Distance learning of geographic information systems using Google Classroom: Students' assessment and perception

Distance Learning of Geographic Information Systems Using Google Classroom: Students' Assessment and Perception

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Distance education at universities during the COVID-19 pandemic was implemented through various so-called learning management systems ($LMSs$). These environments are primarily used for teacher-student communication, assignment, and sharing of learning materials, testing, and assessment. This article aims to evaluate the Google Classroom environment's perception by university students of the courses Teaching Academic Subjects and Geography, forced to study through distance learning during the second half of the semester. Students filled out a questionnaire focused on the perception and evaluation of the Google Classroom environment at the end of the semester. The students were divided into two groups, depending on whether they worked in the Google Classroom environment for the first time or not. The results were evaluated using the Wilcoxon rank-sum test and the semantic differential method. The results show students' positive attitudes toward this environment, even though some were working with it for the first time. The perception and identification of the strengths and weaknesses of learning environments are essential in their future use in creating curricula and analysis of possible further use in other subjects or situations.

Key Words: Distance learning, geographic information systems, Google Classroom, students' perception

In recent years, when information and communication technologies have been gaining prominence, traditional teaching has also been transformed into a distance or hybrid style. Many learning materials are entering the online environment, making them more accessible to students. In this process, the teacher transforms from a presenter and an explainer to a facilitator (**Berge 1995**). Schools and students are equipped with laptops, tablets, or other devices to open, edit, or share teaching materials. For better organization and collection of teaching materials, unique virtual environments, the so-called learning management systems ($LMSs$), were created. As one part of e-learning, an LMS facilitates collaboration between teachers and students, encouraging creative teaching (**Bayarmaa and Lee 2018**).

Various possibilities fo using LMSs in teaching had become a question and a fundamental problem just at the beginning of 2020 when distance education came to the fore because of the closed schools due to the COVID-19 pandemic (**Mian and Khan 2020**). Teachers and students suddenly had to switch from in-class teaching to out-of-class teaching. Widely used LMS environments include Moodle, Google Classroom, Microsoft Teams, Edmodo, Schoology, Netventic, Easy LMS, and the like. At Slovak universities, the Moodle environment, in particular, is used for distance learning. Moodle is a software package for creating learning systems and electronic online courses. Moodle is provided free of charge as open-source software under the GNU (General Public License). In Slovakia, students log in to this e-learning environment using their login credentials created by the university. The disadvantage of this environment is that the teacher cannot create a course in the university model himself but must ask the university Moodle administrator. The advantage is free usage under the university's auspices and the recognition of registered students based on their student accounts. Using Moodle for the first time can be complex and time-consuming for both the teacher and the student (**Alfalah et al. 2020**). For this reason, we have chosen the Google Classroom LMS system, which is also often used for the distance teaching method, mainly due to its ease of use.

Google Classroom was launched in 2014, and its most significant advantages are its easy availability, simple registration, and flexibility for students and teachers (**Gallagher et al. 2005**). Student access is achieved by an easy login using a code provided by the teacher. Google Classroom provides students with unlimited access to teaching materials (**Chehayeb 2015**), and such a class becomes a virtual library. Thus, Google Classroom represents a virtual classroom, where the teacher mediates teaching materials (text documents, pictures, videos) through contributions in the so-called streaming part of the class. Students can comment on these contributions and discuss them with their teacher or classmates. The main advantage for the teacher is the ability to provide teaching materials for all students in one step and one place. This eliminates confusing e-mail communication between teachers and students, frequently solving the same problem with several students. As a Google service, it is easy to connect Google Classroom with other Google products like Google Docs, Google Drive, Gmail, and other applications (YouTube, Google Sheets, Google Slides, Google Forms; **Kyslova, Semerikov, and Slovak 2014**). The combination of Google Classroom with YouTube videos is very suitable for teaching. Students who watch educational YouTube videos often understand the material better (**Snyder and Burke 2008**). Another function is the task assignment, which is very clear for the teacher and the student, providing a means for feedback and evaluation (**Janzen 2014**). The teacher then has an overview of the progress or difficulties of the student in one place. With Google Sheets, the teacher can export a straightforward spreadsheet and analyze the students' results. Teachers perceive the Google Classroom application positively and found it effective in promoting collaborative learning, minimizing problems, organizing students' documents, and saving time. It encourages teachers to be more creative in using its features to promote better teaching (**Harjanto and Sumarni 2019**). On the other hand, teachers perceive Google Classroom as only a facilitation tool that can be used for document management and essential classroom management without significantly affecting teaching methodologies (**Azhar and Iqbal 2018**).

An LMS can make teaching more environmentally friendly, as all materials are online, and the teacher does not have to distribute printed materials or printed versions of tests and assignments (**Latif 2016**). Another advantage is the reliability of the Google Classroom environment, which users rated as a critical factor (**Al-Maroof and Al-Emran 2018**). Google Classroom can improve students' cognitive skills (**Jakkaew and Hemrungrote 2017**), create an engaging learning atmosphere through the included media (**Fitriningtiyas et al. 2019**), and also effectively enhance the learning abilities of students with various learning disabilities (**Dicicco 2016**). Using Google Classroom also promotes higher order thinking and problem-solving skills and supports "What if ... ?" type questions that are more desirable in this computer age (**Shaharanee, Jamil, and Rodzi 2016**). For example, positive results have been reported in social studies, where Google Classroom has proven to be an effective tool that can improve students' ability to expand their vocabulary through self-directed learning. Despite this advantage, students still suffer from certain limitations on content knowledge level compared to knowledge acquired through textbooks and printed materials as learning resources (**Dicicco 2016**). Student evaluation of Google Classroom has been was studied in learning not only geography (**Bondarenko 2016; Bondarenko, Mantulenko, and Pikilnyak 2018; Rahmad et al. 2019**), but also physics (**Cristiano and Triana 2019**), foreign languages (**Coelho 2019; Albashtawi and Al Bataineh 2020; Saienko and Chugai 2020**), chemistry (**Dash 2019**), and biology (**Sutia, Wulan, and Solihat 2019**).

