use of this software system will allow educational organizations to improve the quality of the results of distance education provided.

Keywords: distance learning, online education, academic integrity, online testing, proctoring software.

1 Introduction

Distance learning is a form of education in which a teacher and a student interact at a distance using information technologies. During distance learning, the student studies independently according to the developed program, looks through the recordings of webinars, solves problems, consults with the teacher in an online chat and periodically sends him his work for verification. Distance learning has become popular with the advent of the Internet, opening up new development opportunities for residents of remote settlements and business people with a busy working schedule. At first, distance learning was perceived only as an additional way of acquiring knowledge or preparing for exams. Now you can take full–fledged distance courses and advanced training programs from prestigious universities, commercial and non–profit companies from different countries, being anywhere in the world. In distance learning, the issue of objective assessment of knowledge is acute. Online proctoring systems are one of the ways to prevent students from academic fraud. The article considers the possibilities and problems of using the online proctoring system for monitoring students ' knowledge. The widespread use of dishonest behavior in educational activities has serious consequences. Firstly, it leads to a low efficiency of investing resources in student education, which, in turn, leads to a decrease in the level of knowledge and skills of graduates and, as a result, a decrease in the economic potential and pace of development of the country. In addition, graduates who have practiced dishonest behavior during their studies are inclined to resort to deception in their work. In addition, a number of empirical studies have shown that the widespread use of academic deception in the educational environment leads to the fact that highly motivated students begin to use these practices in their educational activities. Accordingly, disrespect for the principles of academic dishonesty now can have large–scale negative consequences in the future.

Modern information and communication technologies provide continuous education and have a much more effective impact than traditional means of education. Traditional forms of obtaining higher and postgraduate education in recent years, such an innovative form as distance learning has been gaining more and more popularity.

At the same time, the trends in the development of education indicate that the distance learning format is becoming increasingly popular:

- distance education will lead to a reduction in the costs of students and educational organizations;
- distance education allows you to combine training with work, allows you to study in the family when receiving a postgraduate or second education, as well as when obtaining a bachelor's degree, gives you the opportunity to get practical experience in your chosen specialty during training;
- the format of distance education expands learning opportunities for people with disabilities;
- distance education allows you to study both in Kazakhstan and abroad at the same time;
- the distance learning format allows you to improve and improve your skills.

The spread of Covid–19 has caused many problems for Kazakh and foreign universities. Universities were forced to work remotely, make adjustments to their curricula and educational programs. In addition, a new, remote final exam was provided in an online format. In this format, the final exam of the student was held outside the educational institution. It should be noted that the remote format was used in many leading foreign universities before the pandemic, using their educational platforms (Harvard University, Oxford University, Open Universities Australia, Open University UK, Stanford University, Ottawa University, etc.).
However, distance education is inferior to full–time education when it comes to trust in the results of evaluation activities and diplomas, certificates and certificates issued based on these results. This is due to the complexity of identifying students. It is difficult to keep track of whether a student performs tasks or tests independently. Thus, there is a problem of increasing confidence in the results of evaluation activities carried out in distance education.

Sometimes students who do not want to independently pass testing in any discipline, resort to the help of people or organizations that pass various forms of control for money instead of students. Such situations reduce the quality of distance education and, consequently, the level of trust in it.

2 Literature review

Both the current state of development of distance education and the problems of objective assessment of knowledge, as well as the history of its development, are considered in detail in many

analytical works (Hard, S. F., Conway, J., and Moran, A. S., 2006), (Jones, I. S., Blankenship, D. and Hollier, G., 2013), (Ladyshevsky, R. K., 2015), (Newton, D., 2015), (Spalding, M., 2009), (Stuber–McEwan, D., Mudro, P. and Hoggatt, S., 2009), (Reines, D. A., Ricci, P., Brown, S. L., Eggenberger, T., Hindle, T., and Schiff M., 2011), (Patashkova Y; Kerimkhulle S; Serikova M, Troyanskaya M., 2021). An important result of the study of the state of affairs is the conclusion that distance education has not yet fully realized its potential.

