Evaluation of story maps by future geography teachers

Evaluation of story maps by future geography teachers

Jana Vojtekova [a], Michaela Zoncova [b], Anna Tirpakova [cd] and Matej Vojtek [a]

[a]*Department of Geography and Regional Development, Constantine the Philosopher University in Nitra, Nitra, Slovakia;*

[b]*Department of Geography and Geology, Matej Bel University in Banska Bystrica, Banska Bystrica, Slovakia;*

[c]*Department of School Education, Tomas Bata University in Zlin, Zlin, Czech Republic;*

[d]*Department of Mathematics, Constantine the Philosopher University in Nitra, Nitra, Slovakia*

ABSTRACT

The paper presents pedagogic experiment focused on teaching future geography teachers to work with story maps with the use of three applications (Knight Lab StoryMapJS, Esri ArcGIS StoryMaps, and Google Tour Builder). The experiment was carried out by questionnaire form at two Slovak universities. The respondents were students of the geography teacher training program, whose task was to select and learn one of the mentioned applications to create a story map. The statistical analysis of the research results confirmed that the choice of the application by the students was influenced by their previous experience with the applications; it was not difficult for students to develop a story map using the selected applications even though they did not have enough experience about the selected applications before the experiment; and students would make more use of story maps than other applications in their educational practice.

KEYWORDS

Story maps; StoryMapJS; Tour Builder; ArcGIS StoryMaps; undergraduate students; geography; teaching; education; Slovakia; GIS

Introduction

Story map as a teaching tool

An essential part of human nature is also telling stories, including maps, which can serve as powerful narrative media. The visual nature of maps is ideal for "telling" spatial stories in ways that involve teachers while bridging linguistic and cultural differences. Recent advances in digital technologies, including geographic information systems (GIS), and in the availability of cloud-based data and storage have put countless maps into the hands of millions of people and revolutionized the way people understand and create map-based stories (Strachan & Mitchell, 2014). The development of digital story maps was driven by narrative demand and geovisual analysis (Berendsen et al., 2018).

Digital story maps serve as an important means for effective storytelling (an effective way of explaining and presenting) on any topic. They represent a combination of interactive maps and multimedia content, which have an attractive design, including background maps with a rich content, combinations of data, tables and thematic maps that can be used on all devices - computers, smartphones, tablets, netbooks and the like.

The Internet is needed to create, view and publish story maps. Various map applications, analyses, graphs, photos, videos or sound recordings can be used as well as the results of spatial analysis can be presented without the need for the user to have special skills in geoinformation technologies. In addition, the advantage of the story map is that it can serve as a tool for student motivation (Roth, 2013).

The research published by Strachan and Mitchell (2014) proved the suitability of using story maps in education. Their analysis revealed that story maps were perceived as user-friendly, interactive and engaging. However, they identified the lack of technological resources in schools, the need for additional training and the lack of time as obstacles for their successful implementation. These authors thus pointed to the need to train future teachers to use story maps as a teaching and learning tool. According to the authors, however, it is very important that future teachers improve not only in technical terms, i.e. how to control the program/software, but to be able to use it correctly and fill it with materials that will be effective in the teaching process.

Recently, the use of story maps in education was also studied by Groshans et al. (2019) who described the use of ArcGIS StoryMaps in STEM education. Story maps can also be used to create interactive online atlases of different topics. Berendsen et al. (2018) dealt with the use of story maps to create an atlas for teaching geography at the University of Wyoming in the USA. Iturrioz et al. (2016) focused on the creation of an atlas depicting the expansion of the Black Death in Europe in 1346 and 1347 while Antoniou et al. (2018) focused on the geomorphology and history of Methan Peninsula. Furthermore, Hallsen and Karlsson (2019) analyzed the Swedish education system using story maps. The use of story maps in education was also dealt with by Mukherjee (2019), Egiebor et al. (2018), Lin and Li (2018), and Foelske (2014) points out that story-telling can improve teaching outcomes in various disciplines, such as mathematics (Butler et al., 2013), cultural and social sciences (Burnett et al., 2006), history (Malita & Martin, 2010) or foreign languages (Castaneda, 2013). The literacy is taught and used in all content areas, which makes digital storytelling an effective tool to use with students (Sadik, 2008).

These works point to a wide range of possibilities to use story maps not only in teaching geography. According to Mmguez (2020), the involvement of project tasks using story maps in higher education is necessary, as this method can later be used by students in practice in various fields. Story maps are thus a suitable tool not only for geography teachers, but also for primary and secondary school pupils themselves, through which they can create their own small scientific projects (Corey et al., 2020).

Digital (GIS) skills of students - current situation in the world and in Slovakia

Technological development in the recent decades has brought huge opportunities for the application of geospatial technologies on the Internet. The fundamental change from the past is that geographic information is not provided in paper, static, and often outdated form, but is available thanks to the Internet and network infrastructure anywhere and on various platforms. They are not only classic personal computers, but also mobile geoinformation technologies (Vojtek et al., 2016, 2020). A significant change in the way online maps are created is the interactivity of communication; the users can actively adjust the scope and form of the presented geographical information and even supplement their own data.

The concept of free (open-source) software and information occupies an important place in the development of new technological and content solutions. This technological development also creates

favorable conditions for further development of geospatial technologies and their applications (Hofierka, 2012). The development of GIS has been closely linked to the development of information technology since its inception. The foundations of GIS were laid in the 1960s as part of the ongoing quantitative revolution in science. The expansion and availability of computers for the academic sector has started the development of new methods, geospatial technologies and new scientific disciplines (such as geinformatics or geomatics). New possibilities have opened up for the processing of large amounts of data, including geographic (spatially localized) data (Hofierka, 2011; Longley et al., 1999, 2001; Mitasova & Hofierka, 2003).

Geoinformatics and GIS belong to new disciplines of science that have arisen due to the development of information and communication technologies. GIS have a wide range of applications and they can be experienced in everyday life (Hofierka, 2012). The importance of including geospatial technologies in the educational process is also stressed in their works by Mitchell et al. (2018), Nazareth et al. (2019), Pesaresi (2019), and Bettinger and Merry (2018), and the like.

With the development of IT technologies, specifically GIS technologies, the need for training in GIS in higher education through bachelor and master study programs for future primary or secondary school teachers is closely related. GIS education in Europe is most strongly settled by quality and quantity, especially, in the United Kingdom, Germany, Sweden or the Netherlands. However, Slovakia is also one of the leading countries in the EU, but rather in terms of quality, history, and accreditation of teaching than in terms of quantity. At present, GIS can be studied at seven university faculties in Slovakia (Blist'an et al., 2015). The importance of implementing GIS in the teaching process is also pointed out by African countries. According to Mzuza and Westhuizen (2020) there are only three countries in southern Africa (South Africa, Botswana and Malawi) in which the training of future geography teachers is also enriched by the issue of GIS technologies. Countries that use GIS point out that the course helps with decisionmaking, critical thinking and inquiry-based and learner-centered learning, which have the ability to improve the quality of education. Educators and policy-makers are encouraged to reinforce the inclusion of GIS and use of relevant pedagogical skills in teachertraining universities.

Graduates with geoinformatics skills are preferred in practice and schools that offer this literacy are, therefore, more attractive (Kusendova, 2017). In Slovakia, the penetration of GIS into geographical education have acquired a real dimension and becomes the subject of discussion of the geographical community in the context of the future development of geography at Slovak universities (Matlovic, 2014). In most academic workplaces, the technical equipment for teaching geoinformatics, collection and processing of geographical data has improved, often on the basis of international or national educational grants (Kusendova, 2017).

According to European Commission estimates, up to 90% of jobs, covering all sectors of the economy not just IT, will require some degree of digital skills in 2020. The development of digital skills should, therefore, help young people to succeed and be competitive in the labor market, which will also have a positive impact on the economy. The development of EU countries in digital competitiveness is monitored by the composite Digital Economy and Society Index (2019), which summarizes the relevant indicators of Europe's digital performance. According to DESI, Slovakia ranked 21st among the 28 EU countries in 2019. In order to change this situation, we should first begin in education, whether it is a primary school or secondary school, but mainly it is important to focus on the education of future teachers at the university. If teachers are not able to use digital skills, then they cannot teach pupils how to use them in the educational process (Aladag, 2014).

