The Effect of Online Education on the Teachers' Working Time Efficiency

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Abstract

The aim of this work was to study how the teachers' working time efficiency changed with the transition to an online education. This work is the first to compare the teachers' working time effectiveness for two forms of teaching. We used the evaluation of the teacher's self-efficacy and the criteria for evaluating the educational course quality for this purpose. Teachers with the same efficiency and quality indicators were selected. The time spent by teachers on preparing and conducting offline (control group) and online (experimental group) classes was measured. Since the quality of the courses and the teachers' effectiveness were the same, it was sufficient to compare only the time spent by teachers to achieve the same educational goals in order to compare working time efficiency. The research also involved a questionnaire survey. This study found that the current working time efficiency of teachers who work online is less than those who teach traditionally. However, the efficiency of the efficiency of teacher's working time spent on the presentation of new material is higher with online education. This result can be achieved through using self-made video recordings of lectures. The results of the conducted research are of practical importance for teachers who work online. It allows finding the optimal ratio of time spent and results achieved. It is reasonable to further study the influence of a teacher's age, gender, and pedagogical experience on the working time efficiency.

Keywords: teacher's self-efficacy, course quality, TSES scale, MOOC indicators, interactive methods

1. Introduction

The 2020 pandemic has brought changes in all industries, and the education is no exception. McPherson and Pearce (2022) states that teachers and students have developed completely different attitudes, styles and learning strategies over the last three years. Lammert et al. (2022) notes that teachers found alternative methods of teaching and evaluating students in a short period of time. At the same time, relying on the results of research in the field of education and the introduction of educational innovations (Galvis Panqueva & Carvajal, 2022), in particular with the support of technologies (Iqbal & Bhatti, 2020; Hsu & Lin, 2020). Lammert et al. (2022) emphasizes that the role of the teachers has also changed, now they act as adapters for students in the world of science.

Liebowitz and Porter (2019) points out that educational institutions face an important task of providing students with quality education under any, even extreme, conditions. The results of training depend on many factors, one of which is the efficiency of the employees of these institutions. The quality of teaching is influenced by the teachers' professionalism (Haghighi Irani, Chalak & Heidari Tabrizi, 2020), their emotional state and sense of self-efficacy (Smit, Robin & Rietz, 2021). The latter has pedagogical, psychological, educational and other effects (Alibakhshi, Nikdel & Labbafi, 2020), depends on the teacher' gender, age and pedagogical experience, affects the productivity

and quality of teaching (Mashhadlou & Izadpanah, 2021). For example, lifelong learning allows increasing the effectiveness of a teacher's work. Hsu and Lin (2020) pointed out that professional development courses are created for the professional development of teachers.

The 2020 pandemic exposed the vast majority of teachers to stress caused by many factors, including the need to ensure an adequate level of education and arrange the educational process online, that was new for many teachers. Stress entailed a decreased job satisfaction, which in turn had an impact on the quality of education and the results of students' academic performance. Despite all the difficulties, optimal and effective learning methods were found that can be used in online learning.

The aim of this work was to study how the online form of education affected the teacher's working time efficiency.

The aim involved the following objectives:

1) Determine the criteria for evaluating the teacher's effectiveness;

2) Establish the teacher's working time efficiency;

3) Compare the teacher's working time efficiency for online and offline education.

2. Literature Review

Selvaraj et al. (2021) studied the tools that the teachers prefer, and the teaching methods students consider most effective during distance learning. Students consider asynchronous note-taking of lectures ineffective. Selvaraj et al. (2021) states that synchronous interaction adds dynamism to the learning process. Despite the fact that many teachers and students perceive online education as a time-consuming and burdensome process that takes a lot of time and effort, it gives higher results than offline learning. This is explained by a better arrangement of the course, presentation of information in different ways and styles, etc.

