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## **Geocaching and Mobile Learning in Geographic Education: A System and a Case Study**

### **Abstract:**

The abilities of analyzing and perceiving of the landscape are paramount skills of a geographer. In the context of the corresponding course of the Geography Department of the University of the Aegean, we conducted field activities using a mobile learning system that we have developed and which is the intersection of two emerging learning practices: geocaching and mobile learning. The system consists of a web and a smartphone application for Android devices. The web application allows teachers to create educational geocaching activities by providing point coordinates as well as information, and multiple choice questions relevant to each point. The smart phone application is used by students on the field, in order complete the activities prepared by the teacher. For testing and evaluation of the system, a geocaching activity was designed and conducted within the framework of the "Analysis and Perception of the Landscape" course. The aim of the activity was the identification and analysis of landscape elements. The students were divided into two groups: half of them participated in the field exercises without the use of the system but accompanied by the course professor, while the others used the system exclusively, without supervising or instructing by the professor. Our objective was to compare the educational results of these two methods, using evaluation sheets that were distributed to the participating students after completing the activity. The conclusions of the case study show that geocaching and mobile learning are not only exciting, but also support the achievement of the learning outcomes effectively.

**Keywords:** Geographic education, Geocaching, Mobile learning, Smartphone application, Geoinformatics.

### **Introduction**

Field trips are very popular educational experiences that can simply be described as activities that involve students leaving the classroom in order to visit subject-related places. During these excursions, students interact with exhibits, facilities and surroundings in their functional settings to gain an experiential connection to ideas, materials or phenomena they study in the classroom (Serrat, 2015). Although field trips offer multifaceted benefits regardless of the lesson, it is obvious that such excursions are quintessential for geography education, as geological surveying, observing, describing and mapping skills are essential for geography students. Consequently field trips is an important component of student training in geosciences, and this need is recognized worldwide, as field trips are an important part of Bachelor's degree curricula in the geosciences (Qiu and Hubble, 2002).

Acknowledging the field work's importance, since the early 2000s, many researchers around the world, introduced technology in their excursions, such as GPS devices and PDAs (Lary, 2004). Adding geocaching elements in such trips was found to greatly increase the students' interest and thus improve the learning outcomes even more (Ellbrunner et al., 2014). Since

then, smart phones and mobile technology in general, have grown to a tremendous extent, allowing teachers to implement new innovative activities that will enhance the field trip experience.

The “Analysis and perception of the landscape” course of the University of the Aegean, Geography Department includes two hours of fieldwork weekly, that is conducted traditionally without the use of any mobile learning device. During the first two fieldwork hours of the semester, we implemented and tested a geocaching and mobile learning system we have created, called RouteQuizer. The system consists of a database, an Android application and a web application, and includes information to be presented on site, along with multiple choice type questions to be answered upon arrival at specific locations.

The students were separated in two groups. Half of them, conducted the activity without using the system, accompanied by the professor who at the meantime was also lecturing, and the other half only used the system’s smart phone application in order to complete the activity. At the end of the field trip, all the students completed a questionnaire that helped us determine whether the lesson’s educational goals were achieved or not. The students that used the system’s smart phone application, also evaluated the application by filling an according form.

### **Aims and Objectives**

Although we were aware that the potential benefits of systems such as ours’, can be much more apparent when implemented supportively to courses that do not already include field trips, our aim was to determine whether the system does help in achieving the lesson’s educational goals. Furthermore, by observing the whole activity and by evaluating the students’ performance, we wanted to distinguish the reasons that would lead to the results, regardless of whether they would favor our system.

### **Mobile Learning and its Benefits**

One of the most widely approved definitions of mobile learning, is the one offered by UNESCO: “Mobile learning is learning that occurs in or outside of a classroom or formal education setting, is not fixed to a particular time or place, and is supported by the use of a mobile device. Mobile devices range from standard mobile phones to tablet devices and include personal digital assistants, MP3 players, flash drives, electronic-book readers and smartphones”, (UNESCO, 2012, 10).

The implementation of mobile learning techniques is greatly supported by many institutions worldwide, such as UNESCO by publishing their “Mobile Learning Policy Guidelines” in 2013, which encourages nations to adopt mobile learning policies by following its guidelines (UNESCO, 2013), and the European Commission which in 2015, in the context of its “EUROPE 2020” growth strategy, emphasized on the benefits of mobile learning.