Google Classroom is primarily suitable for activities such as making observations; posing questions; examining books and other sources of information to determine what is already known; planning investigations; reviewing what is already known; using tools (computer software) to analyze the data and interpret data, proposing answers, explanations, and predictions; and communicating (**Shaharanee, Jamil, and Rodzi 2016**).

In our research, students focused on using geographic information systems (GIS; in this case $ArcMap$ 10.5) to create maps with which they interpreted and analyzed selected data, which is the content of the Geographic Information Systems 1 compulsory course. The aim was to determine geography students' perception and evaluation of the Google Classroom virtual classroom. The students completed half of the Geographic Information Systems 1 course using Google Classroom and could compare virtual teaching with traditional teaching. Students' perceptions of educational technologies are significant, as the effective use of these technologies could contribute to better future preparation of online courses (**Shaharanee, Jamil, and Rodzi 2016**). Based on the available research studies, there is a limited amount of research on the factors that influence the acceptance of the Google Classroom environment among university students in general, but especially students in central European countries. GIS has been extensively taught in geography courses, which requires sufficient hardware, software, and data (**Lloyd 2001; Vojtek et al. 2016; Vojtek, Vojteková, and Boltižiar 2020**). This technical factor in traditional learning is commonly resolved by ensuring the availability of a computer laboratory with adequate specifications for GIS, especially in universities. Before the pandemic, GIS was taught in a classical format, consisting of teacher illustration, different steps in GIS explanation, text learning, and various video tutorials (**Vojteková et al. 2014; Vojteková et al. 2022**). The importance of GIS teaching via distance learning is expected to grow (**Vojteková et al. 2021**). It is particularly well suited to serve the needs of many GIS practitioners who were trained "on the job" but lack technical and theoretical background knowledge (**Elsner 2005**). Further training in online teaching development and evaluation is also crucial to increase the quality of the learning process, especially in GIS-related subjects that require high-end computer infrastructure (**Nirwansya 2022**).

Materials and Methods

GIS can be understood as functional units that integrate technology and software resources, geodata, workflows, staff, users, and organizational context. They are focused on the collection, storage, management, analysis, synthesis, and presentation of spatial data for description, analysis, modeling, and simulations of the surrounding world to obtain new information necessary for the rational management and use of this world (**Rapant 2006**).

The course Geographic Information Systems 1 (GIS 1) is compulsory for students of the Teaching of Academic Subjects study program (summer semester in the second year of bachelor's study) and the single-subject Geography study program (summer semester in the first year of bachelor's study). After completing the course, students should be able to define GIS, coordinate systems, data formats (raster, vector), and the principle of geographic information layers. They can also characterize the methods of geographical interpretation and master the basic terminology of GIS, navigate through the $ArcGIS$ software environment, visualize layers of geographic information in the $ArcGIS$ software environment, and modify them graphically. Students learn how to insert descriptions drawn from the attribute tables into the maps, work with attribute tables, work with Microsoft Excel tables attached to the program, and perform basic calculations in layers. They can create cartograms, use other cartographic imaging methods, work with Web Map Service (WMS), select layer elements based on defined conditions from the prepared data, and create a map composition (legend, scale, title, author, etc.). The class took place from the beginning of the semester (3 February 2020) in the traditional way: Once a week, students attended lectures and seminars (a total of eighty minutes) in a specialized GIS classroom on the grounds of the university. The classroom was equipped with sixteen desktop computers, licensed ArcMap 10.5 software, a data projector, and a computer for the instructor.

The total sample comprised forty students between the ages of twenty and thirty (55% women, 45% men) from different parts of Slovakia. The students were divided into three groups. Each group had of a maximum of sixteen students working independently on one computer. According to a predetermined information sheet, the teacher goes through the course's topics, beginning with theoretical knowledge on the topic, and then moving on to practical demonstrations with software, while students work independently on a computer and follow the teacher's steps. The teacher explains the steps orally and illustratively using a data projector. If a student cannot continue to work, the teacher stops and solves the problem. However, the rest of the group has to wait. Students perform all their activities only during the lesson, as they do not have software on their private computers. The specialized classroom is available to them at any time to check the acquired knowledge or process maps for other subjects.

Due to the COVID-19 pandemic, universities closed during the semester (12 March 2020), and teaching continued remotely. This created a problem for GIS 1, mainly due to the availability of software. It was solved by $ESRI$, which provided free licenses for student purposes through the end of August 2020. Otherwise, the subject would have been moved to the next semester, disrupting the entire study schedule. The last step in the teaching process was selecting a suitable virtual environment that would make it easy to register, operate, assign tasks, or share materials. The Google Classroom environment was chosen after the previous teachers' experience. Students restarted the course on 1 April 2020, so the teacher added an explanatory post on the new topic to the streaming section available to all students. The teaching was supplemented by illustrative video demonstrations of work procedures in $ArcMap$ 10.5 software, published using the YouTube channel (**Figure 1**). The number of using distance learning and face-to-face classes was, therefore, approximately the same (3 February — 12 March 2020, thirty-seven days of face-to-face teaching; 1 April-12 May 2020, forty-one days of distance teaching). The sample of students was the same both during face-to-face and distance learning.

Subsequently, the students were given a homework assignment with a submission deadline. Each student uploaded the final homework as a map to the system, and the teacher saw all submitted results in one window. On the left part of the screen, the teacher saw the list of students' names and their points or comments on the task, and on the right part, he saw a preview of the submitted maps (**Figure 2**).

The teacher then commented on the map directly by comments in the picture or through a private chat with the student, assigned points for the task, and returned the evaluation to the student (**Figure 3**).

The summary of all the students' grades in one final table (**Figure 4**), which can also be downloaded in .xls format, is a helpful tool for the teacher.