The problem of monitoring and evaluating students ' knowledge is an important component of the learning process (Beck, V, 2014). The works of a number of scientists are devoted to the problems of the development of distance education, online learning and the study of online proctoring problems: (Christie, B., 2003), (Boehm, P. J., Justice, M., and Weeks, S., 2009), (Etter, S., Kramer, J. J., and Finn, S., 2006), (Etter, S., Kramer, J. J. and Finn, S., 2007), (Alessio, H. M., Malay, N. J., Maurer, K. T., Beiler, A. J.., and Rubin, B., 2017). The authors, investigating the problems of determining and evaluating the level of quality of students ' knowledge, note that the applied forms of knowledge control have significant disadvantages (Grijalva, T. C., Nowell, C. and Kerkvliet, J., 2006). Some scientists pay great attention to the study of the features of remote control and methods of distance learning. The authors define distance learning as the most important direction of supporting the potential of higher education (Grigoriev V. Yu., Novikova S. E., 2020). The authors understand distance learning as a new training format that provides the use of information technologies based on the use of computers, video equipment, audio equipment, space and fiber–optic technology. Distance learning is an educational process that involves an active exchange of information between students and the teacher, as well as between students themselves, and makes maximum use of modern means of new information technologies (audiovisual means, personal computers, telecommunications) (Allen, I. E., Matros, Yu., 2015).

In the conditions of constant improvement of technologies, educational organizations focused on innovative development models should master modern technological innovations, especially aimed at ensuring high–quality training, including in the process of distance learning (Nurzhanovna A., Issayeva B, Tatyana S. and Kaldenova G, 2020), (Aetdinova R., Yerzhanova S., Suleimenova B., Maslova I., 2020), (Bekbenbetova B., Mussirov G., Borisova E., Dzholdosheva T.& Aetdinova R., 2020). The question of academic integrity of students arose earlier with the advent of distance learning and exams. With the help of modern technologies, the possibilities of deception are currently increasing. A study conducted by American scientists revealed the opinion of students that it is easier to" write off " that it is easier to study online during the exam than to study during the daytime (this approach was followed by 73% of students). In addition, according to research, students who take exams in the external control mode deceive teachers more than those who take full–time exams (King S. G., Guyette R. U., Piotrovsky S., 2009). The credibility of online learning is questionable due to the distance between students and teachers, suggesting that this may contribute to a violation of integrity (Moten, Locksmith, Mangal, Leonard and Brown, 2013). Berkey and Halfond (2015), studying the topic and problems of online courses, say that students are not honest during full–time training. According to research by scientists, most students believe that it is easier to cheat the Internet than traditional full–time education (Corrigan–Gibbs, H., Gupta, N., Northcutt, S., Cutrell, E., Tis, U., 2015). A survey of students found that a third consider fraud in any environment, while students showed that fraud in an online classroom is four times more. (Harbin, J. L. and Humphrey, P., 2013). Some studies aimed at the real behavior of students have given contradictory results. Most of the studies on the prevalence of fraud on the Internet were devoted to lessons during the day, and most of these studies were based on student calculations (Corrigan–Gibbs, H., Gupta, N., Northcutt, S., Cutrell, E., and Tis, W., 2015).

3 Material and methods of research

Research methods: analysis of scientific and pedagogical literature on the theory and practice of distance learning, questions of online learning, problems of online proctoring, observation, questioning, expert assessment, study of pedagogical experience of conducting the final test of students using an online proctoring system.

Proctoring allows you to increase the reliability and reliability of the results of diagnostics of students ' academic achievements. Proctors, as well as exam coordinators in the classroom, monitor the process so that participants follow the rules when taking online exams. With the development of digital technologies in education, proctoring is becoming more and more popular, and therefore it is necessary to continue studying the possibilities of optimizing this process.

220 1st–year students of the specialty "Economics", "Management and Management", "Business Informatics", "Accounting and Taxation", "Finance", "Information System" were selected for the study at the Kazakh Agrotechnical University named after S. Seifullin, where about 11,000 students' study.

The purpose of this study was to compare the test results of students studying in several groups of the same online training, where six out of ten groups used a proctoring system for at least one of their tests, and the remaining four groups of the course did not integrate a proctoring system to the tests.

