

# Identification of the determinants of students' preferences in their choice of study mode in economics majors

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**Abstract.** The COVID-19 pandemic affected the methods and results of teaching, posed many challenges, and changed the approach to education, providing an opportunity to review and reconsider the pros and cons of different modes of education. The aim of the study discussed in the article is to determine the factors influencing students' preferences for taking different classes remotely or onsite. The data were obtained through a survey sent to the largest economics universities in Poland, which distributed the link to the survey among their students via email. The study was extended over the period from 4th November 2020 to 31st March 2021 and a total of 604 students took part in it. The authors compared the results relating to general and statistics courses, taking into account the following factors: efficiency, fatigue, concentration, students' activity, workload, quality of lecturers' preparation for classes and the materials used, as well as the availability of the teacher. Statistical methods were used for the analysis, including non-parametric tests and a generalised linear model (GLM).

The respondents considered distance learning more complicated and time-consuming than onsite studying. Students were less active during online statistics courses, which were perceived as more tiring and less effective compared to general courses conducted remotely. The respondents declared a greater need for contact with the lecturers of general courses than the statistics ones. This was due to the lower quality of the provided teaching materials and lower availability of the lecturers of general courses. The ability to focus proved a decisive factor in the choice of the mode of courses in statistics. As regards general subjects, the choices were determined by the degree of fatigue.

**Keywords:** distance learning, statistics courses, majors in economics, GLM, students' preferences

**JEL:** A22, C19, C25, I21, I23

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# Identyfikacja wyznaczników preferencji studentów dotyczących trybu studiowania na kierunkach ekonomicznych

**Streszczenie.** Pandemia COVID-19 wpłynęła na sposób i wyniki nauczania. Postawiła wiele wyzwań, zmieniła podejście do edukacji i dała możliwość zweryfikowania zalet i wad różnych trybów kształcenia. Celem badania omawianego w artykule jest określenie czynników wpływających na preferencje studentów dotyczące odbywania zajęć zdalnie lub stacjonarnie. Dane uzyskano z kwestionariusza ankiety wysłanego do największych uczelni ekonomicznych w Polsce, które e-mailowo przekazały swoim studentom link do ankiety. Badanie trwało od 4 listopada 2020 r. do 31 marca 2021 r.; wzięło w nim udział 604 studentów. Porównano wyniki dotyczące przedmiotów ogólnych i statystycznych, biorąc pod uwagę następujące czynniki: efektywność, zmęczenie, koncentracja, aktywność, obciążenie pracą, przygotowanie wykładowców i materiałów oraz kontakt z nauczycielem. W analizach zastosowano metody statystyczne, m.in. testy nieparametryczne i uogólniony model liniowy.

Respondenci uznali kształcenie na odległość za bardziej skomplikowane i czasochłonne niż kształcenie stacjonarne. Aktywność na zajęciach online ze statystyki ocenili jako mniejszą, a same zajęcia – jako bardziej męczące i mniej efektywne w porównaniu z przedmiotami ogólnymi nauczonymi zdalnie. Deklarowali większą potrzebę kontaktu z wykładowcami przedmiotów ogólnych niż statystycznych, co uzasadniali gorszym przygotowaniem materiałów i gorszym kontaktem z wykładowcami niż na zajęciach ze statystyki. Jako czynnik decydujący o wyborze trybu zajęć ze statystyki zidentyfikowano zdolność skupienia uwagi. W przypadku przedmiotów ogólnych wybór ten był determinowany poziomem zmęczenia.

**Słowa kluczowe:** kształcenie na odległość, przedmioty statystyczne, kierunki ekonomiczne, uogólniony model liniowy, preferencje studentów

## 1. Introduction

The global COVID-19 pandemic, ongoing since March 2020, has undoubtedly affected teaching methods and outcomes. Initially, universities around the world suspended face-to-face teaching and replaced it with online digital educational platforms (Adedoyin & Soykan, 2023). In the second year of the pandemic, many universities turned towards hybrid forms of teaching while planning for the 2021–2022 academic year. The need to transition from in-person to distance learning provided an opportunity to review students' preferences in their choice of the mode of learning.

In many countries, digital transformation (Kopp et al., 2019) and distance learning are not new phenomena, although they often occur only in traditional e-learning. The situation changed due to the COVID-19 pandemic, which ushered in a digital transformation of higher education, eventually resulting in innovations that would otherwise have taken many years. In some cases, changes in regulations were introduced within a few days (Strielkowski, 2020). Most universities initially lacked

the technical capability and strategy for these changes (Zhang et al., 2020). In Poland, universities had very little experience with online teaching, which until the pandemic had never been popular, and teachers had only basic or intermediate skills in using and applying IT. During the pandemic, their skills improved (see, e.g. Batorski et al., 2014; Błaszczński & Srokowski, 2018; Błaszczński et al., 2017; Demeshkant, 2020; Instytut Badań Edukacyjnych, 2013; Romaniuk & Łukasiewicz-Wielba, 2021; Tomczyk & Srokowski, 2016). Online classes have now become commonplace, and the Polish government is supporting many innovative initiatives in this area. The Microsoft Teams platform has become very popular in Poland, also at universities of economics. Many online learning platforms have also started offering free access to their services in response to the high demand.