All students filled out an anonymous questionnaire at the end of the semester, which focused on how students perceive and evaluate the Google Classroom virtual classroom.

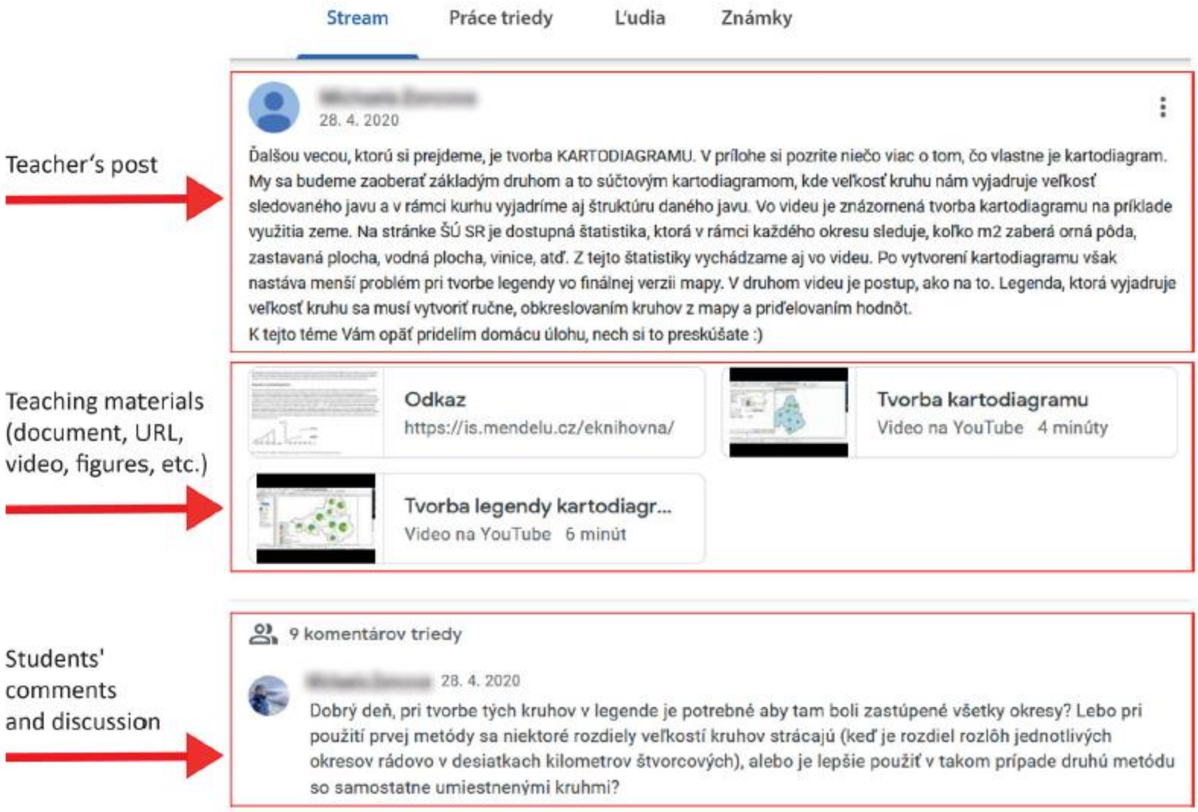

Figure 1 Sharing teaching materials by teachers.

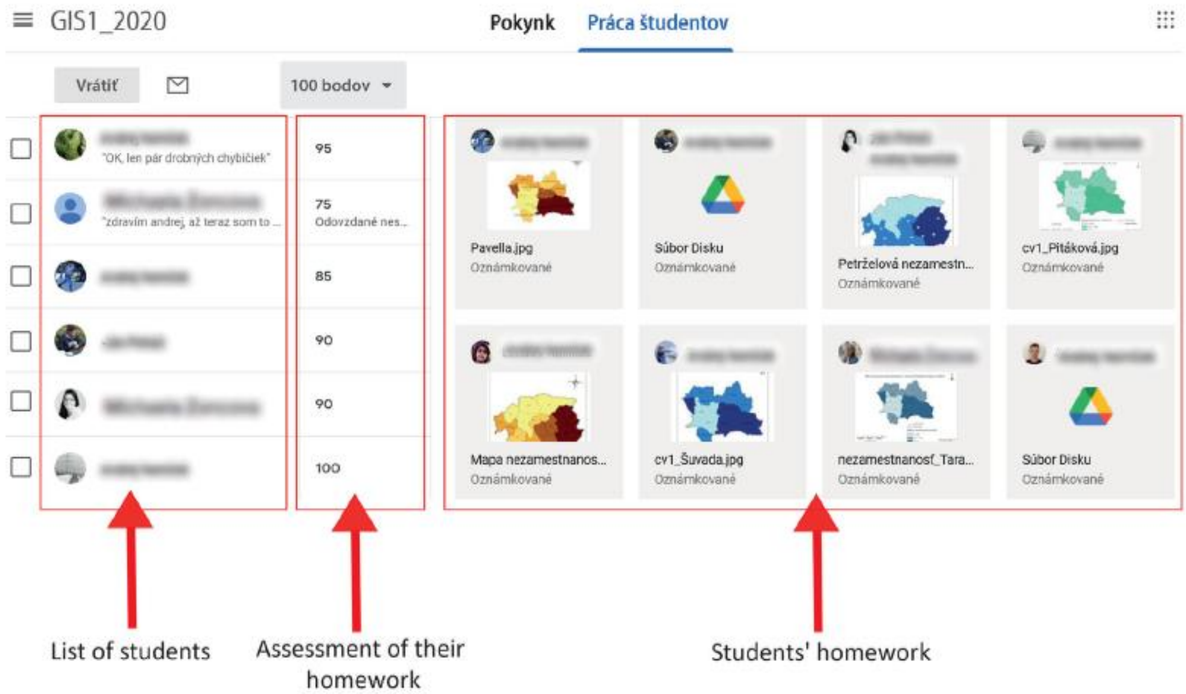

Figure 2 Preview of the student assignments screen.