We also compared the results of students in each section using the proctoring system and without it. Table 1 provides a brief description of the ten sections of the group and indicates that the tests for each subject consist of tests with and without proctoring.

Table 1–Conditions of five tests in different subjects for Saken Seifullin University students for the 2020–2021 academic year

Subjec / Group	Test a	Test b	Test c	Test d	Test e
1	U	U	U	U	U
2	U	P	U	P	U
3	P	P	P	P	P
4	U	U	P	P	U
5	U	U	U	U	U
6	U	U	U	U	U
7	U	U	U	U	U
8	U	P	U	U	U
9	U	P	U	U	U
10	P	P	P	U	U
P – proctored *U – unproctored* Note: Developed by the authors					

From fifteen to thirty students studied in each of the ten groups of this course in total, using the Examus proctoring program (https://ru.examus.net/), remote proctoring software that takes a student on video, blocks some unauthorized actions on the computer and records the students ' desktops during the test. Examus software uses proctors or teachers who review the records after the exam and identify possible situations of cheating.

Here are the violations that the proctor fixes with the help of "Examus":

- face recognition of a person in the frame;
- the presence of an outsider;
- voice detection;
- determining the direction of view;
- changing the active window on the computer;
- conversation during the exam;
- prohibited sites / software are used.

After the tests were completed, the videos from Examus were reviewed for violations of the rules or suspicious activity.
Students of all ten groups were informed that the tests should be conducted independently, without any notes or other resources allowed during the test.

The tests differed in terms of timing, number of questions, and proctoring, but they all covered the same material, and the questions were randomly taken from a common database of questions.

Table 2 – The total number of tests in 10 groups of Saken Seifullin University for the 2020–2021 academic year

Test a	Two tests (n=40) were performed with proctoring; eight tests (n=160) were performed without proctoring
Test b	Five tests (n=100) were performed with proctoring; five tests (n=100) were performed without proctoring
Test c	Three tests (n=60) were performed with proctoring; seven tests (n=140) were performed without proctoring
Test d	Three tests (n=60) were performed with proctoring; seven tests (n=140) were performed without proctoring
Test e	One test (n=20) was performed with proctoring; nine tests (n=180) were performed without proctoring
Test a (on the subject of ICT) Test b (on the subject of mathematics) Test c (by subject Kazakh (Russian) language) Test d (on the subject of political science and sociology) Test e (on the subject of a foreign language) Note: Developed by the authors	

Table 2 shows the number of tests conducted with and without proctoring. Out of the initial 220 students, 5 students failed at least 1 course test. The students ' test results were used in statistical analysis to assess the impact of proctoring on test results and the percentage of allotted time.

4 Data analysis

The impact of proctoring on student academic performance was evaluated using a linear mixed effects model (Verbeke & Molenberghs, 1997; Montgomery, 2013).

Linear model of mixed effects 1.

An alternative to variance analysis is regression analysis using mixed linear models. The essence of this method is as follows. The effects (factors) affecting an independent variable are conditionally divided into two types: fixed and random. There are sometimes disputes about the pedagogical and methodological aspects of dividing effects into given parts (Gelman, A., 2005).

The main object of interest is the variables between one or more independent variables that differ in their dependent value. Everything else–the temperature in the room, the time of day, the differences of individual objects, stimulating properties and other factors–is considered "noise" or an accidental error, the influence of which the experimenter tries to avoid all available methods. The main object of interest is the variables between one or more independent variables that differ in their dependent value. Everything else–the temperature in the room, the time of day, the differences of individual objects, stimulating properties and other factors–is considered "noise" or an accidental error, the influence of which the experimenter tries to avoid all available methods. These are the least important of the restrictions, which are almost never observed in practice, and their violations usually do not lead to significant problems (Gelman, H., 2007).

The main data requirements in the case of mixed models are the presence of groups of interrelated observations. In addition, mixed linear models require the same assumptions as conventional linear models:

- the effects in the model are additive, that is, the influence of one parameter does not depend on the level of another parameter;
- there is a linear relationship between the independent and the dependent variable;
- the errors (residuals) have equal variance and are distributed normally.