Nowadays, the technological status is such that mobile learning can be adopted more easily and effectively than ever, mainly because of the smart phone, whose high portability, internet connectivity, low cost and energy efficiency make it ideal for educational use.

Mobile learning benefits are multiple and multifaceted as they can be distinguished in many sub-categories such as practical, social and educational.

Practically, mobile devices, because of their physical dimensions enable the accommodation of more devices in the classroom in comparison with laptops, when used for note taking are much lighter and less bulky than a bag full of files and papers, enable anywhere-anytime learning and cost much less than laptops, while also avoiding learning material costs.

The use of mobile devices in education, can also socially benefit students as learners can interact with each other and with their tutor instead of hiding behind large monitors (Mehta, 2016), they engage learners (Mehta, 2016) and they expand the reach and equity of education (UNESCO, 2013).

In terms of educational benefits learners also acquire digital skills which are pivotal for living and working in today's society (European Commission, 2015) immediate access to information such as lessons, video and audio clips, students can easily share information via wireless network or Bluetooth and mobile devices provide a colorful and inviting learning material, while also being fascinating to our generation's students.

### **Geocaching and its Benefits**

Geocaching is a modern version of the "Treasure Hunt" game. Participants use GPS devices, and nowadays smart phones (Ihamäki, 2012), to hide or find geocaches around the world. A geocache is usually a box containing a pencil, a calendar, which is signed by everyone that visits the geocache, and sometimes various small collectibles.

Our system's smart phone application, works in a similar way, although in RouteQuizer's case the physical existence of a geocache is not necessary.

Geocaching, offers a wide variety of benefits. Clearly the benefits associated with the natural state of the participant are obvious, but also there are many benefits related to sociability of the participant.

According to (Taylor et al., 2010) the benefits that geocaching provides, can be distinguished in three main categories. Physical, social and educational benefits.

The physical benefits of geocaching are: geocaching requires physical activity, the search of geocaches develops the students' sense of orientation, the element of adventure gives a high level of interest and participants feel successful after the discovery of a geocache.

Socially, participants can be benefited as the discovery of a geocache gives people the pleasant feeling of achieving a goal, and therefore, especially children, build their self-esteem, geocaching when used in groups, offers the sense of togetherness, it is ideal for socializing with other participants, when used by a group, it is a powerful tool for developing the cohesion and collaboration of the team and it encourages the communication between group members.

The educational benefits of geocaching are also multiple, as geocaching can be used for learning by visiting historical or geographic significant places. Also participants are informed about the history and significance of each place they visit, considering that the curiosity about an area that someone visits is a natural human tendency.

### **RouteQuizer System**

The RouteQuizer system consists of two applications. The web application refers to the teachers while the smartphone one to the students. It operates in three basic stages.

- 1) Teachers, using the system's web application, create or edit an activity.
- 2) Students take part in the activity, using the smartphone application.
- 3) Teachers browse the students' results via the web application.

A RouteQuizer activity, requires from the students to approach, in a predetermined by the teacher order, specific geographical points within a certain distance. The exact location of each point is not known and in order to visit it, students have to use the information provided and a distance meter, which indicates their current distance from the point. In order to make sure that no student gets lost, there is also a help button that indicates the position of the destination point on the map, as well as the route to follow in order to get there. As soon as they reach their destination, a question along with four possible answers automatically appears. After they answer the question, the application loads the next point, and the students are asked to repeat the process, until they finish the activity.