Currently, the national project entitled “IT Academy - Education for the 21st Century” is running in Slovakia. The project was to run from 2016 to 2020, but due to the COVID-19 pandemic, the project was extended until 2021. The project is aimed at primary and secondary schools, but also at universities. Regarding the primary and secondary schools, the project activities are divided into the following sub-activities -Sub-activity 1.1: Innovation of science and technical education at primary and secondary schools; Sub-activity 1.2: Education of teachers of informatics, mathematics, science and technology subjects at primary schools; Sub-activity 1.3: Motivation of pupils and students to study information and communication technologies (ICT) within natural and technical sciences; Sub-activity 1.4: Standards for digital literacy, personal development and communication competencies for secondary schools; and Sub-activity 1.5: Creation of partnerships and networks of primary and secondary schools and IT companies. As for universities, the individual activities are divided as follows - Sub-activity 2.1: Innovation of preparing university students for employment in the IT sector; Subactivity 2.2: Standards for digital literacy and personal development; and Sub-activity 2.3: Creating partnerships and networks of universities and IT companies. Most of these activities have already taken place (e.g., 1.4. Standards for digital literacy, personal development and communication competencies for secondary schools) while some are still ongoing (e.g., 1.1 Innovation of science and technology education at primary and secondary schools).

This project responds to the requirements of the IT sector to adapt the education system to the current and prospective needs of the labor market. The strategic objective of the project is to create a model of education and training of young people for current and prospective needs of the knowledge society and labor market with a focus on information and ICT. The project also focuses on technical and science education innovations at primary and secondary schools. The innovation should aim at updating the content, forms and methods of teaching vocational and science subjects. In the long term, the main task of the IT Academy is to build a modern and creative learning environment that, in terms of sustainability, will allow long-term training of qualified professionals for a wide portfolio of IT career opportunities.

The project is financed by the Ministry of Education of the Slovak Republic and cofinanced by the European Social Fund within the Operational Program Human Resources - Priority Axis Education (IT Academy, 2019). Department of Geography and Regional Development FNS CPU in Nitra and the Department of Geography and Geology FNS MBU in Banska Bystrica are also involved in this project. The main task of the departments within the project was the preparation of methodologies focused on teaching geography through ICT and IBSE (Inquiry Based Science Education) for primary and secondary schools, training geography teachers at primary and secondary schools using ICT, and involving in the conferences focused on teaching geography using ICT and IBSE. Within the seminars, that are described in the next sub-section and in which the presented research was carried out, the future geography teachers are taught the practical possibilities of using ICT, as well as digital skills in their pedagogical practice.

An innovative approach in teaching GIS (not only in Slovakia) is also brought to the fore by Michaeli et al. (2015) who focused in their research on the development of competencies of future teachers using GIS technologies. The use of these technologies in secondary or primary schools is conditioned by the precise training of future teachers and, in particular, the creation of story maps is an example of an innovative and undemanding method (Chvojka & Vojtek, 2016).

Aim

The presented research was conducted on a seminar which is focused on the use of digital skills in geography teaching. After reviewing the annual reports of the Faculty of Natural Sciences CPU in Nitra (https://www.ukf.sk/univerzita/vyrocne-spravy), it was found that the interest of students in natural sciences is declining at this faculty. Comparing the years 2008 and 2018, the faculty recorded a decrease in students by up to 42%. These findings also correspond with the Faculty of Natural Sciences MBU in Banska Bystrica, which is also proved by the annual reports (https://www.umb.sk/univerzita/univerzita/ o-univerzite/vyrocne-spravy-umb.html). This faculty recorded a decrease in students up to 75% in the period 2008-2018. Therefore, in recent years, individual departments, but also faculties have begun to focus more on popularization events as well as create more activity on social networks as well as directly at primary and secondary schools.

These findings were also reflected in this research and, therefore, for more relevant results, we present research at two Slovak geographical departments where a seminar with the same focus is taught. In particular, the research was conducted at the Department of Geography and Regional Development FNS CPU in Nitra and the Department of Geography and Geology FNS MBU in Banska Bystrica. The seminar is intended for students attending the teacher training program at the master study. The seminar deals with the use of ICT in teaching geography at primary and secondary schools in practice. Students are presented with topics such as virtual reality, augmented reality, mLearning, use of various educational online applications, and the like. Specific tasks that students have to perform in this seminar are, for example, completion of mLearning route, which is usually realized near the university or selection of educational video in virtual reality and its specific application in teaching geography (Vojtekova et al., 2019), creation of educational tasks in learningapps.org, creation maps in ArcGIS Online as well as one of the tasks is to create a story map in the selected application.

As for the pedagogical research, which was conducted at the two geographical departments, three most popular and used applications for creating story maps (Knight Lab StoryMapJS, Esri ArcGIS StoryMaps, and Google Tour Builder) were chosen for students. It should be noted that we did not introduce these applications to the students. Students were only explained what the story maps are in general in order not to affect their choice of the story map application. Since the students were from the first and second year of the master study, they already had some GIS skills, which they gained in their bachelor study attending the GIS courses using predominantly ArcGIS Desktop software. Students learned the basics of GIS on these courses, such as applying various cartographic methods on statistical data, working with geodatabases, georeferencing tools, creating and modifying GIS layers, creating map layouts, and the like.

As mentioned above, the research was conducted on a seminar focused on digital skills applicable in educational practice. In this course, students have the opportunity to learn to work also with other GIS applications (namely ArcGIS Online and story maps), in addition to the one they learn before (ArcGIS Desktop). As long as we asked students at the beginning of the class (before each topic) if they had some experience or skills with the topic, we knew that most students had experience with ArcGIS Online (approximately 70%). However, almost 90% of students did not have any experience with story maps while the rest of the students only heard about the story maps, i.e. they did not work with any story map application.

The research on narrative-based geospatial technologies (story maps) is needful due to possibilities they offer to the user, whether it is a teacher or a pupil/student. In geography education, story maps can help teachers to present geographical content in a more attractive way. On the other hand, they can help pupils/students in better understanding of various geographical phenomena while

simultaneously developing their spatial thinking. Story maps applications are powerful tools with many well-designed templates to create a website to showcase own work and tell a story. In addition, they enable to incorporate maps and other spatial data with other multimedia contents. Therefore, the aim of the paper is to analyze the perception of story maps by future geography teachers and to point out the ease of creating and using story maps applications in the educational process.

Methods

The paper deals specifically with the use of story maps in education, where students were asked to create story maps on any geographic topic within the seminars "Modern Trends in Geographical Education" and "Touch Technologies in Geographical Education". They could choose from three applications, which are used to create story maps and they had to learn to work with them. The following applications were selected: i) application with a strong Google brand called Tour Builder although it has limited capabilities and can only show a tour, ii) application from Northwestern University (Knightlab -StoryMapJS) which also has limited capabilities, but can be very productive if the user has development skills, and iii) application (ArcGIS StoryMaps) from the strongest company in this field - Esri due to the fact that students already had previous experience with ArcGIS Online and ArcGIS Desktop software.

Moreover, they were not given precise instructions on how to create a story map so that their selection of the application was not affected by the teacher's interpretation. They had to study the three applications on their own and choose the most suitable application for them. They had two weeks to create story maps. The topic for creating story maps was the presentation of any region in the world. The research was attended by 20 students from the Department of Geography and Regional Development and 22 students from the Department of Geography and Geology during the winter semester of the academic year 2019/2020. The target group of students was chosen on the basis of their specialization (teacher training program), as we wanted to find out whether students would use story maps in their teaching practice. We also wanted to know if students who used other software for their presentation before the seminar will use this software again because they know it well or they will choose the newly introduced story map application. In addition, we were also interested in which of the three offered applications for creating story maps they will choose.

Students had to choose from the following three (above-mentioned) applications:

- Knight Lab - StoryMapJS

It is a free web-based tool that allows a user to create story maps in several ways. This tool was developed at Northwestern University in the USA and the user logs into it using a Google account. The user can add imagery for each location in the story, change the visual style of the map in preferences or create own style using Mapbox. It can connect media from various sources: Twitter, Flickr, YouTube, Vimeo, Vine, Dailymotion, Google Maps, Wikipedia, SoundCloud or Cloud documents. StoryMapJS uses JSON data as its native data format. The user can load data from a file on the web or create a JavaScript object in any other way. If data from a URL are added, it must be either on the same server as the page where story map is displayed or from a server with properly configured CORS headers. After login, the application supports 28 languages (Knight Lab, 2017).