According to Noetel et al. (2021), teachers frequently used video among other tools as an alternative to traditional teaching methods in the spring of 2020. Despite the concerns of many teachers, time and research have proven that synchronous video conferences arranged by teachers for students and asynchronous video recordings of lectures, practical and laboratory work can be used as teaching methods in extreme conditions. The effectiveness of video is achieved through the opportunity it gives the student to independently control viewing and studying the material according to one's own capabilities (Shamne, Dotsevych & Akimova, 2019). At the same time, video has become a cost-effective way to create multimedia due to the availability of smartphones. A video can be viewed and edited by the teacher several times before it takes the form of an ideal information resource and reaches students. Such a video usually does not contain inessential items. Noetel et al. (2021) proved that more content does not always mean better learning outcomes.

Chernikova et al. (2020) notes that simulation of certain processes or situations is another effective method of learning. It gives the opportunity to practice making the right professional decisions with minimal risks of negative consequences. Chen et al. (2018) indicates that the computer is often the mediator between the teacher and the student during distance learning. ICT provides additional opportunities in the educational process and contributes to increasing its productivity. The development of technology gave impetus to the popularity of digital video games (DeCoito & Estaiteyeh, 2022) and using virtual reality in the educational process (Fromm et al., 2021). Guillén-Gámez et al. (2022) stated that the preparation of digital educational content in the absence of proper digital literacy took too much time from teachers. And it did not always lead to positive results in achieving the educational goal, as Çamlıbel-Acar and Eveyik-Aydın (2022) found.

According to Heilporn, Lakhal and Bélisle (2021), online learning can be effective when the course is well structured, reach in integrated synchronous and asynchronous types of work on the learning content. This promotes student engagement, which is a key component of their success, but requires significant effort and time of the teacher.

Swart, Nielen and Sikkema-de Jong (2019) found another condition for effective learning during online education, which is maintaining feedback by the teacher with students. This requires a lot of time from the teacher. Moons, Vandervieren and Colpaert (2022) offered using automation tools in order to facilitate the process of arranging feedback.

Macias et al. (2022) studied whether it is possible to ensure the achievement of NGSS goals in the course of online learning. Ghanbari and Nowroozi (2021) emphasized that evaluation in online learning is another challenge faced by teachers. They had to spend additional time to acquire the necessary skills for working with various online platforms

that allow the conducting exams online.

The issue of evaluating the teacher's effectiveness by various methods is considered in the academic literature. For example, using the Cultural-historical Activity Theory (CHAT) (McPherson & Pearce, 2022), or the Educational Process and Data Mining (EPDM) model (Okoye et al., 2020), or through the assessment of the level of teacher's identity (Polizzi et al., 2021). The academic literature survey revealed that there are no uniform international criteria for evaluating the teacher's effectiveness (Serafini, 2018; Prokopenko et al., 2020). And there are also no studies on the teachers' working time efficacy in online education. However, this issue is important because it affects a number of factors: the quality of education, the teacher's effectiveness and his or her psycho-emotional state (Rahmatollahi & Zenouzagh, 2021).

3. Methods

This study was conducted in several stages.

The first stage involved the survey of students and teachers to determine which of the teaching methods are most often used in the course of distance education, as well as which of them, according to students and teachers, are the most effective. Self-assessment of the teacher's effectiveness was also carried out using the Teachers' Sense of Efficacy Scale (TSES scale) (Alibakhshi, Nikdel & Labbafi, 2020) and the quality of the courses developed by the teachers of the sample was assessed by experts according to the Massive Open Online Course indicators (Quiliano-Terreros, Ramirez-Hernandez & Barniol, 2019).

The second stage involved the final sample of teachers, who further participated in the study. The selection was carried out based on the demand for use in online teaching of such teaching methods, which had the highest indicators of the effectiveness and quality of the developed courses according to the self-efficacy scale and according to experts.