The following fixed effects were included in the mixed regression model: the number of observations, the number of subjects, the number of questions of the subject, the number of students, the correctness of the answer. The mixed linear model extends the general linear model, which allows you to display the interrelated and non–constant variability of data. The mixed linear model provides flexibility for modeling not only data averages, but also variances and covariances.

$$y_{ijk} = \mu_k + \beta_P I_{ijk} + \beta_Q Q_{ik} + \delta_i + \gamma_{ij} + \epsilon_{ijk} \quad (1)$$

where we model the *k*–th test score for the *j*–th student in the *i*–th section, meaning the parametrization of the average test values, mccs that use non–core exams with 20 questions as a baseline. The terms of the model associated with fixed effects are defined by:

μ_k – average score on the k test without proctoring software and 20 questions (basic level), β_P- additive change of the base score when using video testing in the test, I_{ijk} -Indicator function for using proctoring software in the *k* test for student *j* in section *i*, β_Q - additive change of the base score for each additional question above the base, Q_{ik} - the number of questions exceeding the base value of 20 on the *k* test in section *i*.

Random effects (factors) $\delta_i, \gamma_{ij}, \epsilon_{ijk}$ are given as follows:

$$cov(X,Y) = \frac{1}{n}\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y}) \quad (2)$$

where the average value of the samples is determined by the formulas $\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$, $\bar{Y} = \frac{1}{n}\sum_{i=1}^{n} Y_i$.

$$cov(X,Y) = \begin{cases} 0, & i \neq l \ section, j \neq m \ student, k \neq n \ test \\ \sigma^2_s, & i \neq l \ section, j \neq m \ student, k = n \ test \\ \sigma^2 + \sigma^2_s, & i \neq l \ section, j = m \ student, k = n \ test \\ \sigma^2 + \sigma^2 + \sigma^2_s, & i = l \ section, j = m \ student, k = n \ test \end{cases}$$

It was suggested that academic integrity is associated with additional time spent searching for prohibited reference materials. To study the impact of the online proctoring system on the time spent on performing tests, we applied a linear model of mixed effects to the percentage of allotted time. The metric used in modeling the differences in time use was the percentage of allocated time used by the student; this is done to maintain a consistent interpretation with a different number of questions and the time allowed in different sections. The model selection and diagnostics were carried out in the same way as in the model for test scores, and the model covariances and random effects for the selected model turned out to be identical to the structure described in Equation 1. The model for the percentage of time spent corresponds to the form:

Linear model of mixed effects 2.

$$z_{ijk} = \mu_k + \beta_P I_{ijk} + \beta_Q Q_{ik} + \delta_i + \gamma_{ij} + \epsilon_{ijk} \quad (3)$$

Data analysis, visual graphics and calculations of linear mixed models were created using R software using the packages dplyr, ggplot2, nlme (R Core Team, 2014).

6 Results and discussion

6.1 Online survey of students

Among 150 full–time students (75 girls, 75 boys) of the Kazakh Agrotechnical University named after S. Seifullin in the format of an anonymous survey (by means of forms docs.google.com test) a study was conducted, as a result of which the pros and cons of distance education were analyzed. According to the form, the questions were divided into open–a free answer, for example, "What do you think to do after studying at a university?" and closed–the answer is to choose from several statements offered in the questionnaire. Open–ended questions provide more in–depth information, but with a large number of questionnaires, they lead to significant difficulties in processing due to the non–standard answers. Table 3 shows statistics on the answers to the question about the desire of students to use distance education.

Table 3–Statistics of answers to question No.1

Would you like to take written exams and final tests remotely and at a convenient time?	total	%
yes	132	88
no	18	12
I find it difficult to answer	0	0

Only 12% of students would like to take various forms of final certification in the traditional form, when students and the teacher gather at the same time in the classroom and the long process of passing an exam or test begins. The remaining 88% of students would like to take exams in a comfortable environment and at any time convenient for them. People organize their time in different ways and, it can be assumed that everyone has their most favorable time for passing an important test.

Table 4–Statistics of answers to question No.2

On average, how many disciplines per semester include testing on the platform Platonus (https://platonus.kazatu.kz/)?	total	%
1	0	0
2	0	0
more than 2	100	100

Statistics on the average number of disciplines on the Platonus platform per semester are presented in Table 4.