It also compared the distance form of teaching in this environment with a full-time, in-person form of teaching. The online questionnaire was created using Google Forms and then sent to students in the form of a task in the Google Classroom environment. Google Forms is a convenient way to collect students' opinions when evaluating Google Classroom. This method was also used in the work of **Jakkaew and Hemrungrote** (**2017**).

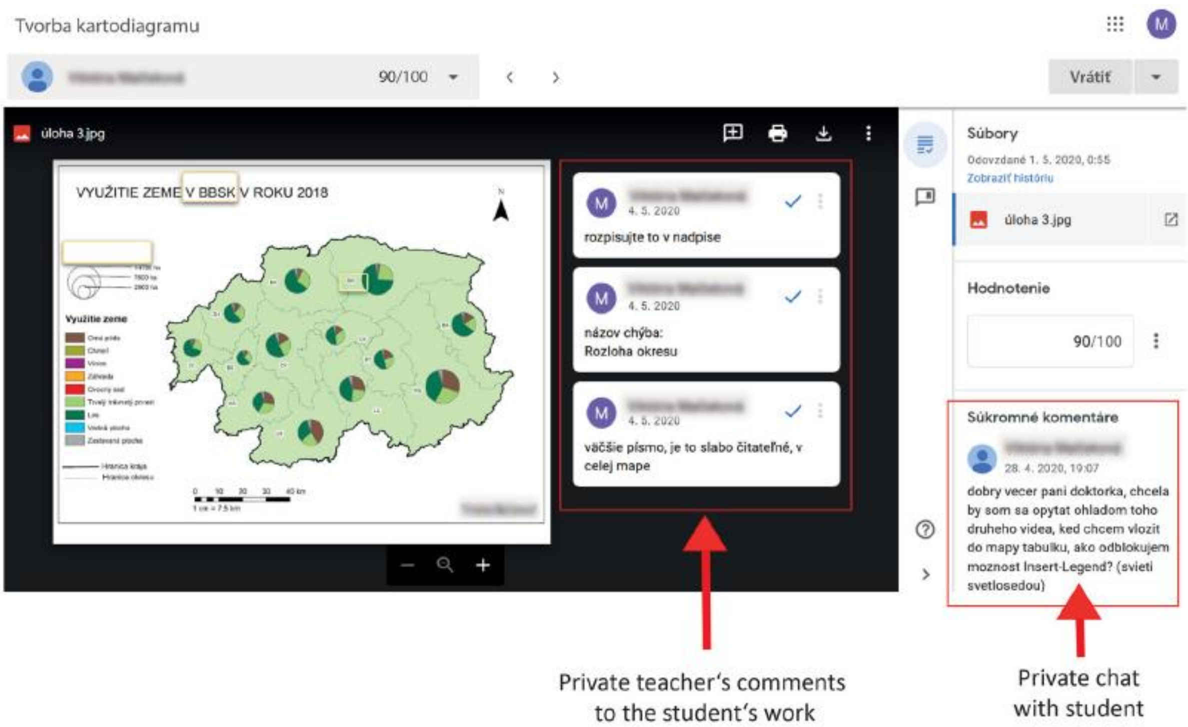

Figure 3 Preview of the submitted work evaluation screen.

Figure 4 Summary of student grades in Google Classroom.

Students had one week to complete and submit the anonymous questionnaire. The questionnaire contained a total of seventeen questions, three of which were open-ended questions. One question included the possibility of choosing one answer from the list, one had the possibility of choosing more answers from the list, and twelve questions were compiled using a Likert scale ranging from 1 (agree) to 5 (disagree; **Table 1**). The questionnaire was designed based on the work of **Cristiano and Triana** (**2019**) and modified for our research.

In the research presented here, we wanted to find out whether there are differences between the two groups of students in to their answers to the questions on the questionnaire, so the groups of students were created according to whether they were working with Google Classroom for the first time (Y) or not (N).

Table 1 Questions from the questionnaire

Question no.	Question	Options
0	I worked in the Google Classroom environment for the first time.	Yes/no
1	I signed in to Google Classroom using these devices:	PC, laptop/smartphone, tablet, other
2	If you answered "yes" to the previous question, list the environments you used.	Open question
3	The Google Classroom environment is attractive, comfortable, and precise.	Likert scale from 1 (*agree*) to 5 (*disagree*)
4	Logging in to the Google Classroom environment is very straightforward.	Likert scale from 1 (*agree*) to 5 (*disagree*)
5	The teacher's materials in Google Classroom were explicit and sufficient to understand the curriculum.	Likert scale from 1 (*agree*) to 5 (*disagree*)
6	Communication with the teacher in Google Classroom is straightforward.	Likert scale from 1 (*agree*) to 5 (*disagree*)
7	YouTube videos published in Google Classroom were a suitable way to explain the new topic.	Likert scale from 1 (*agree*) to 5 (*disagree*)
8	Email notifications for new Google Classroom activity is a helpful feature.	Likert scale from 1 (*agree*) to 5 (*disagree*)
9	The way of assigning and submitting homework was clear and understandable.	Likert scale from 1 (*agree*) to 5 (*disagree*)
10	The way of displaying feedback from the teacher on homework was appropriate and satisfactory.	Likert scale from 1 (*agree*) to 5 (*disagree*)
11	The ability to comment on posts is a significant advantage of the Google Classroom environment.	Likert scale from 1 (*agree*) to 5 (*disagree*)
12	Google Classroom would be an excellent complement to communication between students and the teacher during regular classes.	Likert scale from 1 (*agree*) to 5 (*disagree*)
13	Teaching with instructional videos and tutorials in Google Classroom was a more appropriate way for me to teach than classical classroom teaching.	Likert scale from 1 (*agree*) to 5 (*disagree*)
14	I learned more during "distance" teaching than during a classic lesson.	Likert scale from 1 (*agree*) to 5 (*disagree*)
17	What is the most significant advantage of the Google Classroom environment over the traditional way of teaching?	Open question
18	What is the weakness of the Google Classroom environment, according to you?	Open question

Based on this information, we established the following research hypothesis:

> $H1$: Student groups Y and N do not have differing views or attitudes about working in the Google Classroom environment.