Researchers worldwide are conducting various types of studies on the impact of the pandemic on different fields of both economics and education. Analyses of the methods, modalities and the quality of education have focused on the opinions of both students and academic teachers. Muthuprasad et al. (2021) show that during the COVID-19 pandemic, most students in India (70%) opted for online classes. Students pointed to the flexibility of such courses as the main reason for their popularity. Several studies also demonstrate that online and traditional education can be equally effective (Butnaru et al., 2021; Comi et al., 2017; Zalewska & Trzcińska, 2022).

In some research, students rated their own skills (Butnaru et al., 2021), while in others they assessed their teachers, indicating, for example, that instructors had improved their online teaching skills since the beginning of the pandemic (68.1%) and that online education was now pragmatic (77.9%; Chakraborty et al., 2021). They also rated highly online learning software and materials used to support distance learning.

Within the span of two years, remote learning became widespread, created a highly personalised and dynamic learning environment for higher education, and gained increasing popularity (Barrat & Durran, 2021). However, course completion rates and student activity declined (Kuo et al., 2021). Respondents claimed online education was stressful and negatively affected their health and social life (Barrat & Durran, 2021).

Statistics-related courses require both the use of a whiteboard (to write out mathematical formulae) and specialised computer programmes. It was revealed that student activity and concentration declined as courses, particularly those in statistics, were taught remotely. Many students feared potential poor performance during courses in statistics (Zhang et al., 2021), especially if they were taught remotely. Those attitudes towards statistics and mathematical subjects have previously been the subject of research (Primi et al., 2020). Similar perspectives can be observed in

Poland, as evidenced by a survey conducted at universities of economics. The pandemic posed many challenges, changed the attitude to education and its methods, and at the same time, made direct social contact more difficult, negatively affecting students' mental health and wellbeing. On the other hand, this kind of instruction saved time and financial resources and contributed to the enhancement of several competencies of both lecturers and students. The pandemic also opened a new perspective on the 'global citizenship' within higher education (Blanco, 2021; Guimarães & Finardi, 2021).

Various types of research relating to the pandemic have become popular in social sciences. This study was carried out during the second wave of the pandemic in Poland, so when remote teaching had already become established practice in universities of economics. Throughout the 2020/2021 academic year, classes at most such universities were conducted exclusively online, so at the time the survey was conducted, students were already able to assess the effectiveness of remote classes and estimate the time required to master the knowledge to a satisfactory degree. They were also able to compare classes in statistics to those in other subjects, which, among other things, offered hints on how to improve the quality of teaching statistics, and which new methods to turn to.

The aim of the article is to determine the factors influencing student preferences for taking different courses/subjects remotely or onsite. The research hypotheses that students tend to work harder during traditional onsite studies than while studying in a distance-learning mode, and that they are less involved and focused in the latter case, especially during statistics courses, have been confirmed.

The article presents the results of the research on various aspects and preferences relating to distance learning carried out among students in Poland, mostly those majoring in economics.

## **2. Research method**

The subject of the study was the analysis of the results of a survey conducted between 4th November 2020 and 31st March 2021, when universities of economics in Poland adopted remote teaching as their main teaching mode. The survey used the CAWI (Computer-Assisted Web Interview) method. The questionnaire was sent to the nine largest economic universities in Poland, which circulated it among their students via email and through social media. The size of the overall student population was 25,232, of whom 604 (2,4% of the population) took part in our research. The study took into account mainly Finance and Accounting, Economics, Economic Analytics, Administration, Logistics and IT in Business.

Women constituted almost 60% of the respondents and almost 70% of them were full-time students. BA students accounted for 93.4% of the sample, and MA students for 6.6%. Students living in rural areas constituted 29% of the sample, those from small towns (up to 50,000 inhabitants) 17.5%, residents of medium-sized towns (50,000–100,000 inhabitants) and of large cities (100,000–500,000 inhabitants) 8.5% each, and those from Poland's largest cities (over 500,000 inhabitants) 36.5%.

The survey was divided into three sections: general subjects (excluding statistics-related; 13 questions), statistics-related subjects (13 questions), statistical programmes (three questions), and a survey metric (six questions). All questions were obligatory once the student decided to take part in the survey. Most questions were closed and used a Likert scale of five responses arranged in the order from complete rejection to complete acceptance. A few were based on a three-point scale and another few on a seven-point scale. Questions designed to compare different forms of instruction concerned lectures, classes, laboratories, consultations and seminars. A detailed description of the questions and answers will be presented later in the article.