### Web Application

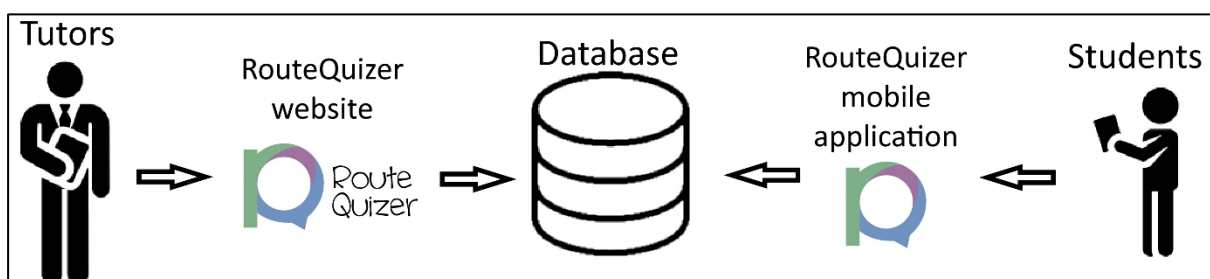


Figure 1. How RouteQuizer works

As aforementioned, the system's web application enables the teachers to create/manage activities and browse their students' performance. In order to be able to use the website, teachers have to create a free account, and login. By selecting the "Create & Manage Activities" button, on the homepage, they can either view and edit/delete an activity, or select the "Create a new activity" button in order to create an activity. An activity is created by filling a simple form, with the following data: *Code* (The activity's name), *Point Order* (The order in which every point will be loaded), *Latitude* (The point's latitude), *Longitude* (The point's longitude), *Information* (Information related to each point), *Question*, *Answer 1*, *Answer 2*, *Answer 3*, *Answer 4*, *Right Answer* and *Distance* (The distance in which the students have to approach the point).

In order to view the students' results, by selecting the button "Activity Results" and typing the name of the activity, a table containing the following data appears: *User* (The user's or group's name), *Code* (The activity's name), *Point* (The point visited), *Result* (Contains either "Correct" or "Wrong"), *Help* (Contains either "Did not use help" or "Used Help", depending on whether the student used the application's help option) and *Date and Time* (The exact date and time the student answered the question).

### Smartphone Application

The system's smartphone application is developed for Google's Android operating system for smartphones. The application's main objective was to provide a simple, fluent and fun user experience, so that even people with no former smartphone experience could use it.

For that reason, complex menus and options are absent. The students only have to type their name as well as the activity's one, and select "OK" in order to get started. The main screen, contains of a big map, four buttons and a distance meter (Figure 2). The center map button centers the screen on the user's current position, which is indicated with a blue dot, if needed, the map type selection button, enables the user to select the preferable map type (road, terrain, satellite or hybrid map), the help button indicates the position of the destination point and the route to follow in order to reach it, and the information button, displays all information provided by the teacher. The distance meter which is the basic tool that students use, displays the current distance of the user from the point.

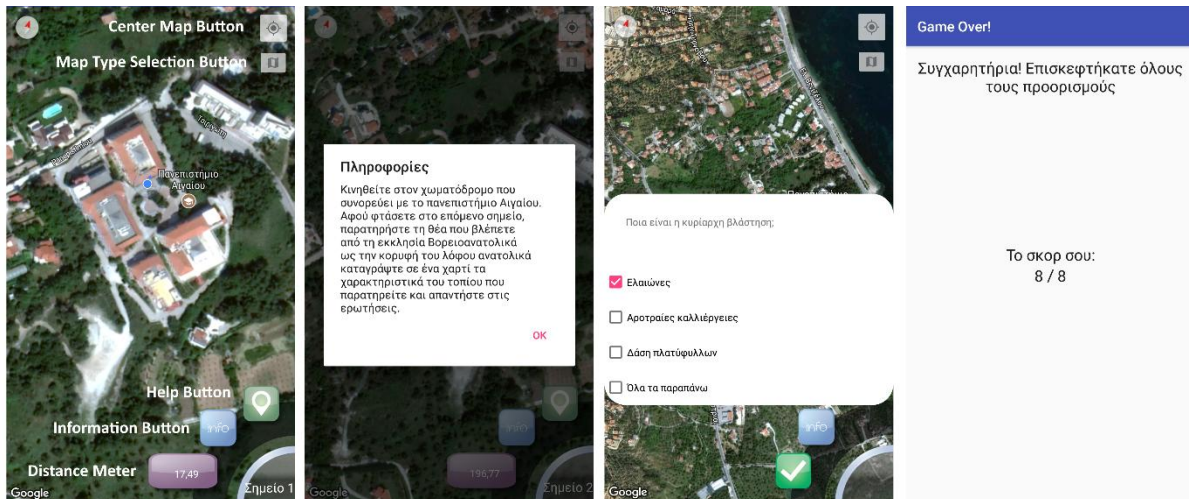


Figure 2. RouteQuizer mobile Application

## Case Study

As mentioned above, our case study was conducted during the first 2 fieldwork hours of the "Analysis and Perception of the landscape" course of the University of the Aegean, Geography Department. The class deals with the multiple meanings and approaches that make up landscape studies today. A number of different approaches and disciplines are presented, discussed and practiced in the labs. The first laboratory's/field trip's title, according to the course's syllabus is "What is a landscape" and the lesson's educational goals, set by the professor were the following:

