International Journal of Research in E-learning
Vol. 2 (1), 2016, pp. 57–70

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Geolocation Services in Education Outside the Classroom

Abstract

Geolocation services such as Geocaching, Wherigo, or Foursquare are very popular all over the world nowadays. Millions of people are involved in these games, and, in addition to the entertainment, they learn about geography and history. Geolocation games can be used very effectively in instruction as well. The article contains analysis, design, development, implementation, and evaluation of educational games using a geolocation service Geocaching. Sometimes the concept "educaching" is used, which was created by combining the words "education" and "geocaching."

K e y w o r d s: didactic game, geolocation services, GPS technologies, geocaching, educaching

Introduction

All of us, even those who no longer attend school, know that the Czech pedagogue and philosopher J. A. Comenius spreads the idea of using games in classroom-based education in his work, *Schola Ludus*. Therein, he shows how to use the natural creative energy of children for the dramatisation of the subject matter. This allows the student to create learning experience from such an activity, and determines its accurate and lasting adoption.

Even today, there is still an interest in Comenius' concept of dramatising the subject matter, as it is obvious given the number of educational projects in European Union. Our department also participated in the Historical Recreation as a Pedagogical Project (Madeira, 2009). Each of the participating countries presented their own historically-themed educational game. You can find out more about the project by visiting the website www.osu.eu/history/.

Nowadays, the term "educational game" usually indicates a computer game. We can find a plethora of these on CD-ROMs, on DVDs, or even on the Internet, especially when we are not limited to only those in Czech language.

Technology is advancing rapidly, and students – although not only students – follow this development closely. Students are attracted to social networks; also, those who are involved in the production of educational games are heading towards this environment. One of the most favourite games played all over the world is geocaching. This game consists of searching for a hidden cache based on given geographic coordinates using the GPS navigation system. The popularity of this adventure game was used to create a stimulating and enjoyable atmosphere during the lesson. The educational application of geocaching even received a name – educaching.

When devising new ideas for teaching that are supported by all those amazing technology-based toys, we should not forget pedagogical principles, not only those given in the works of J. A. Comenius, but also those that have evolved over the last century.

The study is methodologically based on the ADDIE model, which defines the individual steps of the implementation of the educational application – analysis, development, implementation, and evaluation. The evaluation consisted of a pedagogical experiment and an evaluation questionnaire. The interpretation of the evaluation results contributed to theoretical and methodological foundations in the field of Information and Communication Technologies in Education.

Theoretical Background

Didactic Game

All teachers have completed pedagogical and didactic courses, and have certainly encountered the topic of didactic games and their use in teaching. Computer games that are challenging – especially when it comes to developing multimedia objects – are often created by IT specialists who are not familiar with pedagogy and didactics. The optimal solution is a close cooperation between those two fields. It will not do any harm to either of these groups to reiterate some pedagogical principles that apply to didactic games. We recommend, for example, the paper

by Sochorová, "Didactic Game and its Significance in Teaching" (Sochorová, 2011). The paper is conducted as a study review. First, the author defines the term "game" from the perspective of several authors. Thereafter, she offers a list of types or kinds of games divided according to various aspects, and she considers the significance of a game for children. Yet, mostly she deals with the issue of didactic games as a teaching method, its concept, functions, types, use, impact on the student, importance, and teacher's use of this method.

The definition of didactic game taken from The Pedagogical Dictionary (Průcha, Walterová & Mareš, 1995) is as follows: "Didactic game is an analogy of spontaneous activities of children, which pursues didactic goals (not always obvious to the students). It can take place in the classroom, gymnasium, playground, community or in the countryside. It has a set of rules, needs continuous direction and a final evaluation. It is intended for individuals as well as groups of students. The role of the head teacher has a wide range from an organiser up to an observer. This role possesses the advantage of creating a positive, stimulating environment because it fosters interest, boosts students' involvement in carried out activities, inspires their creativity, spontaneity, cooperation, competition, forces them to use their knowledge and skills and integrate their life experience. Some didactic games are very similar to model situations from real life." It is interesting to compare this definition with the requirements for contemporary computer games mentioned in some foreign sources, for example, the web portal Games in Schools at http://games.eun.org/.

Educational Computer Game

Computer games take place in a virtual world which is influenced by a player using input devices; that is, the player performs assigned tasks. Generally, a computer game is designed for fun, but it can also cultivate psychomotor and cognitive skills. However, what is the real cognitive benefit of games? Is it necessary to design games with explicitly educational purposes in order to use them in the educational process?