The analysis took into account different aspects of the individual evaluation of the effectiveness of the courses, concentration skills, fatigue, activity and workload. Comparisons were made between courses in statistics and general courses on the basis of answers to questions on the willingness to participate in classes, the preferred mode of classes, methods and software, and quality of preparation for classes both by lecturers and students. The answers were analysed in pairs, i.e. the answers to the same question asked about statistics courses and about non-statistics courses, in the first two parts of the survey.

The study adopted statistical methods. Data analysis was based on descriptive measures and non-parametric tests. Most of the data were qualitative, collected as ordinal variables. In order to determine whether there were differences in the examined aspects between the modes of learning and types of courses and due to the presence of nominal or ordinal variables, the following statistical tools were used: the Kolmogorov-Smirnov distribution compatibility test, the Wilcoxon test for pairwise observations, the Kruskal-Wallis test, and the Mann-Whitney U test. In addition, a chi-square test and Yule's coefficient of association were applied to determine the presence of a relationship and its strength between the studied variables and the student's gender and his or her mode of learning.

We also wanted to identify the factors that influenced students' preferences for different modes of courses (stationary, real-time online, asynchronous online) using regression models. Since the dependent variable was a categorical one (with more than two categories), we applied the multinomial generalised linear model (multinomial GLM). All analyses were performed using the Statistics, SPSS and Jamovi programmes.

### 3. Results and discussion

#### 3.1. Activity and effort

Students were asked to indicate their willingness to take an active part in onsite classes, real-time online classes and asynchronous online classes. Almost 22% of the students did not have asynchronous classes. First-year students, who did not have full-time classes in statistics, were excluded from the analyses. There were significant differences between the declared level of activity during classes in statistics and general subjects, regardless of the mode of the course (Wilcoxon test,  $p = 0.000$ ). Students who were more likely to volunteer to answer during general classes were less likely to be active in statistics subjects. The Kolmogorov-Smirnov test, used to compare response distributions only in the case of asynchronous classes, indicated that the distributions were the same for both statistics-related courses and other courses ( $p > 0.1000$ ). In the case of in-person lectures ( $p < 0.0010$ ) and online classes ( $p < 0.0050$ ), the distributions differed. This confirmed that students were less active during statistics courses taught remotely than during other courses taught in such a mode.

Students were asked which remote or onsite activities they put more work into, and then write how many percent more. Almost 57.5% of students put more work into remote activities in general subjects, while 55.2% in statistics courses. The type of activities in which students put more work (online/stationary) did not depend on gender (chi-square test of independence for general courses was  $p = 0.8345$ ; for statistics courses  $p = 0.5574$ ). Gender likewise had no effect on the responses. Similarly, the mode of the study did not affect the responses nor did it affect which type of activities students put more effort into (for general courses  $p = 0.1194$ ; for statistics courses  $p = 0.1684$ ). Accordingly, 40.5% and 42.9% of full-time students put more work into remotely-taught general and statistics subjects. Almost 47.3% and 49% of the distance learning students put more work into remote learning of general and statistics subjects, respectively. Applying the Wilcoxon test, no significant differences could be seen in the responses for general and statistics subjects. There were no grounds to reject the hypothesis that the medians of the amount of the work put into learning are equal ( $p = 0.2753$ ). Furthermore, the distributions of the responses can be considered identical ( $p > 0.1000$ ).

Additionally, students were asked how much more effort they put into their studies. 18 students of general subjects, and 20 students of statistics courses, did not participate in a full-time study programme and so were excluded from this part of the survey. A test of equality of the measures of location (mean value) and dispersion (variance) of additional time spent studying was performed on the basis of the

responses of the remaining (full-time) students. They declared putting more effort into remote than to onsite learning (mean  $p = 0.8406$ ; variance  $p = 0.7087$ ). For students devoting more effort to onsite learning than into other forms of study, the values  $p = 0.6105$  (mean) and  $p = 0.0883$  (variance) were obtained, respectively. Table 1 shows the values for each analysed group (onsite and remote). Students declared spending less time on studying in the remote mode compared to stationary classes. Other analyses show that they also had more learning materials prepared by lecturers of statistics courses, who were much better prepared for lectures than academic teachers of other subjects or all lecturers in general.

**Table 1.** The parameters of the declared by students additional time put into onsite and distance learning

Variable	Mean	Median	Modal	Min	Max	Q1	Q3	Standard deviation	Coefficient of variation
	in %								
<b>Onsite learning</b>									
General courses .....	47.14	47.50	50.00	0.00	200.00	30.00	60.00	200.00	58.21
Statistics courses .....	46.00	42.50	50.00	0.00	200.00	20.00	60.00	200.00	65.53
<b>Distance learning</b>									
General courses .....	40.54	30.00	50.00	10.00	250.00	20.00	50.00	240.00	65.49
Statistics courses .....	40.07	30.00	50.00	10.00	150.00	20.00	50.00	150.00	64.72

Source: authors' work based on the survey results.