- Esri - ArcGIS StoryMaps

This tool was developed by the Esri company allowing user to create interactive maps using either web maps and scenes created in ArcGIS Online and ArcGIS Pro or express maps and enhance them with

pop-ups, demographic, lifestyle or any other data or choose from current collection of available maps from Living Atlas of the World. It is compatible with web maps and scenes, supports embedded web content, it is designed according to WCAG 2.0 accessibility guidelines, it includes express maps, allows unpublished changes and more. It is free under the user's public account. The user can log in to the application using a Google account, Facebook account or by creating an account on the website. This web application is hosted on ArcGIS Online. It is supported in browsers that support JavaScript and cookies, such as Apple Safari, Google Chrome, Microsoft Edge and Mozilla Firefox. After login, the application supports 37 languages (Esri, 2019).

- Google - Tour Builder

This free application was developed by Google and can be logged in with a Google account. The application is supported in English language. As background maps, it uses images from Google Earth. The user can also add photos, videos, text and the like. When creating story maps, the user can also use previews from the Jane Goodall Institute, which can be downloaded. Layers in KML/KMZ format can also be added into the application (Tour Builder, 2018).

Before starting the research, the following research hypotheses were set:

- H1 – The choice of the application by students is influenced by their previous experience with the application.

- H2 – It will not be difficult for students to develop a story map using the mentioned applications despite the fact that they did not have enough experience about the selected applications before the experiment.

- H3 – Students will make more use of story maps in their educational practice than other applications.

After creating story maps, students presented the created story maps during the class. In addition, they completed an anonymous questionnaire which focused on how students perceive the usefulness of story maps in their future educational practice. The online unauthorized questionnaire was created using Google forms and then sent to students for their email accounts. Students had one week to complete and submit the anonymous questionnaire. The questionnaire contained 4 open questions and 5 multiple choice questions (Table 1).

Statistical analysis of the results of questionnaire survey

After completion, the questionnaire was analyzed using statistical methods for qualitative data, namely the independence test for the association table and x2 independence test for the pivot table k x m (Markechova et al., 2011).

First, statistical methods were used to verify the validity of the research hypothesis H2, i.e. whether it would be difficult for students to develop a story map using the mentioned applications even though they did not have enough experience with these applications before the experiment.

In this case, the statistical analysis was used to verify whether students' experience with story maps applications prior to the seminar had an impact on the students' attitude to developing a story map using selected applications.

Table 1. Questions from questionnaire survey.

Did you know about story maps applications before this seminar?	Yes No
Which website did you choose to create your story map?	Knight Lab StoryMapJS Esri ArcGIS StoryMap Google Tour Builder
Why did you choose this website?	-Open answer-
What did you like about creating presentations using story maps?	-Open answer-
What did you not like when creating presentations using story maps?	-Open answer-
Was it difficult for you to make a story map?	Yes No
Would you use story maps to teach geography in practice?	Yes No Maybe
Which software do you prefer to create presentations? (you can choose more options)	PowerPoint Prezi Story maps Other
If you answered "Other", please specify them:	-Open answer-

Therefore, the dependence of two qualitative attributes A, B was tested, where A denotes the students' experience with story maps applications and B denotes the students' attitude for creating a story map. Both A and B have two options for verbal answers: yes and no. The null hypothesis (H0) was the hypothesis of the independence of the observed attributes A, B. In finding the answer to the question, the test for the association table was used. The test criterion was represented by the following statistics (Equation 1):

$$x^2 = \sum_{j=1}^{4} \frac{(f_{ej} - f_{oj})^2}{f_{oj}} \qquad (1)$$

where fj are empirical and foj expected (theoretical) frequencies. Statistics x2 has asymptotical distribution with one degree of freedom under the tested hypothesis H0. The tested hypothesis H0 on the independence of the observed attributes A, B on the level of significance a is rejected if the value of the test criterion x2 exceeds the critical value (1) of the x2 distribution. If the calculated value of the test criterion x2 exceeds the critical value x201 (1) = 3.841, the null hypothesis at the significance level a = 0.05 is rejected in favor of the alternative hypothesis and the dependence between the observed attributes is considered to be statistically significant. Otherwise, the observed attributes are statistically independent.

This test can also be evaluated using the p value, which is the probability of the error that is made when the tested hypothesis is rejected. If the probability p value is sufficiently small ($p < 0.05$ or $p < 0.01$), the tested hypothesis of the independence of the observed attributes A, B is rejected (at the significance level of 0.05 or 0.01). Otherwise, the hypothesis cannot be rejected.

The analogous procedure was applied when verifying the hypothesis H3, i.e. the ability of students to develop story maps using selected applications is related to students' willingness to use story maps in geography teaching in practice.

Finally, the statistical methods were used to verify the validity of the research hypothesis H1, i.e. whether the choice of the application by the students is influenced by their previous experience with the applications. Since students were able to choose from several options to answer the question of choosing the application, another statistical method was used to verify the validity of the research hypothesis H1. Specifically, it was the method for verifying the dependence of two quality attributes A, B, i.e. the x2 independence test for a pivot table of the type k x m. It is assumed that the attribute A acquires k levels A1, A2, ... , Ak and the attribute B acquires m levels B1; B2, ... , Bm while k >2 or m >2. The null hypothesis H0 was tested: attributes A, B are independent of the alternative hypothesis Hy attributes A, B are dependent. As the test criterion, the following statistics was used (Equation 2):

$$x^2 = \sum_{i=1}^{k} \sum_{j=1}^{m} \frac{(f_{ij} - o_{ij})^2}{o_{ij}} \qquad (2)$$

where f they are empirical and Oj expected (theoretical) frequencies. Testing statistics x2 has, under the tested hypothesis H0, distribution with number of degrees of freedom r = (k - 1)(m - 1). The tested hypothesis H0 is rejected on the level of significance if the value of the test criterion x2 exceeds the critical value xa (r).

The STATISTICA software was used to perform the tests.

Results

After performing the independence test x^2, the association table, test criterion value of the test and p value were obtained (Table 2).

Since the probability p value (p = 0.013) is less than 0.05, the hypothesis H0 on the independence of the observed attributes was rejected at the significance level a = 0.05. The test showed that students' attitude to the difficulty of developing the story map using selected applications depended on whether the student had experience with the story maps applications prior to the seminar or not (Figure 1). Thus, the research hypothesis H2 was confirmed.

From Figure 1, it can be seen that up to 86% of respondents answered that they did not have the experience about story maps applications and, at the same time, they did not consider making a story map difficult.

The results of the independence test x^2, verifying the hypothesis H3 that the ability of students to develop story maps using selected applications is related to students' willingness to use story maps in geography teaching in practice, are shown in Table 3.

Table 2. Results of the x^2 test (%).

	Difficulty of making story maps		
Experience before the seminar	Yes	No	Total
Yes	2	0	2
No	12	86	98
Total	14	86	100

Chi-square: 6.146, df = 1, p = 0.013 (*)

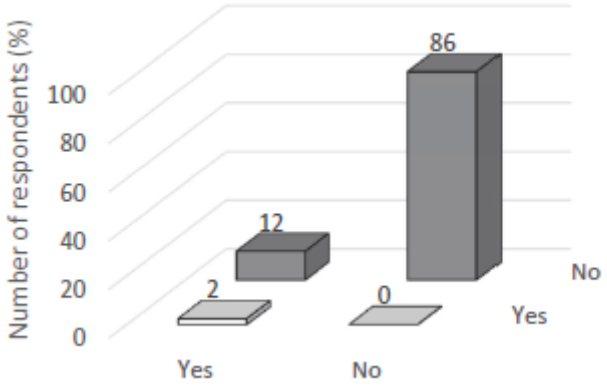

Figure 1. Dependence of students' attitude to the difficulty of developing a story map.

Table 3. Results of the x^2 test (%).