- The perception of the landscape depends on the scale.
- As the scale decreases, more senses are triggered.
- The landscape depends on the season.

The activity called "GEOAPL", took place in Mytilene Greece, on the outskirts of the University of the Aegean Campus. It consisted of 8 questions in 3 different locations and the total distance that the students had to cover was around 1.6 kilometers including their return.

Prior to the field trip, all 25 students attended an hour long lecture by the professor, and where then separated into two groups of 12 and 13 students. The first group, accompanied by the professor, was given a 20 minute head start in order to ensure that the two groups would not meet during the trip. At the meantime the second group of students was separated into three smaller groups that were handed one smart phone device each. A five minute briefing about how the application works took place and the students launched the

Code	Point Order	Latitude	Longitude	Information	Question	Answer 1	Answer 2	Answer 3	Answer 4	Right Answer	Distance	Update
GEOAPL8		39.084111	26.563875	Μείνετε στο ίδιο σημείο	Αν έρθουμε ξανά σε 4 μήνες τι θα έχει αλλάξει;	Τίποτα	Τα χρώματα	Τα χαρακτηριστικά		Τα χρώματα	20	<a href="#">Edit</a>   <a href="#">Delete</a>
GEOAPL7		39.084111	26.563875	Μείνετε στο ίδιο σημείο	Τι έχει αλλάξει ανάμεσα στα δύο σημεία όσον αφορά στην αντίληψη του τοπίου;	Η κλίμακα	Τίποτα	Τα πάντα		Η κλίμακα	20	<a href="#">Edit</a>   <a href="#">Delete</a>
GEOAPL6		39.084111	26.563875	Μείνετε στο ίδιο σημείο	Ποια από τα χαρακτηριστικά που είδατε στο προηγούμενο σημείο βλέπετε και τώρα;	Όλα	Κανένα	Μερικά		Μερικά	20	<a href="#">Edit</a>   <a href="#">Delete</a>
GEOAPL5		39.084111	26.563875	Προχωρήστε ευθεία και δεξιά μέχρι να φτάσετε στο επόμενο σημείο, το οποίο βρίσκεται μέσα στο τοπίο που παρατηρούσατε. Σημειώστε σε ένα χαρτί τι έχει αλλάξει στα χαρακτηριστικά του τοπίου και απαντήστε στις ερωτήσεις	Πριν, χρησιμοποιήσαμε μόνο την όραση για να αντιληφθούμε το τοπίο. Τώρα ποιες αισθήσεις χρησιμοποιούμε;	Όσφρηση	Ακοή	Αφή	Όλες	Όλες	20	<a href="#">Edit</a>   <a href="#">Delete</a>
GEOAPL4		39.084091	26.566790	Μείνετε στο ίδιο σημείο	Άλλα χαρακτηριστικά που βλέπετε;	Δρόμοι	Αναβαθμίδες	Ρέματα	Όλα τα παραπάνω	Όλα τα παραπάνω	20	<a href="#">Edit</a>   <a href="#">Delete</a>
GEOAPL3		39.084091	26.566790	Μείνετε στο ίδιο σημείο	Οι κατοικίες που βλέπετε είναι:	Μόνο διάσπαρτες οικισμούς	Μόνο σε οικισμούς	Διάσπαρτες και σε οικισμούς		Κατοικίες, Διασπαρτες και σε οικισμούς	20	<a href="#">Edit</a>   <a href="#">Delete</a>
GEOAPL2		39.084091	26.566790	Κινηθείτε στον χωματόδρομο που συνορεύει με το πανεπιστήμιο Αιγαίου. Αφού φτάσετε στο επόμενο σημείο, παρατηρήστε τη θέα που βλέπετε από τη εκκλησία Βορειοανατολικά ως την κορυφή του λόφου ανατολικά καταγράψτε σε ένα χαρτί τα χαρακτηριστικά του τοπίου που παρατηρείτε και απαντήστε στις ερωτήσεις.	Ποια είναι η κυρίαρχη βλάστηση;	Ελαιώνες	Αροτραίες καλλιέργειες	Δάση πλατύφυλλων	Όλα τα παραπάνω	Ελαιώνες	20	<a href="#">Edit</a>   <a href="#">Delete</a>
GEOAPL1		39.084993	26.568706	Μετακινηθείτε στο κέντρο του ανοιχτού αμφιθεάτρου	Θέλετε να ξεκινήσει το εργαστήριο 1;	Ναι	Όχι			Ναι	13	<a href="#">Edit</a>   <a href="#">Delete</a>