### 3.2. Tiredness, concentration and efficiency

Compared to onsite, general courses held online were declared to be less tiring than online classes in statistics<sup>1</sup> (Wilcoxon test,  $p < 0.000$ ) by 42.4% of students and over 27% of students in statistics subjects. The Mann-Whitney U test indicated ( $p = 0.000$ ) that the distribution of responses for both onsite and statistics classes differed in terms of gender and mode of learning. Classes conducted in the remote-learning mode were more tiring for women than for men and for full-time students than for part-time ones (for general courses: Me = 2 for women, Me = 4 for men, for statistics courses: Me = Q<sub>3</sub> = 3 for women, Me = 3, Q<sub>3</sub> = 4 for men; for general courses: Me = 2 for full-time students, Me = 4 for part-time students, for statistics: Me = 2 for full-time students, Me = 3 for part-time students).<sup>2</sup>

Statistics classes held in the distance-learning mode compared to those conducted onsite were declared less effective than in the case of general courses held in the same

<sup>1</sup> Answers to this question: 1 – much more tiring, 2 – more tiring, 3 – equally tiring, 4 – less tiring, 5 – considerably less tiring.

<sup>2</sup> Answers to this question: 1 – significantly more tiring, 2 – more tiring, 3 – equally tiring, 4 – less tiring, 5 – significantly less tiring.

mode<sup>3</sup> by nearly 62% of male students and more than 46.1% of female students taking general subjects. More than 11.3% (almost 14.6%) and 3.3% (5.13%) of students indicated that statistics classes were more effective in a remote mode, while 3.3% stated they were significantly more effective (nearly 4.6% and 5.13% said the same with regard to general classes). In total, this is 5.13% fewer students than in the case of general subjects.

The distributions of responses were not the same (Kolmogorov-Smirnov test,  $p < 0.0010$ ). Furthermore, there were significant differences in both responses. The hypothesis on the equality of the median responses above was thus rejected ( $p = 0.000$ ).

There were significant differences between students' declared concentration during statistics courses and general courses (Wilcoxon test,  $p = 0.000$ ). 23% of students reported that statistics courses required more concentration when held online than in person, while 20% believed the same was true for all non-statistics courses. On the other hand, 59% of students reported that statistics courses required less concentration when held online than in person, and 47% said the same about the general courses. In general subjects (Kolmogorov-Smirnov test,  $p = 0.1020$ ) and statistics subjects (Kolmogorov-Smirnov test,  $p = 0.2250$ ), women had to concentrate less than men. Such differences were not observed between full-time and part-time students (Kolmogorov-Smirnov test,  $p = 0.000$ ).

### 3.3. Preference of the form of courses and used methods

Respondents specified which form of class mode (asynchronous online, real-time online, stationary) and to what degree<sup>4</sup> they preferred lectures, classes, laboratories, consultations and seminars. Every second student preferred real-time online lectures, of whom a half indicated a definite preference (presented in Table 2). As regards classes and laboratories, approximately 70% of students preferred them conducted in person, out of which 44% preferred them definitely more. Almost the same percentage, about 46–47%, preferred consultations online in real-time over the in-person form (and a smaller percentage indicated a definite preference). Every second student preferred real-time online seminars.

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<sup>3</sup> Answers to this question: 1 – much more effective, 2 – more effective, 3 – equally effective, 4 – less effective, 5 – significantly less effective.

<sup>4</sup> Answers to this question: 1 – slightly more, 2 – moderately more, 3 – definitely more.



**Table 2.** Preference of class mode by type of course

Class mode	Preferred form	Degree of preference		
		slightly more	moderately more	definitely more
	in %			
<b>Lectures</b>				
Asynchronous online .....	21.85	13.64	33.33	53.03
Real-time online .....	53.31	12.73	38.20	49.07
Stationary .....	24.83	20.00	34.00	46.00
<b>Total</b> .....	.	<b>14.74</b>	<b>36.09</b>	<b>49.17</b>
<b>Classes</b>				
Asynchronous online .....	4.80	24.14	27.59	48.28
Real-time online .....	25.99	20.38	45.86	33.76
Stationary .....	69.21	22.97	33.01	44.02
<b>Total</b> .....	.	<b>22.35</b>	<b>36.09</b>	<b>41.56</b>
<b>Laboratories</b>				
Asynchronous online .....	6.29	21.05	42.11	36.84
Real-time online .....	23.18	15.00	46.43	38.57
Stationary .....	70.53	25.12	33.57	41.31
<b>Total</b> .....	.	<b>22.52</b>	<b>37.09</b>	<b>40.40</b>
<b>Consultations</b>				
Asynchronous online .....	6.95	42.86	38.10	19.05
Real-time online .....	46.03	29.86	43.88	26.26
Stationary .....	47.02	27.82	40.85	31.34
<b>Total</b> .....	.	<b>29.80</b>	<b>42.05</b>	<b>28.15</b>
<b>Seminars</b>				
Asynchronous online .....	7.62	17.39	43.48	39.13
Real-time online .....	39.74	28.75	44.17	27.08
Stationary .....	52.65	26.10	42.14	31.76
<b>Total</b> .....	.	<b>26.49</b>	<b>43.05</b>	<b>30.46</b>

Source: authors' work based on the survey results.