At the third stage, teachers were invited to participate in the experiment and conduct it. Each of the teachers had to prepare at least 20 classes in the subject that he or she teaches for conducting them offline (control group), as well as for conducting classes online (experimental group). At the same time, it was necessary to organize all stages of students' work on the content of the course: introduction to the new material, building practical abilities and skills, assessment of the level of knowledge acquired. A mandatory requirement was to record the time spent on preparing classes, conducting them and arranging feedback, as well as to make entries in the online diary.

The fourth stage provided for establishing the relationship between the efficiency of the work performed and the teacher's working time. The time spent by teachers who were part of the control and experimental groups was also compared.

The sample included a total of 78 teachers. All of them had 5 to 30 years of teaching experience. That is, each of them had experience of teaching both offline and online (during a pandemic). There were teachers with academic degrees (7 Doctors and 71 PhDs). They belonged to different age categories (from 30 to 60 years old). Of them, 32 were men, and 46 were women. The study also involved 492 students of the 2nd-3rd years of study in higher education institutions. All of them reached 18 years old at the time of the survey. The average age was 20.3 years. All of them gave their written consent to participate in this study. After the selection carried out at the second stage of the study, 31 teachers continued to participate in it (15 were included in the experimental group, 16 — in the control group).

The study was conducted during one academic year between September 2021 and May 2022. During this period, there was both offline and online education in higher educational institutions. The condition for participation in the study was the implementation of online teaching and learning at the time of the study and the necessary technological competence for this.

The research involved the following methods: surveys based on adapted questionnaires (Çamlıbel-Acar & Eveyik-Aydın, 2022; Selvaraj et al., 2021). Questionnaires were sent to e-mails through Google forms. Quality indicators were also used (Quiliano-Terreros, Ramirez-Hernandez & Barniol, 2019). Besides, mathematical methods for data processing, as well as Statistica application software were used.

4. Results

Figure 1 illustrates the results of a survey of teachers and students regarding the effectiveness of online learning methods.
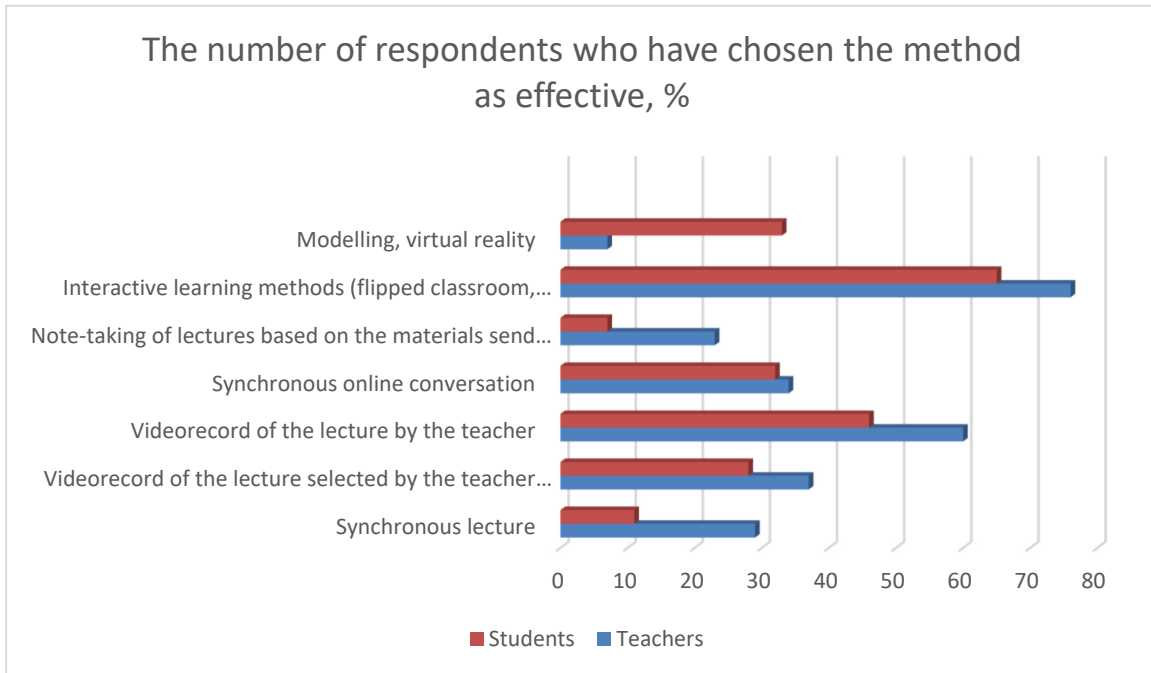