Figure 3. The activity's data as viewed by the website

application and begun taking part in the activity. Analytically the data submitted by the professor via the system's web application can be seen in Figure 3.

After completing the activity, all students including those that did not use the smartphone application, completed a questionnaire, which included the following 4 open-ended questions, that would help us determine whether the educational goals were achieved or not:

**Question 1:** What is the relationship between scale and landscape features?

**Question 2:** What is the relationship between scale and sensory landscape perception?

**Question 3:** What is the appropriate scale in order to perceive the landscape?

**Question 4:** How do landscapes change over time?

In addition to the above questionnaire, all students that participated using the RouteQuizer smartphone application were asked to evaluate the application, by filling a small form containing the following questions: 1) Did the application help you in answering the previous questions? a) Not at all, b) A little, c) Enough, d) A lot, and e) I do not know/I do not answer. 2) On a scale of 1 to 10 how would you evaluate the application in terms of: a) Functionality, b) Ease of use, c) Loading speed and d) Content.

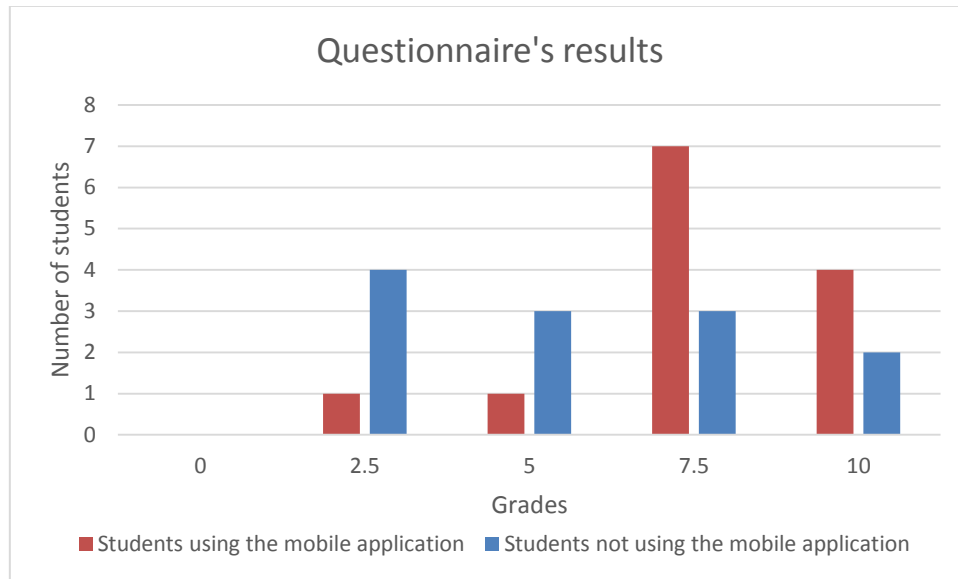


Figure 4. Students Participating in the Activity



## Result Evaluation

After grading and rating the students' answers, the first group of students that did not use the system's application managed a 56.25% score, while the second group scored 76.92%, (Graph 1). The 20.67% difference between the groups, becomes even more impressive when taking into account the fact that the first group, was accompanied by the professor, who was also lecturing while conducting the field trip. On the other hand, the second group conducted the activity on their own, only relying on the information provided by the application.