Based on the answers to this question, we can draw the following conclusions that the student passes all exams on the Platonus educational platform. Table 5 shows the ratio of students who rely only on their knowledge during testing, and students who use additional sources of information.

Table 5–Statistics of answers to question No.3

Do you rely only on your own knowledge during testing?	total	%
yes	98	65
no	52	35
I find it difficult to answer	0	0

An analysis of the survey results shows that two–thirds of students use additional sources, which is during a regular exam, which some teachers consider a violation. Statistics on the actions that students resort to during testing are presented in Table 6.

Table 6–Statistics of answers to question No.4

What actions did you resort to during testing?	total	%
None of the above	12	8
Other people's help	39	26
Use of lecture materials	48	32
Search for information on the Internet	51	34

This table shows the following statistics: 26% of the surveyed students resorted to the help of other people during testing, 34% use the Internet during testing to find answers to questions and 32% of the respondents use lecture materials. All these actions are usually violations of the rules of behavior on a traditional exam. Only 8% said that they had not resorted to any of the previously listed actions. Table 7 shows statistics on students ' compliance with the rules for passing remote testing, provided that they will be monitored by video surveillance.

Table 7–Statistics of answers to question No.5

Would you follow the rules for passing remote testing if you were being monitored by video surveillance during testing?	total	%
yes	129	86
no	21	14
I find it difficult to answer	0	0

The statistics presented in the diagram allows us to conclude that 86% of the surveyed students, realizing that they are being monitored by video surveillance, will not take actions that are violations of the rules of testing. Students have heard both positive and negative reviews about the distance education system (62%). Only negative reviews were highlighted by 13% and only positive ones by 25%, which indicates an ambiguous attitude of students to the distance education system (Table 8).

Table 8–Statistics of answers to question No.6

What reviews have you heard about distance education?	total	%
only positive	38	25
both positive and negative	93	62
only negative	19	13
I didn't hear anything	0	0

Students highlight the freedom and flexibility of learning as the main advantage of distance education, 86.5% of respondents answered this way, which fully confirms our hypothesis. Also, 60% of individual training and 45% of the availability of training for any person are identified as positive aspects (Table 9).

Table 9–Statistics of answers to question No.7

What positive features can you identify in the distance education system?	total	%
Teaching disciplines at an individual pace	91	60
Freedom and flexibility of learning	130	86,5
Accessibility of training for any person	113	45
Technological effectiveness of the educational process	23	15
The opportunity to work in a comfortable environment	46	31
Availability of training materials	48	32
Communication speed	36	24
The opportunity to work with each student individually	32	21

Table 10–Statistics of answers to question No.8

What negative features can you identify in the distance education system?	total	%
lack of practical knowledge	134	89
written form of answers to tasks	97	65
electronic courses or programs are not well developed	15	15

lack of regular monitoring of students the	23	31
need to understand digital technologies	48	32
lack of personal communication	81	54

The main disadvantage of distance learning is the lack of practical training (66%). 34% noted the lack of control over the student. Among the negative features that can be identified in the distance education system, the first place is occupied by a lack of practical knowledge, 89% of respondents answered this way.

Among the negative signs, the second place is taken by the written form of answers (31.3%), which is not always convenient for the student. For many students, it is easier to "live" communication with the teacher. And the third place is taken by the lack of personal communication, as well as communication with other students (54%) (Table 10).

Students were asked to evaluate the main features of distance education on a ten–point scale. As a result of the distribution of answers, the following results were obtained:

- parallelism – 10 points.
- flexibility – 9 points;
- asynchrony – 8.1 points;
- long–term exposure – 7.8 points;
- profitability – 5 points;
- modularity – 4.5 points.

The main advantage of distance learning is that it can be carried out when combining the main professional activity with study, i.e. "on–the–job production". Students offered such implementations into the distance education system as practical classes and strengthening the server of the educational institution.