Figure 1. The Results of a Survey of Students and Teachers on the Effectiveness of Online Learning Methods

The average score that the teachers received on the Teachers' Sense of Efficacy Scale (TSESscale) ranged from 3 to 9 (Figure 2).
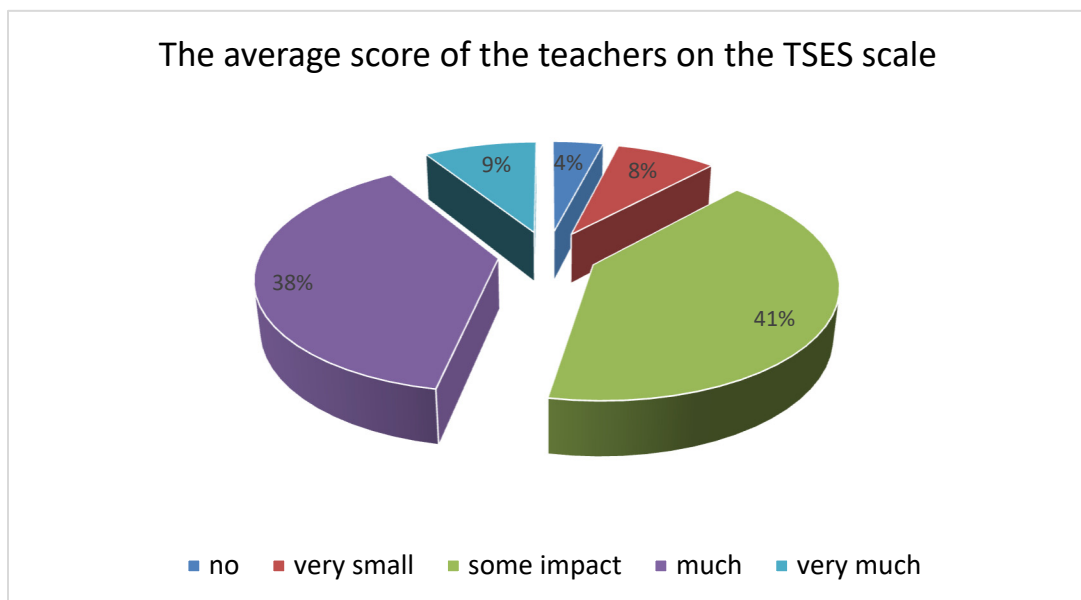