More than 50% of students preferred lectures in a remote form. Almost 25% of respondents preferred full-time lectures in statistics, while for general subjects it was 30%. The majority of respondents (about 70%) liked participating in statistics courses and laboratory work in the onsite form. In the case of general subjects, such a form of lectures was chosen by about 65% of students. Slightly over 46% preferred statistics consultations online in real-time, and 47% liked more in-person statistics classes. There were similar proportions for statistics classes, i.e. 48% and 44%, respectively. In-person seminars in statistics were chosen by about 50% of the respondents, and online real-time ones by 40%. As the pairwise comparison of the responses for general subjects and the statistics subjects, and the performance of the Wilcoxon test demonstrate, the hypothesis about significant changes in responses concerning lectures ( $p = 0.000$ ), exercises ( $p = 0.000$ ), laboratories ( $p = 0.0400$ ) and

seminars ( $p = 0.0300$ ) can be accepted. Statistically, students were more likely to choose statistics courses in an onsite form. Only in the case of consultations there was no basis for rejecting the hypothesis that the medians of the two responses were equal ( $p = 0.0900$ ). Analogous conclusions could be reached for the hypothesis about the identity of distributions. There are no foundations for rejecting such a hypothesis only in the case of consultations (Kolmogorov-Smirnov test,  $p > 0.1000$ , in other forms of courses,  $p < 0.0010$ ). Statistics subjects were regarded by students as more difficult, so in their opinion, classes should take place in an onsite form.

Distance lectures in statistics were preferred by 51% of the students, of whom 42.5% definitely preferred such a mode of learning, and almost 45.5% preferred it moderately. Statistically, onsite lectures would be chosen by 29% of students, of which more than 48% definitely preferred such a form of classes, and over 35.5% did so moderately. Almost 66% of students preferred in-person exercises and laboratories (46% definitely preferred this mode of exercises and laboratories, and 34% preferred it moderately). Nearly 44% of respondents would like to have consultations in an in-person form, while 48% preferred a distance mode. As regards seminars, 50% of students preferred having them in an onsite form, while 40.5% were more inclined towards the remote mode. Online real-time classes were moderately preferred by approximately 55% of respondents, and the onsite ones by approximately 40%.

Students were also asked about solving problems on the whiteboard and using computer programmes during statistics classes, and which of these two forms of problem-solving they preferred. Almost 6.8% of them said there were no tasks performed on the board during their classes, whereas for 7.5% it was the only method for doing all the tasks. 34.4% of the respondents indicated they did a small part of their assignments on the whiteboard, for 24.8% it was the method used to do about half of their assignments, and 26.5% said they used the whiteboard to do most of their tasks. Only 2.8% of students indicated that in their classes no tasks were performed using computer programmes, while 15.4% said that all tasks were done in this manner. A minority of problems solved using computer programmes was indicated by 11.4% of the respondents, while 49.3% of students pointed to this method as the most frequently-used way of solving problems. Full-time students more often indicated that their assignments were done using computer programmes than part-time students.

There was a strong relationship between the mode of instruction and the preferred method of doing tasks ( $p = 0.000$ ). 50.5% of respondents solved problems by means of computer programmes while learning in a remote mode, and 42.4% used a mixed method for this purpose. The preference of the mixed method was indicated by 47.7% of respondents and the whiteboard method by 28.5%. Solving

problems using computer programmes was the least popular method in classes held in the onsite learning mode. The form of classes differs depending on the choice of the method used in solving the tasks (Wilcoxon test,  $p = 0.000$ ).

In addition, respondents expressed their opinion on the usefulness of the given forms of problem-solving related to quantitative issues in their future professional life. A chi-square test demonstrated that there was no relationship between the form of solving problems in professional life and gender, but there was a very weak (Yule's  $\phi = 0.11$ ), yet significant ( $p = 0.0300$ ) relationship between that and the mode of studying. Full-time students more often than part-time students indicated 'using computer programmes' (75% vs. 66%), while a 'mixed' form was less popular (23% vs. 28%).

### **3.4. Lecturers: quality of preparation and contact**

The next phase of the study concerned students' evaluation of the quality of lecturers' preparation for distance learning courses, as well as the quality of the supplementary teaching materials. The response distributions were not equal (Kolmogorov-Smirnov test,  $p < 0.001$ ). The answers differed in pairs. Students rated the quality of lecturers' preparation for statistics subjects higher than for other subjects (Wilcoxon test,  $p = 0.000$ ). The mean grade for lecturers of general courses in the sample was 4.16, with a standard deviation of 0.714. The mean score of lecturers of statistics subjects was 4.4, with a standard deviation of 0.719. The average ratings were not equal, as confirmed by a test of the equality of averages ( $p = 0.000$ ). Lecturers of statistics were assessed very well by 52% of students, whereas for general courses lecturers it was 32%. Lecturers of statistics were assessed as good by almost 37% of respondents, and lecturers of general courses were similarly evaluated by 53% of students.