Educational games are specifically designed for educational purposes. Well-designed games motivate the player and so become the perfect environment for learning. They have rules, structure, and goals that inspire motivation. They are interactive, and provide results and feedback. Real issues that can be set up in the game can involve people in the process of learning.

Let us reminisce about one computer game for children. It is multimedia software originally designed for Macintosh and released in March 1992. Today it also works in other environments including a mobile application. Its name is "Just Grandma and Me," and its content is very simple: Little Critter and his grandmother spend the day at the beach. The game contains all that should be present in a multimedia application and is pleasing as well as witty. It is possible to switch between English, Spanish, and Japanese version. When the game first

appeared, we were thrilled by it and even learned some Spanish words. Even today many authors imitate this legend of educational games. We do not know how great the cognitive benefit to children was; perhaps there exists some research, but were not able to find any report.

Two interesting Czech papers about digital educational games are posted on the Methodological Portal FEP (Framework Education Program, http://www.rvp.cz/). Even though the papers were posted in 2009, they still offer a good overview of educational games in schools. They contain information regarding various kinds and forms of games, their pros and cons, ways to evaluate their benefit, tips and tricks for teachers, and a number of useful links to resources. The first paper entitled "Digital Educational Games in Schools – Research" (Naske, 2009a) reports on EUN Schoolnet research as a part of a project "How Are Digital Games Used in Schools?," which was conducted in years 2008 and 2009. The paper uses the term "GBL" (game based learning) and regards it as "the use of a digital game as a source of support for a reasonable, professional and committed teacher, who perceives a game as a significant tool in the world of children and uses the game rules for specific educational purpose. Therefore, we do not mean independent study done at home by children using digital technology in order to attain specific skills, unless these games were specifically used in a lesson by the teacher." The second paper, "Digital Educational Games in Schools – Czech Experience" (Naske, 2009b), as the title already suggests, summarises Czech experience and resources. Given the publication date, the discussion would most likely go in a different direction nowadays.

The same portal also holds a recently published paper entitled "Educational Game of the Future" (Janda, 2013), in which the author presents his ideas and visions. Again, we recommend looking at the links of mathematical and educational environments and communities, if only for the reason not to invent or develop something that already exists and works well, for example, the portal Khan Academy (https://www.khanacademy.org/) and its database of learning resources. Mathematical topics are represented by knowledge maps in order to establish the links between them. It is not only about the source of information, since the explanation, comprehension of terms, and their framework are also important.

What more is there to add? The same rule applies to traditional textbooks as well as educational games – they are completely useless unless used in a suitable way. That means more of the teacher's energy and time than when the lesson is conducted in a traditional way. Why then be bothered? Perhaps one of the reasons is that teachers are interested in the environment in which children will learn in the future. Will it bear any resemblance to a game or rather to traditional textbook study? If we want to prepare children for the future, we have to do it in an environment that most resembles the future one.

Edutainment

By integrating entertainment and education, a new term came into existence, and later also a whole new branch of the computer industry. Products that are meant to educate as well as entertain are labelled with this term. It depends on the developers, but also on users (teachers and students) whether the educational part will dominate.

Some can object that educational entertainment has been around for quite a long time (fables, parables in the Bible). The term "edutainment" emerged in 1948 in Walt Disney Studios. In its current understanding, it includes television, movies, museum exhibitions, and even software. One should note that edutainment also changes the paradigm of science centres or museums (Langlotz, 2011). This approach requires a greater degree of entertainment in addition to – or perhaps at the expense of – educational content. This is based on the assumption that people are used to the environment of amusement parks, and require similar comfort from science centres and/or museums.

Computer Games in Social Networks Environment

In recent years, there has been a strong development in social networks, and it was only a matter of time until this phenomenon reached schools. It has already entered the Learning Management System (LMS). LMS Moodle, which is frequently used in schools in the Czech Republic, is nowhere near social networks. Nevertheless, there are other online systems with greater interaction between students that provide easy and quick feedback, and many other features and functions required in social networks. Users (both students and teachers) are involved in content creation, respond to assignments, and are in mutual contact. Quick feedback when solving tasks is an advantage.