Figure 2. The Ratio of the Number of Teachers by TSES Scores

The experts evaluated the courses developed by the teachers of the sample, which they teach online, through the following indicators: pedagogical (pedagogical approach, accessibility for users, motivational ability); functionality (ease of use, user autonomy, the ability to control, documentation functionality); technological (navigation, the ability to interact, visibility, versatility); time (indicated schedules and schedules of exams, events, meetings, training exercises, availability of a discussion board). According to these indicators, the teachers of the sample had different average scores (Figure 3). However, teachers whose average score for each indicator was not lower than 3 continued to participate in the study. There were 42 of them out of 78 who were evaluated by experts. However, 11 of them did not score 7 points on the TSES scale, so they did not participate in the further experiment.
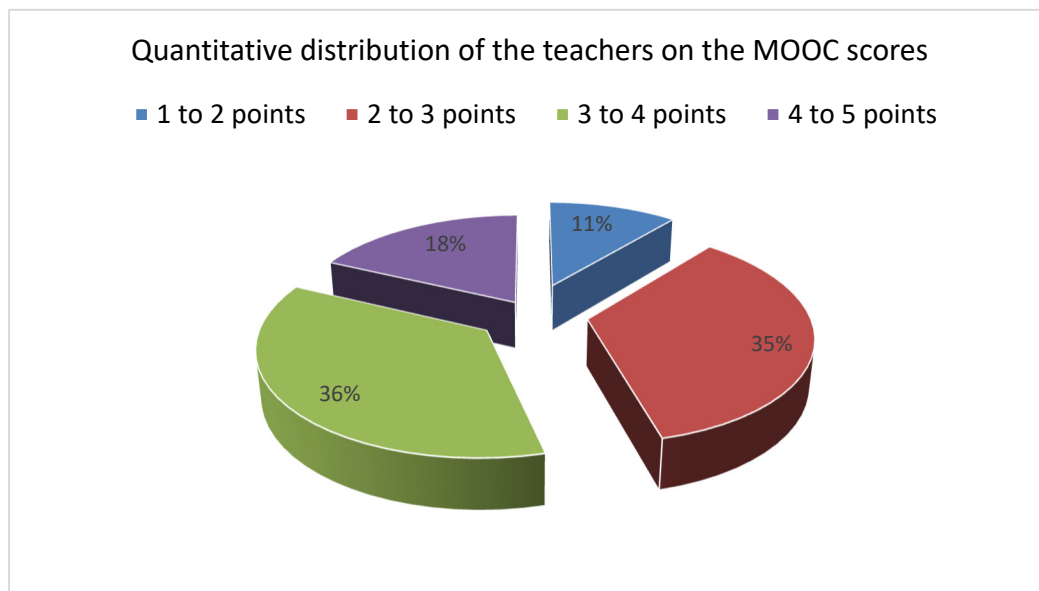

Figure 3. Distribution of the Teachers on the MOOC Scores

The survey of teachers and students conducted at the 1st stage of the research found that the absence of the need to spend time getting to the place of work or study was one of the factors that saved time of both teachers and students during online education. The advantage of online education compared to traditional education was flexibility, which allowed achieving higher results with a larger number of students who, for various reasons, could not always attend classes during traditional education.

At the first stage of the research, it was established that the attempt to reproduce traditional lectures synchronously using online platforms is not effective, so it was not considered in this study. The highest effect could be achieved through simulation of difficult-to-perceive processes, or the use of virtual reality and stimulators to practice the necessary skills and abilities in students. However, this study revealed only 7% of teachers who could implement these types of work in the educational process. Therefore, this type of work was also not taken into account in this study.

Regardless of the complexity of organizing the online learning process, teachers do not have the right to simplify the learning material or, on the contrary, overload students by making them study a large volume of material on their own.

The reports provided by the teachers with the specified types of work and the time spent on their completion showed the step-by-step implementation of the preparatory work. For online lectures, many teachers preferred to use video. These could be records found on the Internet or created by themselves. Comparing the time that teachers spent searching for the necessary video on the Internet with the time they spent recording their own videos, the first method saved time.

But we should take into account that it was not possible to choose a video that would 100% meet the educational needs of particular students with a certain level of knowledge, opportunities at a certain stage of working with educational material, in which emphasis would be placed on the necessary points. Therefore, the resulting effect from such a lecture was lower than from one created by the teacher himself or herself for a particular group. When

preparing video lectures, the teachers divided all the theoretical material into fragments, where each subsequent fragment was built according to the students' perception of the previous material. More than 70% of teachers in the sample did not record a 90-minute video. That is, they did not try to completely reproduce the lecture as it was during offline teaching. Usually, the duration of the video recording was from 15 to 40 minutes. However, teachers spent a lot of time on making and editing a video, from 1 to 4 hours per video. As a result, we received a video without secondary content.