6.2 Studies of the influence of the proctoring system on the results of online tests

In online and distance learning, the issue of an objective assessment of knowledge is acute. Online education continues to grow, creating opportunities and difficulties for students and teachers. One of the difficulties is the perception that the academic integrity associated with online tests is being compromised due to undetected fraud that gives artificially higher scores. To solve these problems, an online proctoring system was developed to eliminate and prevent academic dishonesty.

Figure 1 – Test results (%) in ten groups (Group 1 – Group 10), colored by the proctoring status.

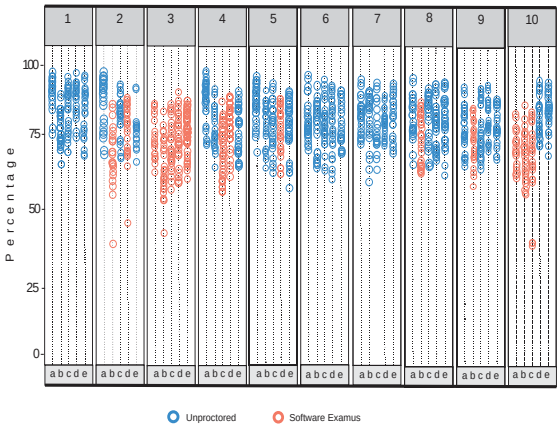
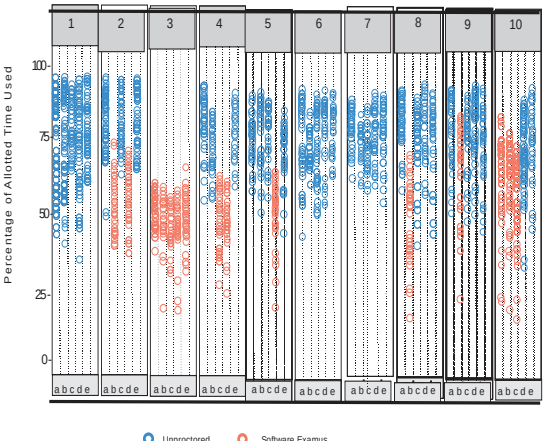


Figure 1 visually presents the results and time obtained on the tests in each group, and is colored to emphasize the proctoring status of each test group. The average results of tests with a proctoring system and tests without proctoring were 79.3% and 90.8%. The average percentage of allocated time spent on tests with proctoring was 40.4%, and tests without proctoring – 60.2%. This shows that students spent about more than half of the time passing the proctoring system compared to tests without proctoring. Tests with proctoring (red), as a rule, scored less points and took less time than tests without a proctoring system (blue). (Figure 1, Figure 2).

Figure 2 – Results (time used in % of the allotted time) in ten groups (Group 1 – Group 10), colored by the proctoring status.



Note–developed by the authors

A complete list of statistical data on test results and the percentage of allotted time used in proctoring groups is given in Table 11.

Table 11–List of statistical data on test results

Type of exam	Test results (%)	Average value of time used (% of the specified time)	Numbero f tests	Number of students
Without an online proctoring system	90,8	60,2	36	833
With proctoring (with video monitoring) (Software Examus)	79,3	40,4	14	327

The initial average values for tests from 1 to 5, with tests without proctoring (20 questions), were: 89.7, 87.8, 83.4 and 84.8, respectively. This explains the general differences in difficulty, when the first two tests were less difficult than the last three.

Fixed Effect	Linear model 1	Estimation	Confidence Interval (95%)
Test 1	y_1	88.77	(86.87, 91.20)
Test 2	y_2	88.81	(83.87, 91.14)
Test 3	y_3	82.37	(80.87, 85.12)
Test 4	y_4	84.70	(80.17, 87.26)
Test 5	y_5	80.63	(76.92, 84.17)
Proctored (protected by software or response monitor) effect	β_P	–18.23	(–16.62, – 9.83)
Additional questions effect	β_Q	0.35	(0.21; 0.41)

Random Effect	Variation	Estimation of variance	Percentage of total variance
Section	σ^2	10.1	11.2 %
Student	σ^2	28.3	31.3 %
Residual error	σ^2	52.0	57.5 %