The respondents' evaluation of the quality of the preparation of lecturers of general subjects for classes depended on gender (chi-square test,  $p = 0.0253$ ) and the mode of study ( $p = 0.0030$ ), while for lecturers of statistics subjects, such relationships were not observed ( $p = 0.5550$  and  $p = 0.5890$ , respectively). Almost 49.8% of male and 53.48% of female respondents assessed the quality of statistics lecturers' preparation for classes very well, and approximately 36.5% of both male and female students gave them good ratings (median female rating = 5, median male rating = 4).<sup>5</sup> 53.5% of men and 52.6% of women rated lecturers of general subjects well (median grade = 4), while 28% of men and 35% of women assessed them very well. There were outliers in the ratings ('bad' and 'very bad') for men in general subjects and for women in statistics courses. These were 3.7% and 1.1%, respectively.

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<sup>5</sup> Answers to this question: 1 – very bad, 2 – bad, 3 – average, 4 – good, 5 – very good.

The average male-awarded score for lecturers of general subjects was 4.06 and for lecturers of statistics 4.36, while women's ratings for the same categories of lecturers were 4.22 and 4.42, respectively.

The median of ratings according to the mode of study was 4 (for general subjects) and 5 (for statistics subjects). Almost 51.4% (37.4%) of full-time and 53.3% (34.8%) of part-time students gave very good (good) marks to statistics lecturers. It was different for the lecturers of general subjects. More than 52% of full-time students and almost 55% of part-time students rated these lecturers well; 35% and 26% of these respondents, respectively, rated them very well. There were outliers ('bad' and 'very bad') in the ratings of lecturers of general subjects. These accounted for 1.82% of all responses. There was 1% of outliers in the case of the ratings of lecturers of statistics subjects.

The response distributions regarding the quality of materials prepared for lectures were not equal (Kolmogorov-Smirnov test,  $p = 0.000$ ). Materials for statistics courses were seen by students as prepared with more diligence (almost 90% rated their quality as good or very good) than the materials for general courses (almost 80% rated them as good or very good; Wilcoxon test,  $p = 0.000$ ). These percentages were not equal, as confirmed by a test of the equality of proportions ( $p = 0.000$ ).

The assessment of the quality of the materials prepared by lecturers for general courses depended on gender (Mann-Whitney U test,  $p = 0.0420$ ). Women (83.5%) assessed the materials more positively than men (75.5%), while no such dependencies were observed in the case of the assessment of materials for statistics courses (Mann-Whitney U test,  $p = 0.1600$ ). No relationship was detected between the assessment of the preparation of materials and respondents' mode of study, both regarding general and statistics courses (Mann-Whitney U test,  $p = 0.5580$  and  $p = 0.4480$ , respectively). Nearly 91% of female and 87% of male respondents assessed the materials for statistics courses as very good or good. Almost 81% of full-time students and 78% of part-time students assessed materials for general courses as very good or good. Approximately 89% of full-time students and 90% of part-time students assessed materials for statistics courses as very good or good.

Students were then asked how often they contacted lecturers after classes. Here we were comparing onsite, real-time online and asynchronous online types of classes. Almost 30% of students declared there were no asynchronous online classes available for them. For all types of courses, the Wilcoxon test indicated a significant change regarding the level of activity for statistics courses compared to the general ones ( $p < 0.0010$ ). For all types of courses, students more often made use of contact with a lecturer for general subjects.

### 3.5. Factors influencing preferences

We were interested to determine which factors influenced students' preferences regarding the mode of studying (onsite, real-time online, or asynchronous online courses). These factors were: activity, the quality of the contact with the lecturer, workload, the quality of lecturers' preparation, the quality of supplementary teaching materials, the concentration level, tiredness and efficiency. The dependent variable was a categorical (with more than two categories), so the multinomial generalised linear model (multinomial GLM) was applied. Not all dependent variables turned out to be statistically significant (5%), so we decided to remove those from further analysis using a backward stepwise selection. Ultimately, there was a significant main effect for the factors included in Table 3.