The teacher usually implemented practicing students' abilities and skills in offline education in the course of a conversation, discussion or problem solving. When teaching online, these forms of work did not give the desired result, so the vast majority of teachers had to look for other, more effective teaching methods. For example, 76% of teachers used interactive learning methods: flipped classroom, business games, case studies, problem-based learning, project method, etc. This entailed spending additional teacher's working time. It was necessary to prepare game scenarios, detailed instructions, case materials, think up a list of topics for projects that is larger than in the traditional form of education, etc. At the same time, it is always necessary to plan how it can be implemented with the help of existing technologies used in distance learning. A lot of time was spent on conducting such classes synchronously. They usually lasted from 1 hour to 1 hour and 30 minutes. But this, in turn, provided a higher effect, contributed to the motivation and involvement of students, prompted them to think about the topic being studied, allowed students to integrate the entire content of the material that was studied asynchronously. This helped them deepen their knowledge of the subject, stimulated cognitive activity.

The organization of feedback was another teacher activity that was necessary to achieve the desired learning effect, but on which teachers spent a lot of time. Each of the teachers spent an average of 1 to 3 hours a day on it. In traditional teaching, feedback was provided directly in the classroom during the lesson. Teachers could immediately assess the reaction of students to the educational material, their perception of it, and rearrange the form of its presentation during the lesson. In online learning, arranging feedback takes more effort and time. The evidence is the fact that the time spent on the same dialogue conducted in oral form is much lower than in written form. Therefore, many students lose the desire to maintain such communication. The teacher shall apply various forms of interaction with students, establish trusting relationships and maintain contact regularly in order to overcome such a problem. The teacher's communication with students was not limited to educational material, but also related to organizational issues. For example, joint overcoming of technical difficulties, joint search for methods and forms of presentation of educational material optimal for all students of the group, well-being of students who are forced to spend a lot of time in front of monitors, advice on maintaining health under such conditions, etc. This also resulted in maintaining the effectiveness of learning.

Online evaluation of students' learning outcomes also required significant time to be spend by teachers. Even if the teacher has a questionnaire on paper or in electronic form, it still needs to be entered on the online platform and the necessary settings must be made. For example, they shall provide the settings that will reduce the possibility of dishonestly passing the evaluation of the level of knowledge in the subject.

As Table 1 shows, working time spent by teachers on preparing and conveying new educational material to students can be saved because of no need to read a lecture during online education. The material is presented using a video fragment, the preparation of which takes more time (1.5 hours) than the creation of, for example, a presentation (1 hour). However, the preparation and implementation of the knowledge improvement stage requires an average of 2 hours more with online education, compared to the traditional form. It can be partially (approximately 40 minutes) compensated by organizing control of the level of knowledge. In this case, checking written works of students with an average duration of about 2.5 hours can be replaced by online testing with automatic calculation of results.

Organization and implementation of feedback had the biggest difference in time spent. What is said orally takes much less time than the same written and edited.

So, as we can see from Table 1, the teacher's working time spent for the organization and implementation of the educational process online is still greater than with the traditional form of education. However, it is worth considering that the time spent by teachers on getting to the workplace is saved during online education.

Since the effectiveness of the courses created by the teachers of the control and experimental groups, as well as their effectiveness, were the same, and the time spent by the teachers on creating these courses was greater in the experimental group, it can be concluded that the effectiveness of the working time of the teachers of the experimental group is lower than that of the control group.

The intergroup variance d, which is the weighted sum of the squared deviations of the group means from the overall

mean, ranged from 121 to 714 because of the heterogeneity of the sample. This means the participation in the study of teachers from different educational institutions, with different ages and genders, who work with students with the same level of knowledge.

It was also found that the standard deviation from the mean obtained when evaluating the same criterion was different. At the same time, the intergroup variance, which describes the fluctuations of these groups, and the intragroup variance, which describes the fluctuations caused by random factors not taken into account, are unequal, which indicates that the null hypothesis is not valid.

As for the Pearson test, after calculating the value of χ_1^2 in the experimental group (χ_1^2=3.4), comparing it with $\chi_2^2 = 0.4$ obtained in the control group, it was found that $\chi_1^2 > \chi_2^2$. This is a reason to believe that there is a certain relationship between the teacher effectiveness and the time he or she spends on work.