Some specialised online learning management systems with elements of social networks (iTřída, Edemodo, a Schoology) are mentioned in the paper "Social Networks for Teaching" (Moldřík, 2013).

Educaching

Geocaching

When searching for a definition of geocaching, we found the following text on the web. It seemed so concise that we will use it here (Rouse, 2001):

> Geocaching, also referred to as GPS stash hunting, is a recreational activity in which someone buries something for others to try to find using a Global Positioning System (GPS) receiver. The pursuit can be thought of as a GPS

enabled treasure hunt. Usually, a geocache consists of a small, waterproof container that holds a logbook and inexpensive trinkets. Participants are called geocachers.

A note from the Czech environment is as follows: Geocaching is a hybrid game of sport and tourism. The cache is known by its geographic coordinates and is located in places that are of interest, but are not typical tourist destinations. The cache description contains information about the peculiarities and attractions of the place (Geocaching.cz, 2017).

Other location-based services (LBS) – that is, services and applications working with the user's or device location – can be used when teaching; see http://geokarlovka.cz/. Recently, a game called Wherigo (http://www.wherigo.com/), which was developed by the same authors as the geocaching game, has been very popular.

Educaching

Educaching is bringing the popular adventure sport of Geocaching into the classroom. Teachers around the world are giving GPS devices to their students to create a fun and innovative learning atmosphere.

Educaching (Geocaching and Education, 2012):

- takes the classroom out into the world;
- encourages teamwork and critical thinking; and
- can be used in different subjects, e.g. math, science, history, or physical education.

Teachers are constantly looking for ways to motivate their students to learn. Their motto is: educaching is a fun and active way to learn. On the portal *Educaching*, *A GPS-Based Curriculum for Teachers – Geocaching Lesson* (http://www.educaching.com/), we can find Educaching Curriculum manuals, usually written by a teacher for teachers. Free samples and links to other resources are also useful. How does the portal promote educaching? Quoting from the Educaching website, "[…] Educaching curriculum:

- increases students' early exposure to real-world mathematics and geospatial science;
- provides a comprehensive, easy-to-use STEM (Science, Technology, Engineering and Mathematics) resource to instructors;
- helps transform the traditional classroom into an inquiry-based, exploratory learning environment that is student-centered, teacher-facilitated;
- allows for discovery of content and an engagement with problem solving, applying critical thinking skills;
- provides for critical thinking in a time-sensitive framework, preparing students for STEM career opportunities;

- offers STEM learning opportunities beyond the school day when used as afterschool or summer program. […]"

We would be happy for now if the goal of educaching – "to get teachers and students of the classroom" – was achieved. Yet, we need to hurry up before somebody comes up with the idea of virtual educaching, and students will sit in their classrooms and stare at the monitors again.

An Example of Using the Geolocation Networks in School

The educational game called "Lost places in Ostrava," which is described in the thesis entitled "The Use of Geolocation Networks in Education" (Šrámek, 2013) aims to educate game participants in an entertaining way about the history of architecturally interesting places in Ostrava city centre using the GPS. Participants in the game consist of the students of an elementary school and any users of a geolocation network Geocaching. Based on the location of the final cache, an educational trail in Ostrava city centre was laid out. The trail has four stops and a final point, where the incentive is hidden. At the specified coordinates, a player looks for a QR code using the GPS. After scanning the QR code into a smartphone, a player can display a webpage with information about the history and historical photographs of the given place. That way he or she gains interesting information about places with historical significance and can at the same time visually compare the present with the past. The webpage also provides the geographic coordinates of the next stop. The cache is registered on the official Geocaching website and so is available to all the users of this network.

Retrieval of Photographs and Information about Places

A suitable source of historical photographs is the Internet. Additionally, Ostrava City Archive converted many of its photographs to an electronic form and provides access to them via web interface. Books dealing with the history of Ostrava city served as another source (Korbelářová, 2000; Lipus, 2006).

The historical centre of Ostrava went through great changes in the last hundred years. Among the main causes for those changes were war, undermining of the city, and even idiosyncratic ways of addressing urban issues during the communist era, when many buildings were torn down rather than maintained or renovated. There are not many places in the city centre that have been left untouched by these significant changes in the last century. The places of interest for our game were selected based on following criteria:

- the place had to be well known so that participants would be curious about the former appearance of the place; and

- the change of the former urban character of the place had to be evident, but at the same time there had to be some clues, that is, original parts.
  The following were selected as suitable places:
- the former German House located on the Dr. E. Beneš Square,
- Smetana Square with Antonín Dvořák Theatre,
- Lauby (present parking lot between Muzejní and Velká streets), and
- Zámostí (area behind the Miloš Sýkora Bridge towards Silesian Ostrava).