Therefore, the analysis was intended to look for differences between two groups of students in the answers to the questionnaire method's questions. The questionnaire contained fourteen questions with a five-point scale, which were thematically divided into three groups, or dimensions:

- Student satisfaction with the Google Classroom ($D1$) environment.
- Student satisfaction with teaching GIS in the Google Classroom ($D2$) environment.

- The Google Classroom environment perception of teaching GIS in the distance form and its use in full-time, in-person teaching ($D3$).

We verified the statistical significance of the differences between the two groups of students in answering the questions on each dimension of the questionnaire. Because the assumption of a normal distribution of the observed features was not fulfilled, we used the nonparametric method of the Wilcoxon rank-sum test, which is a nonparametric analogy of the parametric t test (**Markechová and Tirpáková 2011**), to verify the research hypothesis. This method is often used to evaluate questionnaires to assess processes, forms, and teaching methods from the student's point of view (**Stromso, Grottum, and Lycke 2007; Nuangchalerm and Thammasena 2009; Woltering et al. 2009**). It allows testing the hypothesis of the concordance of two distribution functions. Let (X_1,X_2, …, X_m) and (Y_1, Y_2, …, Y_n) be two independent random selections from continuous distributions. We have to verify the null hypothesis Ho that both selections come from the same basic set; that is, the hypothesis that both distributions' distribution functions are the same. An alternative hypothesis is that the distribution functions of the two distributions are different. As a test criterion, we will use a statistics equation, which has an asymptotically normal normed distribution $N(0,1)$ under the validity of the tested hypothesis. We reject the tested hypothesis H_0 at the level of significance a in favor of the alternative hypothesis if $|U| \geq U_{\propto}$, where ua is the critical value of the normal distribution (**Equation 1**).

$$U = \frac{U_1 - \frac{1}{2}m \cdot n}{\sqrt{\frac{m \cdot n}{12}(m+n+1)}} \qquad (1)$$

In our case, the first sample consisted of students who worked in Google Classroom for the first time, and the second included students who had already worked in that environment. The results of each dimension of the questionnaire (average score) of both groups of students represent the realization of two mutually independent random samples with a continuous distribution. We performed the Wilcoxon rank-sum test in the STATISTICA program. After entering the input data, we received the following results in the computer's output report: the value of the test criterion Z of the Wilcoxon rank-sum test and the probability p for each dimension of the questionnaire.

We evaluated the test for each dimension using the value of p (p is the probability of error we make when we reject the tested hypothesis). If the calculated value of the probability p was small enough ($p < 0.05$ or $p < 0.01$), we would reject the tested hypothesis (at the significance level of 0.05 or 0.01). Because the calculated value of the probability p was a large number, we could not reject the tested hypothesis H_0.

Therefore, further analysis defined the size of the relationship between the two groups in the answers to the questionnaire's questions. The size of the relationship and the dependence between the groups were assessed using the semantic differential method. We proceeded by modifying the method proposed by **Osgood, Suci, and Tannenbaum** (**1957**) as follows: First, we constructed a semantic differential consisting of fourteen questions, where respondents selected from responses on a five-point scale when choosing to answer each question. The respondents' task was to indicate the extent to which they associated the relevant concept with the given questions on the five-point scale. As already mentioned, forty students were involved in the research.

The next step was to assess the distance in the answers between groups 1 and 2 according to **Reiterová** (**2003**) using the statistic D_{YN} defined by **Equation 2**, where di is the difference of the average values on the ith scale.

$$D_{YN} = \sqrt{\sum_{i=1}^{k} d_i^2} \qquad (2)$$

The statistic D_{YN} is a simple measure of the linear distance between groups Y and N. The lower the Dyn value, the smaller the distance between the two groups of students answering the questions in the questionnaire in each dimension. Conversely, a higher D_{YN} value means a greater distance between the Y and N groups in each dimension. We calculated the distance between the considered groups Y and N in each dimension:

$$\text{1. Dimension: } D_{YN} = \sqrt{\textstyle\sum_{i=1}^{k} d_i^2} = 0.020$$

Table 2 Results of the Wilcoxon rank-sum test

Dimension	Z	p
1	−0.128	0.899
2	0.271	0.786
3	0.298	0.766

$$\text{2. Dimension: } D_{YN} = \sqrt{\textstyle\sum_{i=1}^{k} d_i^2} = 0.001$$

$$\text{3. Dimension: } D_{YN} = \sqrt{\textstyle\sum_{i=1}^{k} d_i^2} = 0.010$$

In addition to the statistic D_{YN}, semantic differential data can also be analyzed using the so-called Q-cor-relation (**Reiterová 2003**), a product correlation modification that expresses the degree of similarity between the two profiles. It is possible to infer similarity in understanding concepts from the degree of profile similarity. We expressed the Q-correlation using the correlation coefficient Q_{YN} (**Equation 3**).

$$Q_{YN} = 1 - \frac{\sum_{i=1}^{k} d_i^2 - k(\overline{x}_y - \overline{x}_N)^2 - (\sigma_y - \sigma_N)^2}{2k \cdot \sigma_y \cdot \sigma_N} \qquad (3)$$

The coefficient Q_{YN} takes values from the interval {-1, 1). We interpret its values in the same way as the values of the Pearson correlation coefficient. In our case, we calculated the value of the Q-corre-lation between the groups Y and N.