Table 1. Teachers' Time Spent on Different Types of Work

The stage of the educational process	Type of work	Average time spent by teachers, hours	
		Control group	Experimental group
Learning new material	Preparation of lecture materials	1.3	1.3
	Preparation of visual materials	Presentation	Video fragment
		1	1.5
	Conducting a lecture	1.5	0,1
Total		3.8	2.9
Improving knowledge	Preparation of materials for practical training	1.5	3
	Preparatory organizational stage	0.5	1
	Conducting a practical lesson	1.5	1.5
Total		3.5	5.5
Learning outcomes evaluation	Preparation of assignments	1.5	1.5
	Placing them on a medium accessible to students	0.2	2
	Time of knowledge control	1	0.8
	Checking and communicating results to students	2.5	0.2
Total		5.2	4.5
Arrangement of feedback		0.3	2

Note: Lessons were prepared for standard groups of 18-25 students. None of the students in the group had special educational needs.

5. Discussion

Before the 2020 pandemic, some teachers and students will not be able to learn without interacting with each other directly. Everyone gained the experience of distance learning during the pandemic, learning to work effectively online in a short period of time. Each university has created its own virtual learning environments and has prepared tens of thousands of online courses. This paper evaluates some of them according to the MOOC quality indicators. It was found that more than half of them were rated above 3 points. It was also established that they were created by teachers with a high self-efficacy rating (above 7 points). Of the 200 students and 20 teachers surveyed (Çamlıbel-Acar & Eveyik-Aydın, 2022), 95% of whom had no prior experience working remotely, 57% acquired enough technology skills within a few weeks to feel comfortable. At the same time, 44% indicated that distance learning is flexible, 27% — convenient and comfortable, and 27% noted the improvement of relations between the participants of the educational process. However, a fourth of the respondents consider distance learning to be a

boring, complicated process that contributes to the loss of desire to attend classes. Although there are other opinions.

According to Li, Ma and Liu (2022), about 32% of teachers surveyed in August 2020 had a negative attitude towards distance learning. And almost half of the respondents confirmed the large volume of work that had to be done because of the transition to online learning. There were 13% of respondents who had health problems caused by distance learning (eyes, back, etc.), 15% complained about technical problems (low-quality Internet, high-quality technical equipment). According to Selvaraj et al. (2021), 89% of teachers and almost 93% of students indicated that offline learning was more effective than online learning. And only 6% of teachers and 3.6% of students are convinced that the effectiveness is the same. Smit, Robin and Rietz (2021) states that a low sense of effectiveness itself can lead to increased stress and a decrease in the efforts that the teacher makes in preparing for classes.

Teachers should take all these factors should be taken into account when planning their courses. This, of course, entails spending additional time by teachers and a decreased efficiency. As this study showed, the students should not be overloaded with large volumes of materials for independent study in order to save time spent on preparing online classes, as this does not contribute to achieving high learning outcomes. The efficiency of the teachers' working time depended on what exactly they focused on: on recreating the classroom environment in online learning, or on the implementation of effective teaching methods. These include video recordings of lectures, the effectiveness of which was confirmed by this study, as well as Noetel et al. (2021), whose total sample was 7,776 students. The authors proved that the complete replacement of traditional teaching methods with video recordings of lectures significantly increase student learning outcomes in almost half of the considered cases. And supplementing traditional teaching methods with viewing videos significantly improves student performance. Therefore, it can be an effective alternative during the pandemic. This study showed that the video saves the time that the students spend to learn the information it carries. A 1.5-hour offline lecture can be completely fit into a 40-minute video. This is due to the fact that the teacher is more critical about the content of the lecture, choosing the main points, while omitting the secondary ones. Besides, multimedia is more effective than traditional methods.