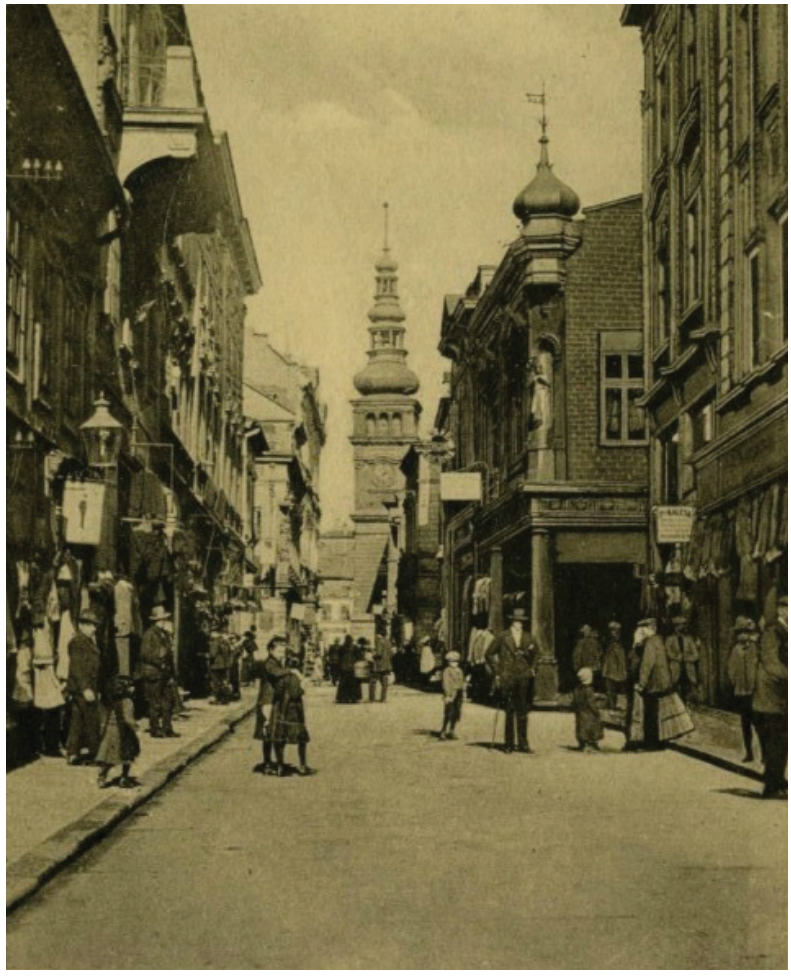

Figure 1. Lauby, an extinct world of pubs, cafés, shops, and cabarets in Ostrava

S o u r c e: Ostrava na starých pohlednicích, 2011–2017.

Certainly, there are many other places in Ostrava city centre deserving attention, not just the four listed above, but a greater number of stops in the game could be discouraging, and too long of an educational trail could prove to be boring.

Development of Webpages and QR Codes

Webpages are developed using manual tagging in a notepad (available as a part of Windows operating system) and Cascading Styles Sheets (CSS). Since webpages were developed for smartphones, they are made in a minimalistic way as to avoid downloading excessive amounts of unnecessary data.

Photographs are published in a resolution that allows them to be small enough for download to a mobile phone, but at the same time suitable for viewing on desktop. If interested, the player can return to the webpages at home and view them through the browser on his or her desktop.

A QR code can be generated using one of the generators freely available on the Internet. To read a QR code, a mobile phone with camera and a QR code scanner (an application for mobile phones) is necessary.

One should note that a QR code is a square figure carrying certain information in a similar way as a barcode. However, while a barcode can store 20 characters, a QR code can theoretically store up to 4300 characters in its largest version. Any kind of textual information can be stored in a QR code, but mostly it is used to store a web address. The code became popular with the advent of smartphones, when the phone's camera could be used as a scanner for scanning a QR code.