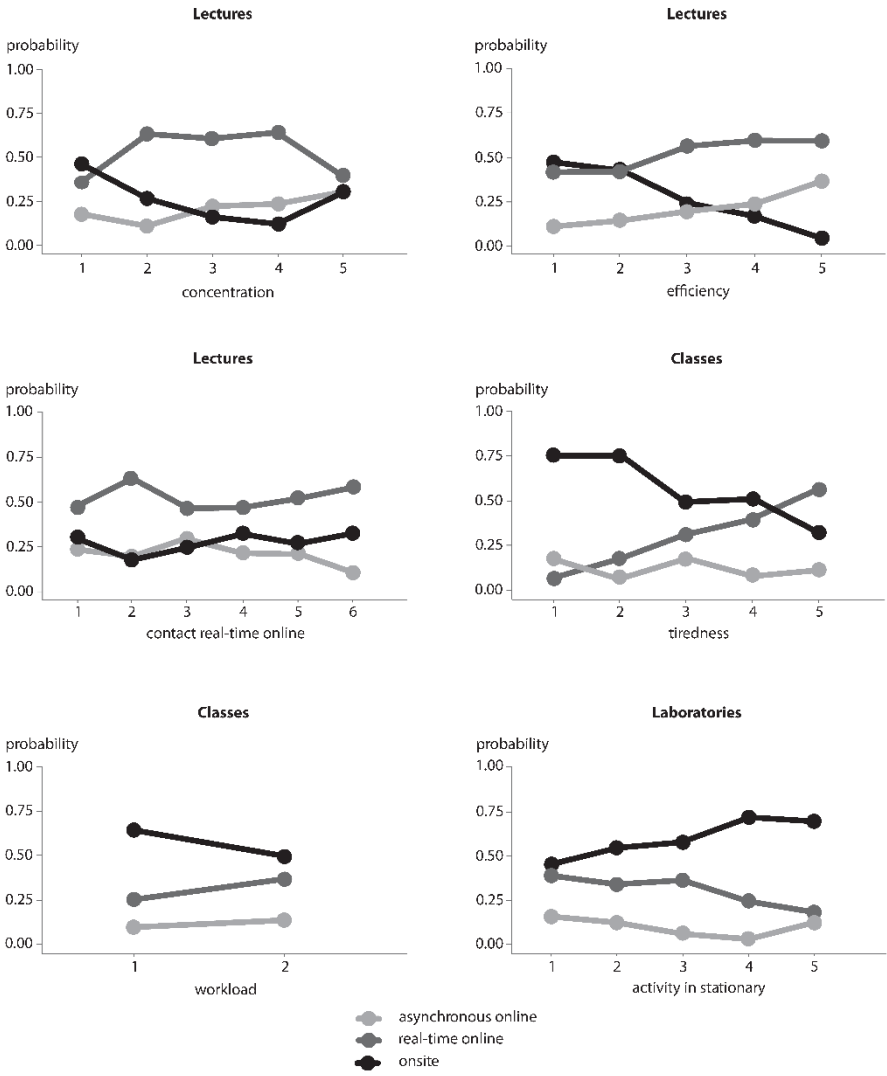
**Table 3.** Significant factors influencing students' preferences of different types of courses

Type of course	General courses	Statistics courses
Lectures	1. Frequency of contact with the lecturer in real-time online courses ( $p = 0.0380$ ) <b>2. Tiredness (<math>p = 0.0230</math>)</b> 3. Efficiency ( $p < 0.0010$ )	<b>1. Concentration (<math>p = 0.0080</math>)</b> 2. Efficiency ( $p = 0.0010$ ) 3. Frequency of contact with the lecturer in real-time online courses ( $p = 0.0480$ )
Classes	1. Activity in onsite courses ( $p = 0.0040$ ) 2. Workload ( $p = 0.0080$ ) 3. Frequency of contact with the lecturer in real-time online courses ( $p = 0.0260$ ) 4. Frequency of contact with the lecturer in asynchronous online courses ( $p = 0.0030$ ) 5. Tiredness ( $p < 0.0010$ ) 6. Efficiency ( $p < 0.0010$ )	1. Activity in onsite courses ( $p < 0.0010$ ) <b>2. Activity in asynchronous online courses (<math>p = 0.0240</math>)</b> 3. Frequency of contact with the lecturer in real-time online courses ( $p = 0.0030$ ) 4. Frequency of contact with the lecturer in asynchronous online courses ( $p = 0.0310$ ) 5. Workload ( $p = 0.0310$ ) 6. Tiredness ( $p < 0.0010$ ) 7. Efficiency ( $p < 0.0010$ ) <b>8. Concentration (<math>p &lt; 0.0010</math>)</b>
Laboratories	1. Activity in onsite courses ( $p = 0.0410$ ) 2. Workload ( $p < 0.0010$ ) 3. Tiredness ( $p = 0.0060$ ) 4. Efficiency ( $p < 0.0010$ )	1. Activity in onsite courses ( $p < 0.0010$ ) 2. Workload ( $p = 0.0010$ ) 3. Tiredness ( $p < 0.0010$ ) 4. Efficiency ( $p < 0.0010$ )
Consultations	<b>1. Activity in real-time online courses (<math>p = 0.0110</math>)</b> <b>2. Activity in asynchronous online courses (<math>p = 0.0370</math>)</b> <b>3. Tiredness (<math>p = 0.0020</math>)</b> 4. Efficiency ( $p < 0.0010$ )	<b>1. Activity in onsite courses (<math>p = 0.0460</math>)</b> 2. Efficiency ( $p < 0.0010$ )

Source: authors' work based on the survey results using Jamovi 1.6.23.