Selvaraj et al. (2021) found that video recordings of lectures (70%) and synchronous online lectures (20%) are most often used. They were used in line with various tools: television, radio, online platforms (GoogleMeet, Zoom, WhatsApp, YouTube, etc.). According to students, online discussions and synchronous discussions contribute the most to learning. Almost 100% of students solved the problems related to having electronic devices at home to organize proper online learning.

The teachers complain that the transition to online education blurred a clear boundary between working and personal time. According to Çamlıbel-Acar and Eveyik-Aydın (2022), this has led to a sense of increased working hours, availability for students and colleagues around the clock, seven days a week. Moons, Vandervieren and Colpaert (2022) found that 49% of the surveyed teachers of the European Union consider the process of maintaining feedback quite cumbersome and exhausting. The same opinion is held by 53% of surveyed teachers in Great Britain.

The feeling of pedagogical discomfort disappeared with the acquisition of experience in online teaching, while new technological skills were acquired. Çamlıbel-Acar and Eveyik-Aydın (2022) proved that this was also facilitated by the organization and conduct of training on the features of distance education, which gave practical skills for conducting various forms of work on some online platforms. The teachers and students saved time during online education was because they didn't have to spend time and energy on getting to the educational institution. It allowed focusing more on the study itself. According to Selvaraj et al. (2021), only about 7% of teachers conducted classes offline in an educational institution.

The surveyed teachers indicated the time they spend on online classes on average per week: 55% — from 3 to 4 hours; 28% — from 4 to 8 hours; 10% — from 8 to 12 hours; 7% — more than 12 hours a week (Selvaraj et al., 2021).

It was established that teachers experienced the biggest problems in the organization of online training at the beginning of the pandemic. A year later, the students have overcome a low motivation observed at the beginning of the pandemic through greater involvement of students in synchronous discussions (Macias et al., 2022), as well as participation in quizzes, forums, interactive videos, game programmes, etc. (Heilporn, Lakhal & Bélisle, 2021). And it is not necessary to attend offline lectures for this purpose (Lu & Cutumisu, 2022). A wide selection of topics for study also helps to enhance students' engagement, although it also increases the time that the teacher has to spend on their selection.

Heilporn, Lakhal and Bélisle (2021) holds that establishing a trusting relationship between the teacher and students also motivates students to study and promotes their involvement. Moreover, it requires additional teacher's time to be

spent, for example, on a weekly correspondence with students via e-mail, social networks, etc. The teacher must give timely feedback on the activities of each student, demonstrate his or her interest in the students' success, thereby stimulating them. The teacher's working time efficiency during online education also depends on the number of students in the group (Heilporn, Lakhal & Bélisle, 2021).

This study had certain limitations. The dependence of the teacher's working time efficiency on the age, gender, pedagogical experience, self-education, etc. was not established. Besides, it was limited in time. The period of the experiment did not take into account the stressful moment of the abrupt transition from offline to distance education. The experiment was conducted at a time when most teachers already had adequate online teaching skills to be sufficiently effective.

6. Conclusions

The current realities of natural and social dangers dictate new requirements to society, including the ability to teach and learn online. This work is a study of how well teachers are prepared for this in order to be effective in their professional activities without excessive spending of working time. The results obtained indicate that the teachers' working time efficiency in online learning is currently somewhat lower than the working time efficiency of teachers who work with students offline.

This effect is observed during the preparation, organization and implementation of the stage of improving students' knowledge. But providing feedback is the most time-consuming. Although in some types of work, the teacher's working time efficiency is higher with online learning, for example, when introducing students into new material and evaluating learning outcomes. These results are of practical importance for teachers and researchers who are working not only to improve the online educational process, but also to preserve the teacher's effectiveness, while preventing excessive spending of working time. Future research should be conducted to determine the dependence of the teacher's working time efficiency on the teacher's age, gender, pedagogical experience, self-education, etc. It is also reasonable to study how the dynamics of the dependence of the educational process effectiveness on the time spent by the teacher on its organization and implementation.

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