	Use of story maps		
Difficulty of making story maps	Yes	No	Total
Yes	2	12	14
No	74	12	86
Total	76	24	100

Chi-square: 13.672, df = 1, p = 0.000 (**)

Since the probability p value is less (p = 0.000) than the selected significance level α = 0.01, the hypothesis H_0 was rejected at the significance level α = 0.01 and the alternative hypothesis H_1 was accepted. This means that the ability of students to develop a story map, using selected applications, (statistically) significantly affects the students' willingness to use of story maps for teaching geography in practice. The test showed that students' opinion on the use of story maps in teaching geography in practice depends (statistically) significantly on whether or not the student has the ability to develop a story map using selected applications (Figure 2). Thus, the research hypothesis H3 was confirmed.

Based on Figure 2, it can be seen that up to 74% of respondents answered that they did not consider making a story map difficult and, at the same time, they would use story maps in teaching geography in practice.

The results of the independence test for the pivot table, which verified if students' experience with story maps applications before the seminar started influenced the choice of the software used to create the presentation, are presented in Table 4.

Since the probability p value is less (p = 0.000) than the selected significance level α = 0.01, the hypothesis H0 was rejected at the significance level a = 0.01 and the alternative hypothesis Hj was accepted. This means that students' experience with story maps applications prior to the start of the seminar had (statistically) significant impact on their choice of software when creating the presentation. The test showed that choosing the software, which was used to create the presentation, depends (statistically) significantly on whether or not the student had experience with story maps applications prior to the start of the seminar (Figure 3). Thus, the research hypothesis H1 was confirmed.

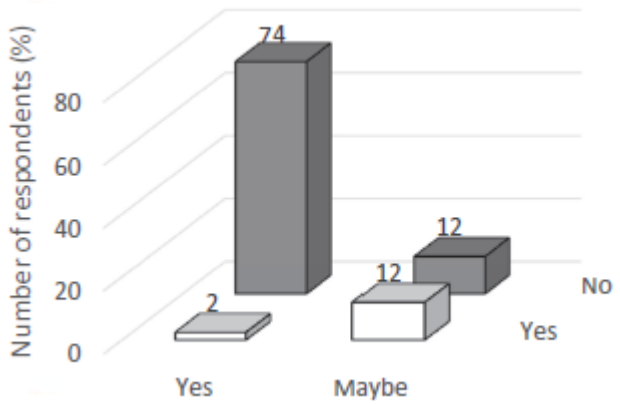

Figure 2. Dependence of students' opinions on the use of story maps for teaching geography in practice to their ability to create a story map using selected applications.

Table 4. Results of the x^2 test (%).

	Software				
Experience before the seminar	PowerPoint	Prezi	Story maps	Other	Total
Yes	0	0	2	0	2
No	83	10	0	5	98
Total	83	10	2	5	100

Chi-square: 42.000, df = 3, p = 0.000 (**)

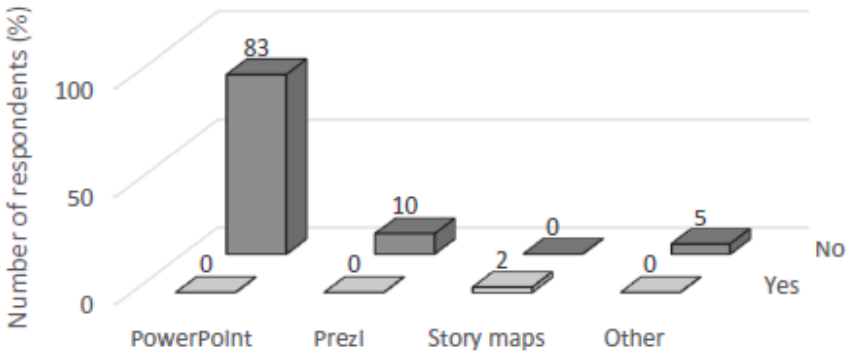

Figure 3. Dependence of software selection to students' experience with given story maps applications before the seminar.

From Figure 3, it can be seen that up to 83% of respondents did not have experience with story maps applications before the seminar and they would also choose PowerPoint for their presentations because they considered it the easiest and most affordable way to create presentations so far.

As for the qualitative analysis, the obtained data were not analyzed using, for example, statistical methods (coding), as the answers to the questions were open. Based on the qualitative assessment of story maps in the form of students' feedback, in terms of selection of the application, the preferred application was Google Tour Builder (Figure 4). Up to half of the students used this application (Figure 5) and the main reasons for its selection were: webpage quality, simplicity of working with the webpage, intuitiveness, ease of use, time saving and, especially, simple login with Google account. They also liked the visual side of this application the most. On the other hand, they were unable to sign in and work in the other two apps. In the other two applications, students had difficulty logging in to the user account and also they had problems working in these applications. Some of the students did not record any disadvantages when working with the Google Tour Builder.

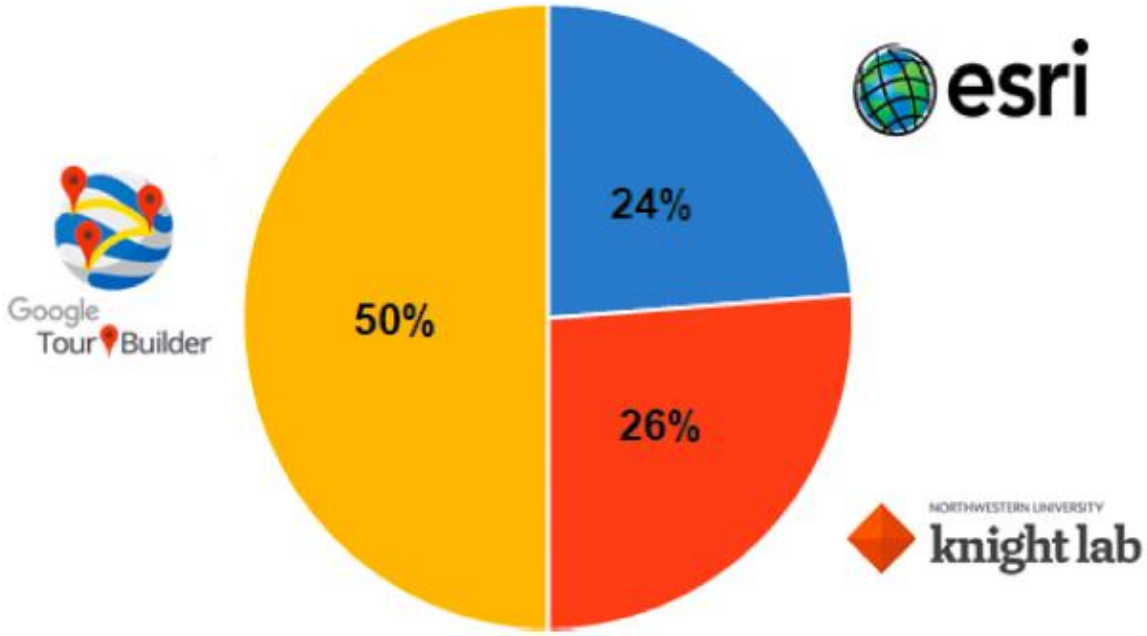

Figure 4. Preferred application by students.