In bold are the differences in the significance of the factors having an influence on the preferences for each type of course. For each, the multinomial GLM was calculated and probabilities were calculated for every indication which is presented in the Figure. Next, general conclusions were made.

**Figure.** Sample graphs showing the probabilities of indicating each category for significant explanatory variables, presented in Table 3



Source: authors' work based on the survey results using Jamovi 1.6.23.

The application of the multinomial GLM resulted in the following general conclusions:

- students who preferred courses online in real-time were more likely to declare that they concentrated more during online lessons (than those who preferred onsite classes);

- students who preferred courses online in real-time were more likely to indicate that online courses were more effective than the onsite ones, and the probability of this event increased from considerably less effective to considerably more effective for students who preferred online courses and decreased for students who preferred onsite courses;
- students who preferred real-time online courses were more likely to indicate that they had contact with lecturers more often during online lessons in real-time and asynchronously, and the probability of this event increased from rarely to very often for students who preferred real-time online courses and the onsite ones, and decreased for students who preferred asynchronous online courses;
- the probability of declaring that the degree of tiredness changed from much more tiring to much less tiring increased for students who preferred online real-time courses and decreased for students preferring onsite courses;
- students who preferred onsite courses were significantly more likely to declare that they put more effort into onsite classes than into the remote ones, with the opposite being true for students who preferred online courses in real-time. Students who preferred asynchronous online courses were slightly more likely to indicate that they put more work into online lessons;
- students who were more actively involved during onsite courses were significantly more likely to declare that they preferred onsite courses;
- students who were more actively involved during real-time online courses were significantly more likely to declare that they preferred this mode of learning;
- students who preferred asynchronous online classes were more likely to declare that they were not actively involved in real-time online lectures and the onsite ones.

#### **4. Conclusions**

The article presents an analysis of the results of a survey conducted during the second wave of the COVID-19 pandemic among students of economic universities in Poland. Responses were provided by 604 students.

The main objective of the survey was to identify factors influencing students' choices of the mode of learning (remote/onsite), taking into account different types of courses (classes, lectures, consultations, laboratories, seminars).

Remote learning is for many people an opportunity to develop skills that might prove very useful later in their professional life. It can improve one's technical skills and one's ability to work in a group, and can also teach regularity. A remote form of learning tends to require significantly more activity in acquiring knowledge of

a given material, and takes more time and effort than in the case of traditional onsite education, but it can also be a source of a lot of satisfaction.

The analysis of our research shows that distance learning is more complicated and time-consuming than onsite studying. As mentioned above, it requires more work and higher than average commitment. However, no significant differences occurred between the responses for general courses and the statistics ones regarding the amount of work necessary during remote learning. Choosing this mode of learning, one has to be prepared that his or her interpersonal contacts will be limited and social relations disrupted. Lack of eye contact reduces focus and undermines self-confidence. Students in the survey were reluctant to speak up and be active. Students who were more likely to actively participate in general subjects were less likely to be active in statistics courses. In the case of general teaching modes, a significant difference was observed between students' active involvement in statistics courses and their activity in other classes. In addition, technical problems made it difficult to connect, listen, work in groups, solve tasks and issues, and engage in classes. General courses conducted in a distance form compared to a stationary form were seen as less tiring than statistics classes. Compared to the stationary form, statistics classes conducted in a distance form were considered less effective than in the case of general courses.

On the other hand, remote learning increased the opportunity for students to have contact with their academic teacher, also during the hours outside the designated consultation time. Students more often had contact with lecturers of general subjects than with teachers of statistics. This resulted from the more diligent preparation of materials by lecturers of statistics subjects and a better contact with them during classes. Moreover, students of courses conducted in a distance learning mode assessed the quality of the preparation of statistics lecturers for their courses higher than the quality of preparation of general subjects lecturers for their classes.

Every second student preferred real-time online lectures, half of whom said that they did so definitely more. Approximately 70% of students preferred onsite classes and laboratories, 44% of whom declared definite preference for this kind of instruction. As regards consultations, the percentage was almost the same (about 46–47%) as for real-time online and onsite classes, although it was not so definite. Every second student preferred real-time online seminars.

Students, when deciding about their preferences for the mode of lectures, laboratory classes and consultations, were significantly influenced by three to four factors, while in the case of exercises-based classes it was as many as six to eight influencing factors. The level of concentration affected the choice of the mode of learning not only for statistics courses, but also for general courses. Students who



preferred in-person classes were more likely to indicate that they concentrated less during remote ones.

Students who preferred courses online in real-time declared that they concentrated better during online lessons and that online courses were more effective than the onsite ones. They also had more frequent contact with lecturers during online lessons in real-time, and were less tired. Students who preferred onsite courses declared that this kind of teaching instruction required more effort on their part than remote classes. Students generally preferred these forms of courses (onsite or online) in which they were more actively involved.

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