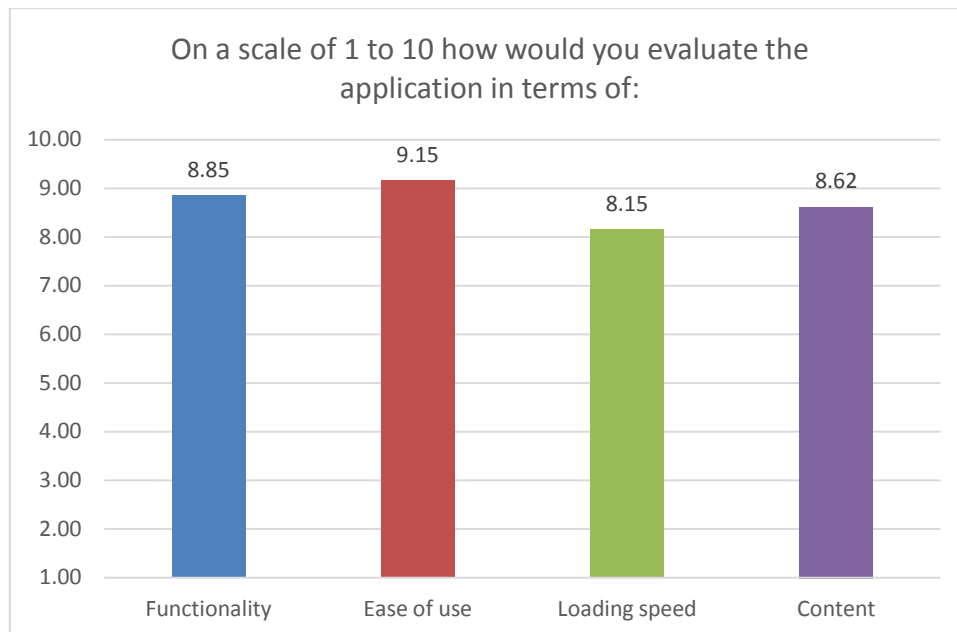


Graph1. Questionnaire's results

The main reasons that can justify these results are:

- Not all students of the first group were paying attention:* Even a small group of 12 people is hard to be kept committed to the lecture on the field. On the other hand, the smaller groups that used the application had to cooperate in order to proceed, while the new to them way of attending a class, kept them interested throughout the activity.
- The application encouraged collaborative learning:* A very popular finding, related studies is the collaborative nature of such activities (Palmárová and Lovászová, 2012). The students using our application, had to cooperate not only in order to locate their destination, but also to answer the questions they were asked. Before answering each question, a small meeting between the members of each group was held, and students were sharing their views and opinions, before picking their answer.
- No questions left unanswered:* Every time the students using the application answered a question incorrectly, they were immediately informed by the application about the right answer. That way, no blind spots were left uncovered.

Regarding the smartphone application's evaluation, students' feedback was more than satisfying. Specifically, 61.54% of the student answered that the application helped them "a lot" in answering the questionnaire's questions, while the rest 38.46% answered "enough". Also, in terms of functionality, ease of use, loading speed and content the application scored 88.46%, 91.54%, 81.54% and 86.15% respectively (Graph 2).



*Graph2. Smartphone application's evaluation*

### **Conclusions**

During but also after completing the activity, all students that participated using our system, seemed to have fun, while also commenting that it was a very interesting experience, something that also can be found in many similar studies, such as (Robison, 2011), (Christie, 2007) and (Michalakis et al. 2017). Based on the results of the questionnaire (Graph 1), those students performed better, leading us to the conclusion that mobile learning and geocaching, except from being a pleasant experience, also improve student outcomes and help effectively in achieving the educational goals. Furthermore, it became clear that certain characteristics of the activity, as it was conducted using our system, were crucial in achieving the aforementioned results. Specifically, the required cooperation levels within the members of each group were high, as locating the destination point and answering the questions presented was a demanding task that kept all students active throughout the activity. Regarding our system's performance and evaluation, every outcome we had during the trip was particularly positive, as technically the system performed flawlessly, while also the feedback we collected by the students that used it, surpassed our expectations. In the future, we intend to conduct more similar activities that will not necessarily concern geography teaching or courses that already include field trips in their curriculum. In addition, we also plan to extend the range of question types provided by our system, by adding open-ended and matching questions as well.

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