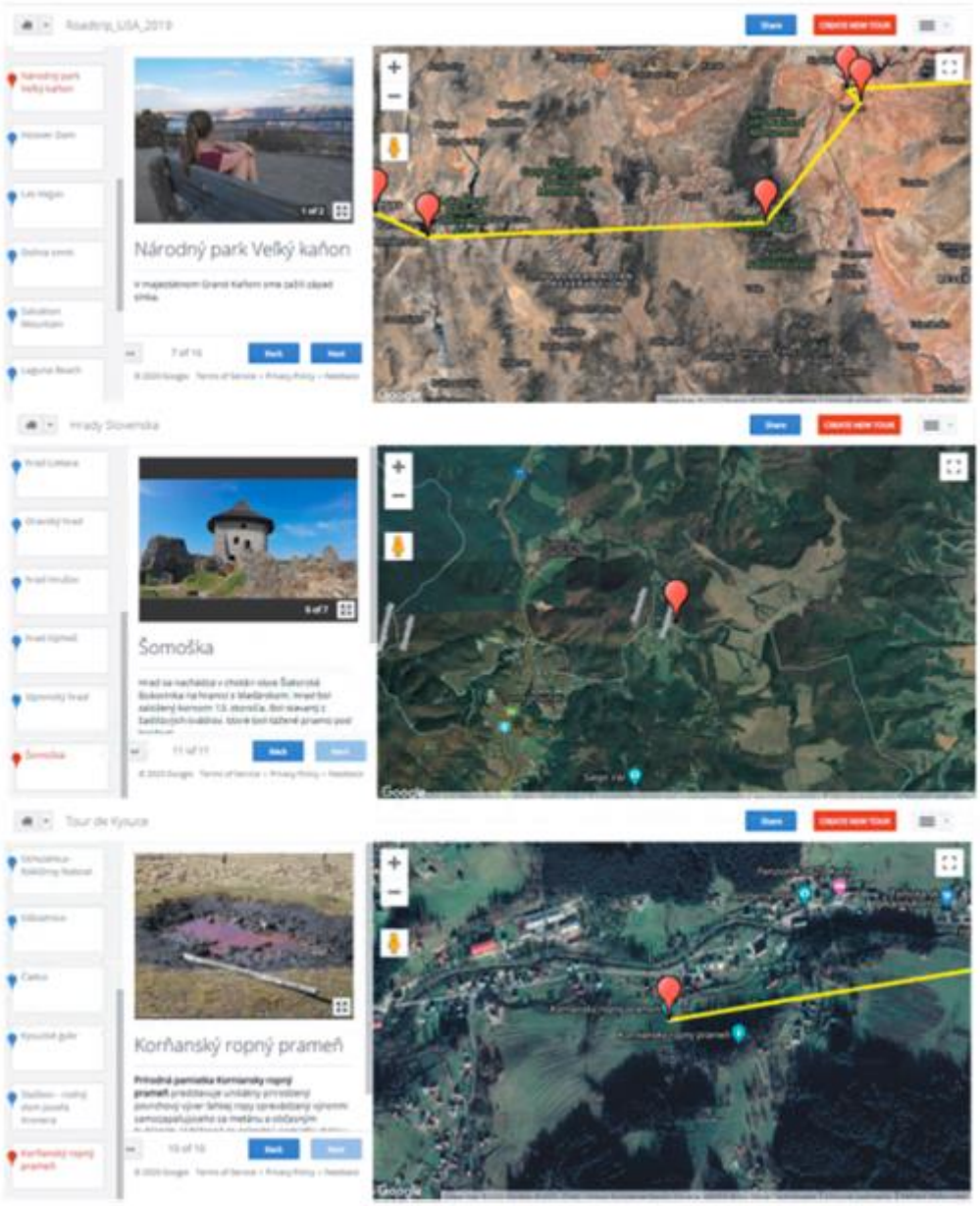

Figure 5. Demonstration of story maps created by students in Tour Builder application (https://tourbuilder.withgoogle.eom/builder#play/ahJzfmd3ZWItdG91cmJ1aWxkZXJyEQsSBFRvdXIYgICg3_TqpggM/ahJzfmd3ZWItdG91cmJ1aWxkZXJyJwsSBFRvdXIYgICg3_TqpggMCxIJUGxhY2VtYXJrGICAoN-2wMAKDA,https://tourbuilder.withgoogle.eom/builder#play/ahJzfmd3ZWItdG91cmJ1aWxkZXJyEQsSBFRvdXIYgICgv_HdmggM/ahJzfmd3ZWItdG91cmJ1aWxkZXJyJwsSBFRvdXIYgICgv_HdmggMCxIJUGxhY2VtYXJrGICAoO_ OmfcIDA, https://tourbuilder.withgoogle.eom/builder#play/ ahJzfmd3ZWItdG91cmJ1aWxkZXJyEQsSBFRvdXIYgICgz9eY0wkM/ahJzfmd3ZWItdG91cmJ1aWxkZXJyJwsSBFRvdXIYgICgz9eY0wkMCxIJUGxhY2VtYXJrGICAoJ-svKgLDA).

On the contrary, some of them stated these weaknesses: almost no possibility of text formatting (changing font size, color, paragraph justification, etc.) or troubles rotating images. Some of them identified as a weakness a small sleection of icons that are embedded in the map, a more outdated visual design compared to the other applications or that the map and description could not be switched to full-screen mode. One of the student salso stated that the website was in English language, which made it more difficult for her to work with it.

Figure 6. Demonstration of story maps created by students in StoryMapJS application (https://uploads.knightlab.com/storymapjs/8fc4163890bbc6034a61332a6b172f57/slovensko/index.html, https://uploads.knightlab.com/storymapjs/878a9feb3e61c935e988f5891e3bca45/zilina/index.html, https://uploads.knightlab.com/storymapjs/f458648bc29872ff92c568add253c0da/metropoly-azie/index.html).

The second most used application was the StoryMapJS, which is available on the Knight Lab website (Figure 6). Students chose this application mainly for two reasons: because it seemed to be the easiest compared to the others and also they liked the graphic design. Students also criticized the application stating several disadvantages:

- Text formatting was not possible.
- Missing “step back” button.
- No option to change the position of an image.
- Only municipalities and cities can be marked on the map.
- No option to erase a wrongly marked point.
- Limitations in functions.
- No option to add multiple photos, only one photo to a given location.
- A limited number of characters in the text.

These observations point to problematic issues of the applications that are not easy-to-use or intuitive for the user. The application may include these functions, but the user does not know how to use them.

The least used application was the Esri ArcGIS StoryMaps (Figure 7). This application was used by less than a quarter of respondents who identified the following main reasons for their selection: simplicity, intuitiveness and the resulting graphic design of the presentation. As one of the negatives, it was stated that there is no informational instructions on how to create story maps for new users. A similar disadvantage to previous applications was the inability to format text or problems with uploading images. Linguistically less proficient users were again restricted as the whole site works in English language, but this problem can be described as a subjective attitude.

Regardless of the application, students rated story maps applications as a very useful and engaging way of presenting. The most frequently mentioned advantage, over the traditionally and constantly used PowerPoint presentations, was mainly the connection of maps, images, videos and text. According to the students, the biggest advantage is the eye-catching design of the final presentation, its clarity and dynamism. One respondent stated that the creation of a story maps is so clear and easy that pupils themselves could plan, for example, an excursion within the selected country and tell the other pupils about the specifics, points of interest or sights in the selected country. This respondent certainly plans to use these applications in his teaching practice.

Discussion

User-friendly and effective integration of GIS technologies into the teaching process has been a topic of discussion in recent years. In the past, GIS technologies were difficult to apply in primary and secondary school environments due to hardware and software complexity. At present, however, it is possible to use free cloud-based online tools that allow the teacher to follow a clear pedagogical strategy, taking into account possible variants of its use, such as demonstration, direct work with GIS in a class or independent and indivudal work (Kholosyn et al., 2018).

The results of our research are in many parts consistent with the findings of similar works, such as Battersby and Remington (2013) or Cope et al. (2018). In their research, they also rated story maps as a teaching tool that can be used on its own or together with a PowerPoint presentation. Respondents also stated that story maps are much more engaging and interactive than a PowerPoint presentation. An important benefit of story maps creation is intuitiveness. The students in our research were not particularly familiar in advance with how they should use the application, which means they had to learn it by themselves. This is also confirmed by the work of Warshawsky (2016), who performed similar research, where students were also able to design and build their own spatial-oriented web applications with minimal support.