Results

The research focused on the perception and evaluation of the Google Classroom environment by university students who completed part of the GIS 1 course during the summer semester of 2019-2020. The first step was to test the hypothesis of agreement of the two distribution functions using the Wilcoxon rank-sum test (**Table 2**).

Based on the results obtained in the statistical analysis in all three questionnaire dimensions, we cannot reject hypothesis H_0; that is, the observed differences are not statistically significant. Based on the preceding results, we can consider both groups of students equal in choosing answers to questions from the previous questionnaire dimensions. The Wilcoxon rank-sum test did not confirm the significance of the differences between the students of the Y and N groups in the answers on any of the three dimensions of the questionnaire.

In the following analysis, we have defined the relationship between the two groups in the answers to the questionnaire's questions using the semantic differential method. **Table 3** shows the calculated average values of the answers for the individual questions. We have supplemented the table with columns of values d_i^2 (d_i^2 is the difference between the average values in the ith question), which was needed to analyze the semantic differential data and a sum row.

Table 3 Average values of answers for individual questions

Question no.	Respondents		
	Group 1	Group 2	d_i^2
5	1.208	1.188	0.000
6	1.417	1.438	0.000
10	1.625	1.375	0.063
13	2.500	2.625	0.016
7	1.167	1.125	0.002
8	1.083	1.063	0.000
9	1.042	1.063	0.000
11	1.042	1.000	0.002
12	1.167	1.125	0.002
3	1.333	1.188	0.021
4	1.083	1.000	0.007
14	2.417	2.375	0.002
Sum	17.08	16.56	0.12
x	1.07	1.04	0.01

Note: Values are based on the Likert scale with options from 1 (agree) to 5 (disagree).

Table 4 Numerical characteristics of the semantic differential

Dimension	$\bar{x}_Y$	$\bar{x}_N$	σ_Y^2	σ_N^2	σ_Y	σ_N
1	1.35	1.33	0.24	0.32	0.49	0.57
2	0.92	0.90	0.00	0.00	0.06	0.05
3	0.97	0.91	0.33	0.37	0.58	0.61

Note: Values are based on the Likert scale with options from 1 (agree) to 5 (disagree).

For both sets, we calculated the numerical characteristics of the semantic differential, which are arithmetic means (denoted as $\bar{X}_Y$ resp. $\bar{x}_N$N), variances (denoted as σ_Y resp. σ_N^2), and standard deviations (denoted as σ_A resp. σ_N). The results are shown in **Table 4**.

The third step was to assess the distance in the responses between Groups 1 and 2 using the statistic Dyn. We see that the "distances" between students' groups in answering the questions are minimal from the individual dimensions' calculated values. The results mean that both student groups answered the questions on all three dimensions in approximately the same way; that is, students in both groups were equally pleased with the Google Classroom environment. They were equally happy with learning GIS in the Google Classroom environment; they also had a very similar perception of GIS learning using the Google Classroom environment in the distance form and GIS learning with the full-time, in-person form of teaching. The situation is also shown in **Figures 5**, **6**, and **7**.

We also analyzed the semantic differential data using the Q-correlation (correlation coefficient Q_{YN}). The result was Q_{YN} — 0.983, which means a very close connection between the two groups of students in their questionnaire answers. In other words, the students answered the individual questions in the questionnaire almost equally, regardless of whether they had worked in the Google Classroom environment or not, which means that although students had the opportunity to work in other environments, they still had a very favorable view of working in the Google Classroom environment. Students who encountered working in this environment for the first time had the same very positive attitude. We also calculated Q-correlations for individual dimensions:

$$Q_{YN}(\mathrm{D1}) = 0.968; Q_{YN}(\mathrm{D2}) = 0.856; Q_{YN}(\mathrm{D3}) = 0.990.$$

In all three cases, we are talking about a very close link between the two groups of students concerning their answers to the individual dimensions' questions, which means that the students in both groups answered the questions on all three dimensions very similarly. Students in both groups—whether they first encountered working in the Google Classroom environment or not—were equally satisfied with the Google Classroom environment and with GIS learning in the Google Classroom environment. They also similarly perceived GIS distance learning in the Google Classroom environment and full-time, inperson teaching.

Discussion and Conclusion

Based on the research, we can say that the Google Classroom environment is a very suitable tool for distance learning of GIS, especially when students have to learn to work in a new environment suddenly, as was the case with the closure of schools during the COVID-19 pandemic. It is possible, however, that a different group of students led by a different teacher could show a different degree of satisfaction with this LMS. The technical skills of the teacher are a critical factor in the final result of distance education. According to **Keleş and Őzel** (**2016**), distance learning is unsuitable for inflexible instructors.

Although the Moodle LMS is often used in Slovakia, using it requires training or instruction. Students perceive Google Classroom positively, though, due to its simplicity and user-friendly environment, even though some experienced it for the first time. The positive perception of the Google Classroom environment has been confirmed by students in several studies (e.g., **Rahmad et al. 2019; Kumar, Bervell, and Osman 2020**) and by teachers themselves (e.g., **Kumar, Bervell, and Osman 2020; Rachma, Nurdiana, and Ghofur 2020**).

Students were asked to indicate the interactive Google Classroom's advantages over classical teaching in one of the open-ended questions. Students most often mentioned the following benefits:

- There is an emphasis on greater independence (e.g., by problem-solving, the teacher does not respond immediately to the problem; in traditional teaching, the students must look for solutions themselves).