Creation of the Trail

The trail was set up by placing the QR codes at all the trail stops and then finding a suitable place to hide the final cache. The QR codes, fashioned as stickers with a durable surface, were placed in such a way as not to attract the attention of passers-by. Their location was to roughly correspond with the location of the taken historical photographs, so that when the player sees the photograph in his or her smartphone, he or she can compare the present with the past. The final cache had to be well hidden, so that no passer-by could find it by accident. At the same time, we had to abide to the geocaching rules, which require that the minimal distance from other caches is 161 meters. The final cache is a container with a volume of about 1 litre, containing a logbook to record the players exploit and trade items with the Ostrava theme, which can be exchanged for other items.

The Approval Process

Geocaching can bring joy through discovery and adventure, but when the cache is hidden in an unsuitable place, it can also mean a risk of injury. To minimise this risk, the placement of a cache is subject to an approval process. Requests for placing a new cache into the registry is approved by a so-called reviewer for a certain region, who also administers control over the compliance with formal requirements. The physical control of the cache, suitability of its placement, and appropriateness of the given level of difficulty are tested by a so-called betatester. There are usually several of them for one region. After a successful approval, the cache becomes available on the web. Since our project was intended only for

students, it did not have to be registered on the Geocaching webpage. Nevertheless, we did apply for approval because we wanted to know whether a geolocation game can be used as an educational tool for the Geocaching community as well.

The Game Plan

The player obtains the first geological coordinates on the http://www.geocaching.com/ website. He or she then arrives at the first stop where he or she finds the first QR code sticker using given help. He or she then scans the QR code with his/her smartphone and obtains a link to a web address. He or she displays the address in his/her smartphone, and views the historical photographs of that place and information about its history. The webpage also contains coordinates for the next stop where the player finds another QR code, and the whole process is repeated. Our trail has four stops and one final stop with incentive.

Feedback

Even before launching the geolocation game, we had to determine a way to receive feedback from players. During the course of three months, about a hundred of Geocaching network users participated in the game and walked the trail. These players participated of their own volition, obtaining the coordinates on the Geocaching website. Using the webpage at the final stop, they were asked to fill out an electronic questionnaire. The questionnaire was voluntary, and its goal was not to test the gained knowledge, but to record the subjective feelings of each player.

Students in the 6th grade at an elementary school in Ostrava-Poruba were another group of players. They walked the trail in two groups – 9 students in one and 13 in another. The students walked the educational trail by themselves. A teacher was present, yet she did not interfere with the game, but only showed the students how to use the smartphone. At the final stop, the students found the container with a "treasure" and were asked to fill out a short test. The goal of this test was to check the gained knowledge from the trail.

On the basis of their subjective feelings, game participants evaluated whether their knowledge of the history of interesting places in Ostrava widened. A total of 75% of the game participants indicated that their knowledge was greatly augmented by the completion of the educational trail. Another 22.5% said that their knowledge was partially widened.

A total of 74% of participants regarded the game as uniquely entertaining. Feedback from participants on the Geocaching website confirmed this fact. These participants said that finding the cache was a great experience for them. Participants expressed their interest in further educational games using geolocation services as Geocaching on similar topics.

The first nine-member group of pupils answered the knowledge questions with a success rate of 83.33%. The second group of thirteen pupils answered knowledge questions with a success rate of 77.69%. The average success rate is 81.45%.

Questionnaires for the Geocaching network users

Although geocaching is popular across all age groups, the group of players between 26 and 35 years was the largest. The difference between the number of males and females is insignificant.

Knowledge of QR codes is essential for the completion of the trail. Players who did not know about them or knew only very little (about 25%) had to learn about them as a part of preparation for the trail.

Basing on their subjective feelings, the players judged whether the trail helped them to gain more knowledge about the history of some interesting places in Ostrava. About 75% stated that it did, 22.5% said it did only partially, and a little over 3% did not gain any new knowledge. The game was received positively concerning the entertainment factor. About 74% of players think that the game is definitely entertaining. The feedback from the Geocaching webpage clearly suggests that finding the cache was a great experience and some even asked whether other interesting places in Ostrava will also be made into another game.

The test for students

The goal was to verify whether the students remembered the information they had learned in the game. The test was completed immediately after walking the trail. It was anonymous, and the students choose either one or more correct answers to the questions.

The group with nine members gave correct answers to 83.3% of the knowledge questions. The group of thirteen members answered the same questions with a 77.7% success. The difference between the groups can be attributed to the different number of students in the groups. Students in bigger groups can feel less involved in the game and tend to become inattentive, passive, bored, or unruly, which can result in a weaker score in the test.