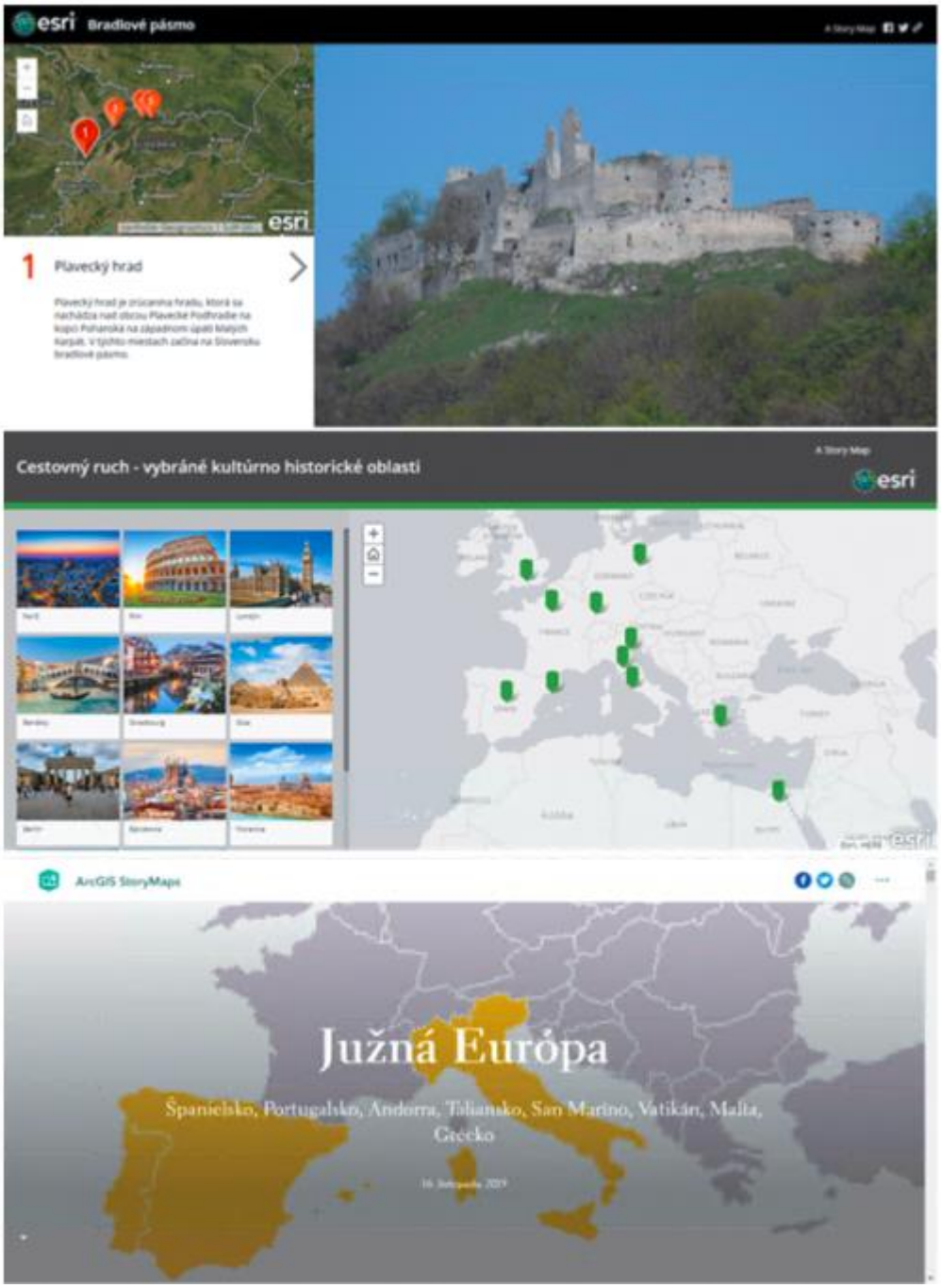

Figure 7. Demonstration of story maps created by students in ArcGIS StoryMaps application (https://www.arcgis.com/apps/MapTour/mdex.html?appid=b75bb3f430c64effbbc58801a15a409e, http://www.arcgis.com/apps/Shortlist/index.html?appid=0a7d6cdd892d4ed9999d74fdf23a52db, https://storymaps.arcgis.com/stories/9b54ae8b28f14259a5ff0505cfe12a41).

The research results of Mah et al. (2020) are very similar to the results of the present research. They also introduced three web mapping applications developed by first-year engineering students at the University of Calgary. Students did not have any previous knowledge in the field of mapping or geospatial information systems (story maps) and their results demonstrate high competence and creativity of students, which was confirmed also in this case. According to the students, these projects were a unique educational experience and an excellent starting point in their teacher career.

Groshans et al. (2019) used story maps from Esri in their research and evaluated the skills gained using this story maps application and the classic PowerPoint presentation, which is distinguishes their research from the one that is presented. However, in their research they also analyzed the perception of students teaching Science, Technology, Engineering, and Mathematics (STEM) using PowerPoint and story maps. Based on this, their results coincide with the results of the presented research, where students also preferred story maps when presenting the curriculum. In addition, Lee (2020) examined the experience of students acquired using story maps and points out the importance of using geospatial technologies in teaching, but this research differs from the presented one. In this case, we do not deal with the knowledge (i.e. new content) acquired through story maps, but students' perception of the selected applications as well as their skills and experience in working with them. The use of story maps in the university environment, specifically in the teaching of geoinformatics, is also addressed by Netek (2014), where students worked with the application from Esri to create story maps.

According to Strachan and Mitchell (2014), the input instructions or instructions for working with story maps are important. If users do not receive any training, they are likely to express a less positive perception of using story maps in the future. However, this fact was not confirmed in this study because the students did not receive any precise instructions and yet their reactions to story maps were very positive. The fact that extensive instruction is not required in advance is also important in the sense that creating story maps should be intuitive and easy-to-use also for primary and secondary school pupils. This was also confirmed in the work by Egiebor et al. (2018), who studied the perception of story maps by the pupils from the 8th grade of primary schools. Pupils perceived story maps in four ways: generating inquiry, visualizing information, mapping interactively and cycling. In addition, they also perceived the geographical and cultural links between story maps and their lives. Furthermore, Dickinson and Telford (2020) dealt with questions about the digital visualities of qualitative research representation for geographical education. They state that story-mapping technologies are more-than-visual form of research representation.

In terms of choosing the application, it was surprising that the Esri application was the least popular among students although students had previous experience with ArcGIS software (ArcGIS Online and ArcGIS Desktop) from this company. However, Esri, as one of the leaders in geoinformation technologies, responded to this phenomenon in 2019 by launching a new version of StoryMaps (Evans, 2019). Esri StoryMaps innovation only reflects the ever-increasing importance and use of the story maps in different spheres of life. In this sense, Esri gradually adds new features and capabilities in order to produce simple maps very quickly using different devices (Evans, 2019).

A study by Strachan and Mitchell (2014) found that teachers in the United States prefer story maps as an educational tool that meets academic standards. These findings also correspond to the research of Berendsen et al. (2018), who suggest that students should prefer story maps over traditional atlas print forms. On the basis of these results, the future development of pedagogical approaches can be changed in that students themselves could create their own story maps to synthesize material and teachers would act only as mediators. Students would become creators of their own content, taking a more active responsibility for their own learning process (Groshans et al., 2019).

Collins and Mittchel (2019) recommend three issues for transformation in teacher practice: pre-service teacher geography and GIS intervention, continuous follow-up and coaching, and including GIS in Academic Standards. In line with these recommendations, we therefore consider it essential that future geography teachers become familiar with GIS technologies during higher education so that they learn to use these technologies and be able to implement them in the teaching process. However, as this is a constantly evolving and changing field, universities and research institutes should also offer

geography teachers additional training courses focused on new possibilities for using GIS technologies. Guo et al. (2020) also argue that the biggest barrier to the use of multimedia technologies in teaching geography is the insufficient skills of teachers. However, in order for a geography teacher to be innovative and use GIS technologies, a change in teaching materials is also needed (Ridha et al., 2020). Teaching materials, textbooks, worksheets are often outdated and do not reflect current developments and the need to use GIS technologies in teaching. In addition to educating future teachers or training current trainers, it is necessary to create teaching materials (sets of tasks) that would focus on working with different types of GIS technologies and provide examples of tasks that teachers could immediately apply in teaching without long time training.

Conclusions

There is a critical need for digital narration as a way of teaching and learning in education in the 21st century. To be successful, students must have skills that are important to technology, information and media (Groshans et al., 2019). The advantage of using story maps, for example, in students' future teaching practice is that these digital maps are easy to use as well as to work with. According to Foelske (2014), they increase students' interactivity, interest and motivation and they can also increase students' learning and engagement. In addition, they improve their skills and provide educational benefits in many curricula, such as natural sciences but also humanities (Foelske, 2014). Moreover, Gonzalez and Torres (2020) describe and discuss the necessity and significance of introducing geospatial technologies into the curriculum of geography in secondary schools.