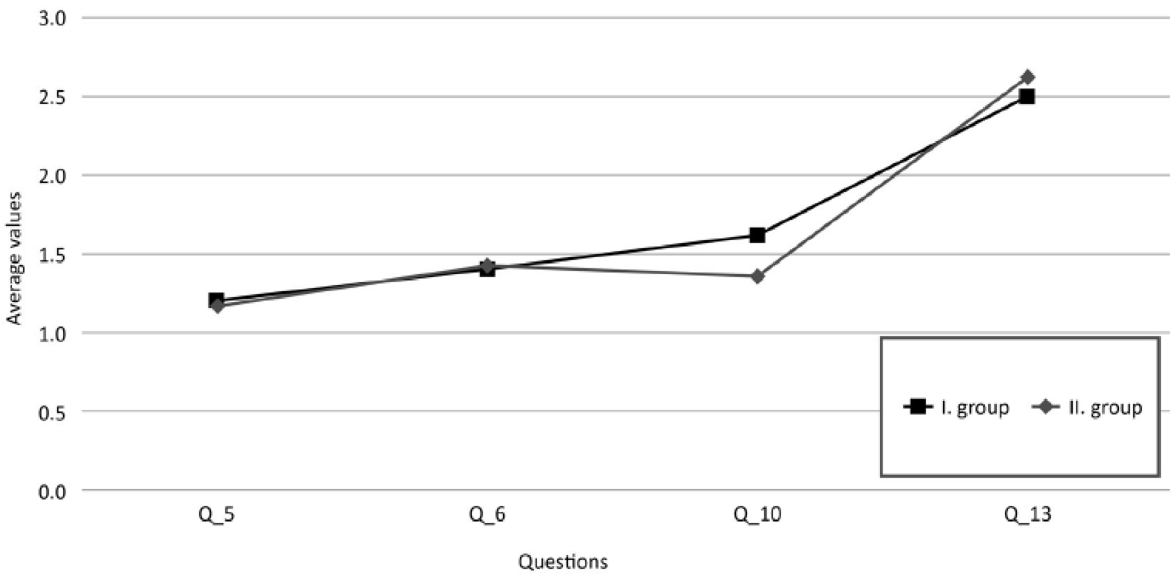

Figure 5 Average values for answers to Dimens ion 1 questions (satisfaction with the Google Classroom environment).

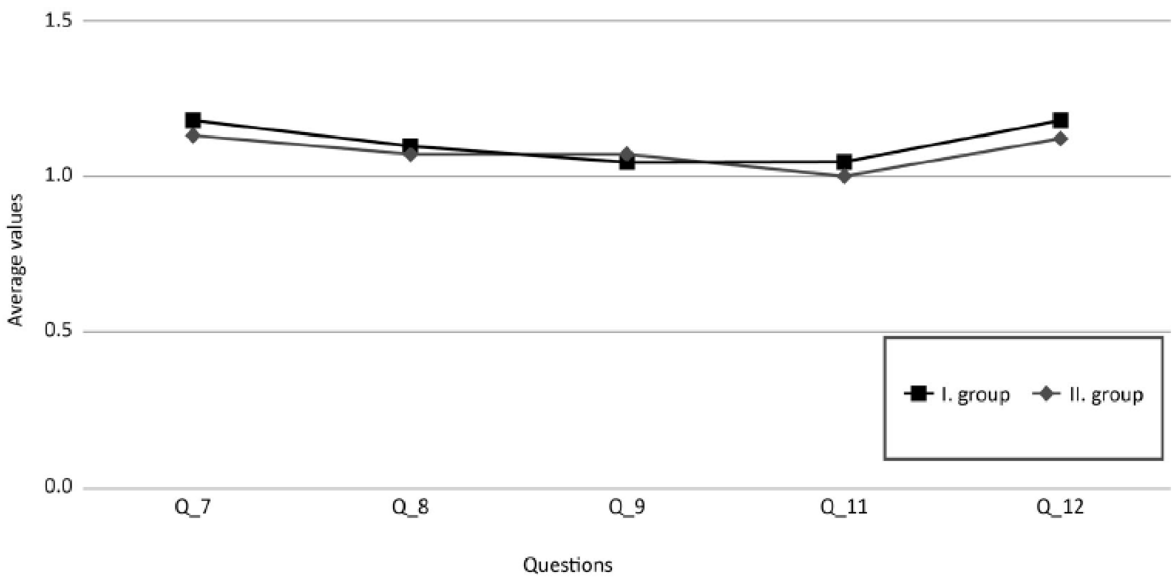

Figure 6 Average values of answers to Dimension 2 questions (student satisfaction with learning GIS in the Google Classroom environment).

- The educational materials (video tutorials) are always available, so students were able to return to them at any time.
- Google Classroom provides time flexibility, the possibility to work on tasks at any time.
- The whole group was often restrained when the teacher had to solve a problem for one student (software problem or misunderstanding of the topic) during traditional lessons, and such problems do not occur in Google Classroom.
- Students could choose their own pace of work.
- Distance learning allowed for better concentration than during a traditional lesson.
- Google Classroom provided an environment for a quick and easy way to complete tasks.
- Deadline reminders were helpful.
- The working environment allowed comments to follow and mutual discussion between the teacher and students.
- Google Classroom was seen as a straightforward and visually pleasant environment.
- When students cannot physically attend a classical classroom lesson, they skip the subject matter, but in Google Classroom, they have all the necessary materials.