Answers to an additional question express the feelings of the students about the game. The students enjoyed the most hunting for the treasure, secondly, recognising the QR codes, and thirdly, the visual comparison of past and present. Gaining information about the city's history was the least popular item of all. It turned out that it is not so important that students enjoyed the entertaining elements of the game more than the educational ones. Despite that, the results of the test show that students "soaked up" the information presented to them on the trail.

Conclusion

Teaching using a geolocation game is an unconventional way of education. As the results show, the students had fun but also gained new knowledge while

participating in our small project of exploring interesting places of Ostrava city centre.

Geolocation game has its specific use. It is advisable to conduct it for smaller groups of students from about twelve years of age. The very core of Geocaching has an educational character because many caches are created as a quiz, and only after doing research about the topic and solving the riddle can a player obtain the geographic coordinates. Similarly, as a didactic game, geolocation game should not be too long so that students will not grow tired of the long trail and be burdened by a great amount of boring information instead of enjoying the game.

The preparation of such a game is rather demanding on the side of a teacher. However, once the game is prepared, it can be used repeatedly. We recommend using it on not-so-busy days, such as before the final reports are given, on the way back from the cinema, an exhibition, or as a part of other extracurricular activities. It is only up to the fantasy and skills of a teacher to create an educational and entertaining game, and incorporate it into the curriculum. Geolocation game is suitable for teachers who like to discover and try out new ways of teaching.

Given the present rapid development of ICT (information and communication technologies) in combination with the enthusiasm for discovering and testing new innovations, there are great opportunities for seeking new ways of using technology in education. Geolocation game is certainly just one of the possible ways of using them.

The findings from the educaching game enriched the theoretical and methodological foundations of leisure time pedagogy, and the use of educational games. In addition to expertise knowledge, the educaching game also contributed to the development of spatial intelligence and key competencies, namely learning, social and personal, communication and work competencies.

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Serwisy geolokalizacyjne w kształceniu poza salą lekcyjną

Streszczenie

Serwisy geolokalizacyjne, takie jak Geocaching, Wherigo czy Foursquare, są obecnie bardzo popularne na świecie. Miliony ludzi angażuje się w te gry, poza rozrywką ucząc się geografii i historii. Gry geolokalizacyjne mogą być bardzo efektywnie wykorzystywane także w nauczaniu. Artykuł obejmuje analizę, projekt, opracowanie, wdrożenie i ocenę gier edukacyjnych wykorzystujących serwis geolokalizacyjny Geocaching. Czasami użyta jest koncepcja „educaching", która została stworzona z połączenia angielskich słów „education" (edukacja) i „geocaching".

Słowa kluczowe: gra dydaktyczna, serwisy geolokalizacyjne, technologie GPS, geocaching, educaching

Pavel Kapoun

Геолокационные сервисы во внеучебной деятельности

Аннотация

Геолокационные сервисы, такие как Геокэшинг, Wherigo или Foursquare пользуются большой популярностью во всем мире в настоящее время. Миллионы людей участвуют в этих играх, и в дополнение к зрелищности они узнают о географии и истории. Геолокационные игры

можно очень эффективно использовать в обучении. В статье представлен анализ, проектирование, разработка, внедрение и оценка образовательных игр с использованием геолокационых служб Geocaching. Иногда используется понятие «educaching», которое было создана путем объединения слов «образование» и «геокэшинга».

К л ю ч е в ы е с л о в а: дидактические игры, геолокационные сервисы, GPS-технологии, геокэшинг, educaching

Pavel Kapoun

Servicios de geolocalización en la educación fuera del aula

R e s u m e n

Los servicios de geolocalización como Geocaching, Wherigo o Foursquare son muy populares en todo el mundo en nuestros días. Millones de personas usan estos juegos que suponen además la posibilidad de aprender sobre la geografía e historia. Los juegos de geolocalización se pueden utilizar muy eficazmente en la educación también. El artículo contiene el análisis, diseño, desarrollo, implementación y evaluación de juegos educativos utilizando el servicio de geolocalización Geocaching. A veces se utiliza el concepto de “educaching”, que se creó combinando las palabras “educación” y “geocaching”.

P a l a b r a s c l a v e: juegos didácticos, servicios de geolocalización, tecnologías GPS, geocaching, educaching