Nowadays, in view of developing and improving digital, technological and information literacy, students can benefit from story maps. For instance, they can apply the acquired skills and experience throughout their future careers (Niemi et al., 2014). Furthermore, story maps can be used from the position of a teacher as an evaluation tool, a tool to attract students' attention, a tool to non-violently include GIS in teaching at primary and secondary schools or university. Students can use them as a presentation tool, a tool for practicing web mapping and data skills, as a way to acquire new experience and skills in an engaging way, and so on.

The quantitative analysis of the results showed that introduction of modern teaching methods using GIS in the university environment, such as an extension of the experience and skills of future teachers, is particularly important for their teaching practice. Although future teachers attend courses focused on professional geographic information systems (ArcGIS, QGIS, and the like), their use in teaching practice is poorly applicable mainly due to difficulties to operate them or time and data availability. Story maps, as a freely available and user-friendly tool, therefore seems to be very suitable for the presentation of geographic information to less skilled ICT users. Based on students' perceptions, they have acquired experience in creating story maps as well as information about the diversity of digital story maps usage in various applications (Tour Builder, ArcGIS StoryMaps and StoryMapJS).

In this research, it was found that the most preferred was the application from the strong Google brand while the least preferred was the application from Esri even though students already had experience with applications from this company (ArcGIS Online, ArcGIS Desktop). The students' responses to questions why they preferred the Google application was that they could easily log in to Tour Builder with their Google Account, but they had trouble logging in to the other two applications. However, we consider this response an inadequate justification as Google Account can also be used to log in to the Esri application. This fact was also confirmed by the other 50% of students who were able to log in to ArcGIS StoryMaps and StoryMapJS. Furthermore, students included in the their answers that the Esri application does not contain any information instructions on how to proceed when creating story maps

for new users, which is partly true, but a number of manuals for creating story maps from Esri are available on youtube.com and also step-by-step guides can be easily found.

The research hypotheses H1, H2 and H3 were confirmed by realization of the experiment and subsequent analysis of research results using statistical methods. It was confirmed that the students' choice of application was influenced by their previous experience with of the given applications (H1); it was not difficult for students to develop a story map using the selected applications even though they did not have enough experience with given the applications before the experiment (H2); and it was also confirmed that students will make more use of story maps in their educational practice than other applications (H3). The study described here was to be followed by another phase of the experiment in April-May 2020 during the students' teaching practice at primary and secondary schools. The students were due to apply their new experiences and skills with story maps in their pedagogical practice. However, this phase of experiment was suspended due to COVID-19 situation.

References

Aladag, E. (2014). An evaluation of geographic information systems in social studies lessons: Teachers' views. Educational Sciences: Theory & Practice, 14(4), 1533-1539. DOI: 10.12738/ estp.2014.4.1804.

Antoniou, V., Ragia, L., Nomikou, P., Bardouli, P., Lampridou, D., Ioannou, T., Kalisperakis, I., & Stentoumis, C. (2018). Creating a story map using geographic information systems to explore geomorphology and history of Methana Peninsula. ISPRS International Journal of GeoInformation, 7(12), 484. https://doi.org/10.3390/ijgi7120484 Battersby, S. E., & Remington, K. C. (2013). Story maps in the classroom. ArcUser. Esri. Retrieved April 22, 2020, from https://www.esri.com/about/newsroom/arcuser/story-maps-in-the-classroom

Berendsen, M. E., Hamerlinck, J. D., & Webster, G. R. (2018). Digital story mapping to advance educational atlas design and enable student engagement. ISPRS International Journal of GeoInformation, 7(3), 125. https://doi.org/10.3390/ijgi7030125 Bettinger, P., & Merry, K. (2018). Follow-up study of the importance of mapping technology knowledge and skills for entry-level forestry job positions, as deduced from recent job advertisements. Mathematical and Computational Forestry & Natural-Resource Sciences, 10(1),15-23. https://mcfns.net/index.php/Journal/article/view/10.5/2018.5

Blistan, P., Kovanic, L., & Kovanicova, M. (2015). The importance of geographic information systems education at universities in the process of building a european knowledge-based society. Procedia - Social and Behavioral Sciences, 191, 2458-2462. https://doi.org/10.1016Zj.sbspro. 2015.04.358

Burnett, C., Dickinson, P., Myers, J., & Merchant, G. (2006). Digital connections: Transforming literacy in the primary school. Cambridge Journal of Education, 36(1), 11-29. https://doi.org/10. 1080/03057640500491120

Butler, A., Monda-Amaya, L., & Yoon, H. (2013). The digital media writing project: Connecting to the common core. TEACHING Exceptional Children, 6(1), 6-14. https://doi.org/10.1177/ 004005991304600101

Castaneda, M. (2013). "I am proud that I did it and it's a piece of me": Digital storytelling in the foreign language classroom. CALICO Journal, 30(1), 44-62. https://doi.org/10.11139/cj. 30.1.44-62

Chvojka, L., & Vojtek, M. (2016). Current state of using geoinformation technologies for Teaching Geography at Secondary Schools in the Nitra self-governing region. Geograficke informacie/

Geographical Information, 20(2), 161-174. https://doi.org/10.17846/GI.2016.20.2.161-174 Collins, L., & Mittchel, J. T. (2019). Teacher training in GIS: What is needed for long-term success? International Research in Geographical and Environmental Education, 28(2), 118-135. https:// doi.org/10.1080/10382046.2018.1497119

Cope, M. P., Mikhailova, E. A., Post, C. J., Schlautman, M. A., & Carbajales-Dale, P. (2018). Developing and evaluating an ESRI story map as an educational tool. Journal of Natural Resources and Life Sciences Education, 47(1), 1-9. https://doi.org/10.4195/nse2018.04.0008 Corey, J. M., Rebecca, L. P., & Shao-Chang Wee, B. (2020). Engaging children to voice their sense of place through location-based story making with photo-story maps. Children's Geographies, 18 (2) , 148-161. https://doi.org/10.1080/14733285.2019.1685073

Dickinson, S., & Telford, A. (2020). The visualities of digital story mapping: Teaching the 'messiness' of qualitative methods through story mapping technologies. Journal of Geography in Higher Education, 44(3), 441-457. https://doi.org/10.1080/03098265.2020.1712686 Digital Economy and Society Index. (2019). European commission. European Commission. Retrieved April 22, 2020, from https://ec.europa.eu/digital-single-market/en/scoreboard/ slovakia

Egiebor, E. E., Foster, E. J., & Ellen, J. (2018). Students' perceptions of their engagement using GIS-story maps source. Journal of Geography, 118(2), 51-65. https://doi.org/10.1080/00221341.2018. 1515975

Esri. (2019). Classic story maps - harness the power of maps to tell your story. Esri. Retrieved April 22, 2020, from https://storymaps-classic.arcgis.com/en

Evans, O. (2019). Moving to the new ArcGIS storymaps. Esri. Retrieved April 22, 2020, from https:// storymaps.arcgis.com/stories/472a6ddd582b40b58a5a6af2c30a4573

Foelske, M. (2014). Digital storytelling: The impact on student engagement and academic learning. Graduate Research Paper, University of Northern Iowa. Retrieved April 22, 2020, from https:// scholarworks.uni.edu/cgi/viewcontent.cgi?article=1162&context=grp

Gonzalez, R. D., & Torres, M. L. D. (2020). WebGIS implementation and effectiveness in secondary education using the digital atlas for school. Journal of Geography, 119(2), 74-85. https://doi.org/10.1080/00221341.2020.1726991

Groshans, G., Mikhailova, E., Post, C., Schlautman, M., Carbajales-Dale, P., & Payne, K. (2019). Digital story map learning for STEM disciplines. Education Science, 9(2), 75. https://doi.org/10. 3390/educsci9020075

Guo, F., Meadows, M. E., Duan, Y., & Gao, C. H. (2020). Geography pre-service teachers' perspectives on multimedia technology and environmental education. Sustainability, 12(17), 6903. https://doi.org/10.3390/su12176903

Hallsen, S., & Karlsson, M. (2019). Teacher or friend? - consumer narratives on private supplementary tutoring in Sweden as policy enactment. Journal of Education Policy, 34(5), 631-646. https://doi.org/10.1080/02680939.2018.1458995