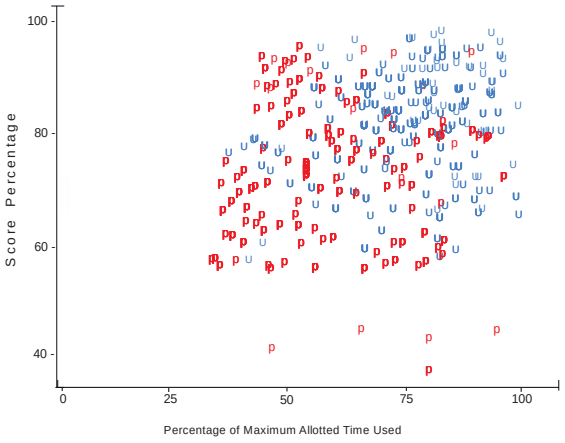
The results of linear mixed–effects models for test scores and the percentage of allotted time used show that the unprocessed tests had significantly higher scores and took significantly longer than the processed tests, while controlling the order of the tests and the number of questions. Table 12–Established coefficients and variance estimates for the linear mixed effects model for the percentage values of test results parameterized in the equation of model 1. The proctoring system not only affected the test results, but also affected how long it would take students to complete the test. The basic tests, consisting of 20 questions without proctoring, show that students need more time to complete subsequent exams. The number of questions did not significantly affect the percentage of time allotted.

Table 13–Established coefficients and variance estimates for the linear mixed effects model as a percentage of the allotted time spent on tests, as indicated in the equation of model 2

Fixed Effect	Linear model 2	Estimation	95% confidence interval
Test 1	z_1	56.10	(46.05; 66.16)
Test 2	z_2	69.67	(58.87; 80.48)
Test 3	z_3	71.43	(60.80; 82.06)
Test 4	z_4	70.50	(59.50; 81.49)
Test 5	z_5	70.50	(59.50; 81.49)
Proctored	β_P	–30.53	(–35.69; –25.36)
Additional questions effect	β_Q	–0.01	(–0.20; 0.18)
Random Effect	Variation	Estimation	Percentage of total variance
Section	σ^2	180.79	28.2 %
Student	σ^2	128.53	21.2 %
Residual error	σ^2	207.19	39.8 %

Note: Developed by the authors

Figure 3. Graph of the test score (%) compared to the amount of time used (%max.) for all the sections combined. The scores correspond to the students in the sections that were processed with the Examus software (blue U), or without the Examus software (Red P).



The results of linear mixed effects models for test results show that the percentage of time used in tests without proctoring scored higher and takes significantly longer than in proctoring tests. We see a clear difference in the testing behavior in Figure 2, which shows the scatter plot of test results and the percentage of allocated time spent with the proctoring status. These findings are that students are looking for prohibited reference materials during testing, and non–compliance with academic integrity is often found in exams.

7 Discussion

Test results are not the only component that takes into account student grades, case studies, homework and other types of work – all this contributed to the final grade in this course. However, the striking difference in scores from tests with proctoring and without proctoring seems to have significantly affected the final scores, as evidenced by the different distributions of final scores. Sixty–five percent of all students in the sections with only tests without proctoring received an A, while 17 % of all students in the sections with tests with proctoring received an A.

8 Conclusion

Thus, the analysis showed:

- a distance learning student does not like the lack of practical classes, but still, if possible, he would not change the form of training;
- the student likes the opportunity to combine the freedom and flexibility of learning with work;
- at the moment, the evaluation activities of distance learning do not achieve the expected results, since most students violate the rules of the distance testing procedure. This is due to the problems of verifying the student and recognizing his behavior during testing;
- test scores of 220 students studying in several sections of the online course were compared using linear models of mixed effects. Students scored an average of 11 points less and used significantly less time in online tests that used proctoring software, compared to tests without proctoring. Significant differences in grades and different use of time occurred on different exams, as within the same course, where some students used the software for testing, and others did not;

Practice shows that the number of violations on the part of exam takers with proctoring is significantly less than without a proctoring system. In disputable situations, the university receives material evidence in the event of an appeal, and students treat the examination procedure more responsibly. Such opportunities are opened by the proctoring technology, which requires further development and wide implementation in all universities of Kazakhstan.

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Primary Paper Section: A

Secondary Paper Section: AM