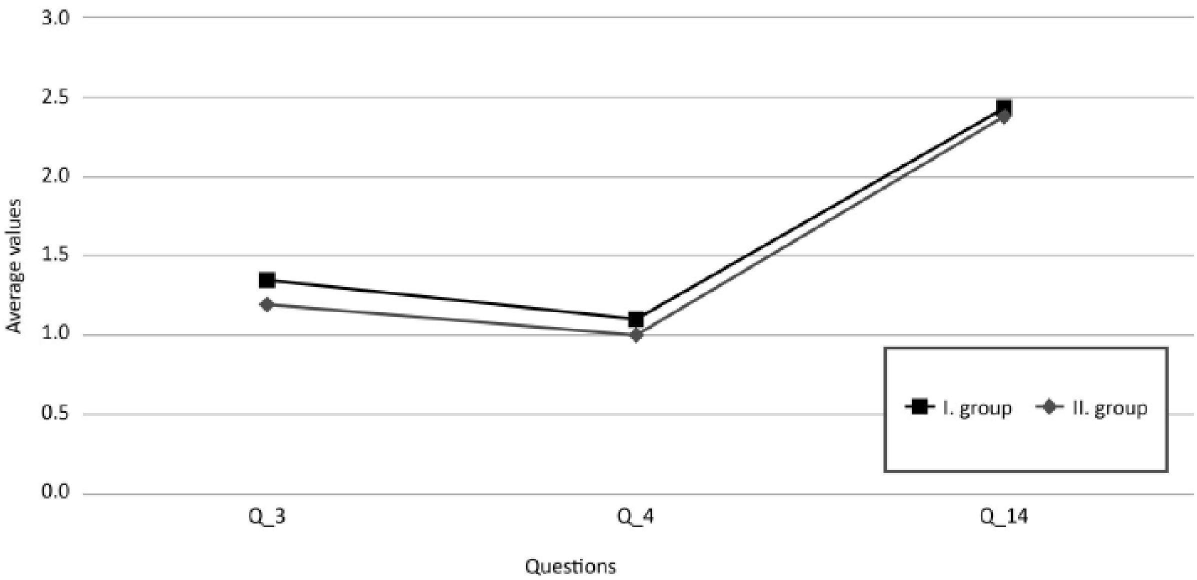

Figure 7 Average values of answers to Dimension 3 questions (perception of the Google Classroom environment in the learning of GIS in the distance form and its use also in the full-time, in-person form of teaching).

Students also reported several significant negatives when evaluating the Google Classroom versus traditional teaching, but we also provide possible solutions for each negative.

- Personal communication with the teacher and classmates is impossible in Google Classroom, but can be partially replaced by a video call, which cannot be realized directly through Google Classroom, but through Google Meet.
- Immediate feedback from the teacher on a problem is not provided, so the students must interrupt the elaboration of the task because they cannot continue on their own. The solution

is to give enough time to complete the tasks so that the teacher can respond to questions and students still have enough time.

- Google Classroom provides a confusing display of comments on pictures (maps), which students have elaborated as homework assignments. Although the students immediately find out the grading evaluation of their work, they do not immediately see the teacher's feedback on the mistakes, which can only be displayed by clicking on the image options and opening it in a new window. The unfamiliarity with this function can cause students not to correct mistakes in their work in the future. The solution is to show this function to students at the beginning of the class.
- There is a higher possibility of cheating compared to classical teaching. The task can be completed by one person but can also be handed in by someone else. This situation is challenging to combat. It is in students' interest to learn the material and check their knowledge through task elaboration. The solution could be to assign individual tasks to each student in a limited time, so there is not much time for cheating.
- Different equipment limitations of students is often a problem. Some students have less powerful computers at home, unlike in classrooms, where they all have the same conditions. Assigning less technically demanding tasks might be the solution.

This research showed that students were satisfied with the Google Classroom environment, regardless of whether they were working in this environment for the first time or not. This finding is significant when neither the teacher nor the students have the time or space to learn to work with the new LMS but need to move to distance learning immediately. Google Classroom appears to be a suitable tool in this respect, mainly because the Google platform is known worldwide, and the use of various products (Gmail, Google Disk, Google Sheets, Google Forms, Google Photos) is straightforward and intuitive.

Based on the positive evaluation of the Google Classroom environment, we think it is a suitable teaching environment during regular study and not only during the crisis that students were exposed to during the COVID-19 pandemic at the beginning of 2020. In their questionnaire responses, many students expressed that they would like to use Google Classroom as a complementary environment to the traditional full-time, in-person teaching method, where they would communicate with classmates and the teacher, and they would have all the teaching materials at their disposal and could work out various tasks. Google Classroom is a suitable environment for so-called just-in-time teaching ($JiTT$). With this method, a part or all of the time students spend preparing for learning itself is used effectively to increase learning quality in the classroom directly. This method relies on tasks called warmup exercises given approximately one day before class. Tasks are usually performed online through an LMS (e.g., the Google Classroom environment; **Novak 2011**). According to research by **Striuk** (**2015**), Google Classroom can also be used in hybrid geography teaching. This teaching method integrates in-class and outside-of-class educational activities that balance traditional and innovative teaching techniques. In their research, **Romero and Artal-Sevil** (**2019**) confirmed the suitability of using the Google Classroom environment even in so-called flipped learning. **Dicicco** (**2016**) also combined Google Classroom with the term self-directed learning (SDL), an instructional strategy where students use instructions from the teacher to decide what and how they will learn. During our research, we gave the students instructions on how to learn how to create a map in ArcMap 10.5, so we followed that method. Google Classroom can thus be considered a valuable tool for active self-learning (**Hemrungrote, Jakkaew, and Assawaboonmee 2017**).

Our results cannot be generalized to all fields of study or universities. Results from other studies suggest that not all university courses offered are suitable for distance learning courses, and not all students are adept at distance learning (**Hsiao 2021**). Distance learning using LMSs is not suitable for every topic (**Elayan 2021**); for example, laboratory and experimental courses cannot be given remotely (**Keleş and Őzel 2016**). The results also evaluate only the viewpoint of students. The research could be extended to teachers' views on using this environment for teaching in the future. The subject of GIS was also attended by future teachers of geography, who got acquainted with the Google Classroom environment this way and will apply it in teaching.

Although the students were satisfied with the Google Classroom environment, one of the shortcomings was the absence of personal contact with the teacher. Therefore, we consider Google Classroom to be a suitable complement to the traditional method of teaching and not a complete replacement for classical teaching. Discussion with a teacher and teacher feedback on the students' work is needed through personal contact and not in electronic form (**Sutia, Wulan, and Solihat 2019**). The results of similar research can be used to improve LMSs, creating enhancements to minimize the burden on the teacher (**Bogachkov, Bukach, and Ukhan 2020**).

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