Hofierka, J. (2011). Nove moznosti komunikacie geografickej informacie pomocou geopriestorovej internetovej technologie Google Maps a Google Earth. Folia Geographica, 17(1), 100-108. http://www.foliageographica.sk/public/media/26613/8-NOV%C3%89%20MO%C5%BDNOSTI %20K0MUNIK%C3%81CIE%20GE0GRAFICKEJ%20INF0RM%C3%81aE%20P0M0C0U %20GEOPRIESTOROVEJ%20INTERNETOVEJ%20TECHNOL%C3%93GIE%20GOOGLE% 20MAPS%20A%20G00GLE%20EARTH.pdf

Hofierka, J. (2012). Geopriestorove internetovetechnologie na komunikaciu geografickej informacie. Kartograficke listy/Cartographic Letters, 20(1), 18-27. https://gis.fns.uniba.sk/karto grafickelisty/archiv/KL20/2.pdf

IT Academy. (2019). Education for 21st century. CVTI SR. Retrieved April 22, 2020, from http:// itakademia.sk

Iturrioz, T., Rodriguez, C. F., Sierra, P. B. S., & Alcarria, R. (2016). Creating story maps for learning purposes: The Black death atlas. In T. Bandrova & M. Konecny (Eds.), Proceedings, 6th international conference on cartography and GIS, Albena.

Kholosyn, I., Bondarenko, O., Hanchuk, O., & Shmelster, E. (2018). Cloud ArcGIS online as an innovative tool for developing geoinformation competence with future geography teachers. CEUR workshop proceedings, 2433, 403-412. https://arxiv.org/ftp/arxiv/papers/1909/1909. 04388.pdf

Knight Lab. (2017). StoryMap. Northwestern University. Retrieved April 22, 2020, from https:// storymap.knightlab.com

Kusendova, D. (2017, March 22-24). Aktualny stav geoinformatiky na Slovensku. Proceedingd GIS Ostrava 2017, Ostrava.

Lee, D. M. (2020). Cultivating preservice geography teachers' awareness of geography using story maps. Journal of Geography in Higher Education, 44(3), 387-405. https://doi.org/10.1080/ 03098265.2019.1700487

Lin, C. I., & Li, Y. Y. (2018). Protecting life on land and below water: Using storytelling to promote undergraduate students' attitudes toward animals. Sustainability, 10(7), 2479. https://doi.org/ 10.3390/su10072479

Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (1999). Geographical information systems: principles, techniques, management and applications. John Wiley & Sons.

Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2001). Geographic information systems and science. John Wiley & Sons.

Mah, C., Hong, D., Chen, V., & Stefanakis, E. (2020). First-year engineering students' research experience in web mapping. Cartographica, 55(1), 53-62. https://doi.org/10.3138/cart-2019-0026

Malita, L., & Martin, C. (2010). Digital storytelling as a web passport to success in the 21st century. Procedia social and behavioral sciences, 2(2), 3060-3064. https://doi.Org/10.1016/j.sbspro.2010.03.465

Markechova, D., Stehkkova, B., & Tirpakova, A. (2011). Statisticke metody a ich aplikacie [Statistical methods and their applications]. CPU in Nitra, Slovakia. 534. p (in Slovak).

Matlovic, R. (2014). Transformacia programov vysokoskolskej geografickej edukacie v kontexte novej paradigmy orientovanej na vysledky vzdelavania. Geografia: casopis pre zakladne skoly, stredne skoly a vysoke skoly, 22(3), 83-91. http://www.casopisgeografia.sk/index.php/Geografia/ issue/viewIssue/6/14

Michaeli, E., Madzikova, A., Solar, V., & Zverkova, M. (2015). Innovative methods and strategies in tertiary education of geography in the Slovak Republic. 15th international multidisciplinary scientific geoconference SGEM 2015, Sofia, STEF92 Technology, pp. 925-932.

Mmguez, C. (2020). Teaching tourism: Urban routes design using GIS story map. Investigaciones Geograficas 75, 25-42. https://doi.org/10.14198/INGEO2020.M

Mitasova, H., & Hofierka, J. (2003). Impact of new mapping technologies on the communication of geospatial information. Kartograficke listy/Cartographic Letters, 11, 53-61. https://gis.fns.uniba.sk/kartografickelisty/archiv/KL11/7.pdf

Mitchell, J. T., Roy, G., Fritch, S., & Wood, B. (2018). GIS professional development for teachers: Lessons learned from high-needs schools. Cartography and Geographic Information Science, 45 (4), 292-304. https://doi.org/10.1080/15230406.2017.1421482

Mukherjee, F. (2019). Exploring cultural geography field course using story maps. Journal of Geography in Higher Education, 43(2), 201-223. https://doi.org/10.1080/03098265.2019. 1597031

Mzuza, M. K., & Westhuizen, C. H. V. D. (2020). Inclusion of GIS in student teacher training and its significance in higher education in southern African countries. International Research in Geographical and Environmental Education, 29(4), 332-346. https://doi.org/10.1080/10382046. 2019.1684660

Nazareth, A., Newcombe, N. S., Shipley, T. F., Velazquez, M., & Weisberg, S. M. (2019). Beyond small-scale spatial skills: Navigation skills and geoscience education. Cognitive Research: Principles and Implications, 55(1), 4. https://doi.org/10.1186/s41235-019-0167-2

Netek, R. (2014). Students tell their story by web maps - educational case study. Geoconference on Informatics, Geoinformatics and Remote Sensing: International Multidisciplinary Scientific GeoConference SGEM, pp. 901-908.

Niemi, H., Harju, V., Vivitsou, M., Viitanen, K., Multisilta, J., & Kuokkanen, A. (2014). Digital storytelling for 21st-Century skills in virtual learning environments. Creative Education, 5(9), 657-671. https://doi.org/10.4236/ce.2014.59078

Pesaresi, C. (2019). From education to job opportunities. Defining professional profiles for geographers with high competences in GIS environment. In Timothy Tambassi (Ed.), Philosophy of GIS (pp. 253-264). Springer Geography.

Ridha, S., Putri, E., Kamil, P. A., Utaya, S., Bachri, S., & Handoyo, B. (2020). The importance of designing GIS learning material based on spatial thinking. IOP conference series, East Java, Indonesia: Earth and environmental science, 485, 012027.

Roth, R. E. (2013). Interactive maps: What we know and what we need to know. Journal of Spatial Information Science, 6, 59-115. http://dx.doi.org/10.5311/JOSIS.2013.6.105

Sadik, A. (2008). Digital storytelling: A meaningful technology-integrated approach for engaged student learning. Educational Technology Research and Development, 56(4), 487-506. https:// doi.org/10.1007/s11423-008-9091-8

Strachan, C., & Mitchell, J. (2014). Teachers' perceptions of Esri story maps as effective teaching tools. Review of International Geographical Education Online, 4(3), 196-220. https://rigeo.org/ wp-content/uploads/2021/05/Teachers-Perceptions-RIGEO-V4-N3-1.pdf

Tour Builder. (2018). Put your story on the map. Google. Retrieved April 22, 2020, from https:// tourbuilder.withgoogle.com

Vojtek, M., Repaska, G., Vilinova, K., & Vojtekova, J. (2016, June 13-17). Potential of using mobile geoinformation technologies (GPS/GNSS) in teaching geography students. In T. Bandrova & M. Konecny (Eds.) 6th international conference on cartography & GIS: Proceedings 1, Albena, Bulgaria, Sofia, Bulgarian Cartographic Association, pp. 127-135.

Vojtek, M., Vojtekova, J., & Boltiziar, M. (2020, September 21-23). Enhancing geoinformation skills of geography students through field geocoding. DIVAI 2020: 13th international scientific conference on distance learning in applied informatics. Conference proceedings, Sturovo, Slovakia, pp. 233-241.

Vojtekova, J., Pitonakova, K., & Vojtek, M. (2019). Virtual reality in geography teaching. ICERI 2019: Proceedings of the 12th international conference of education, research and innovation, 11th-13th November 2019, Seville, Spain, Valencia, IATED Academy, pp. 3663-3669.

Warshawsky, D. N. (2016). Teaching GIS in the classroom: Story maps as a case study. STEM and GIS in Higher Education, 10, 187-196. https://proceedings.esri.com/library/userconf/educ14/papers/1331_342.pdf