Trace learning path by mobile technologies as an Instructional Tool
-Using GPS and GIS in students' field trip to zoo

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Abstract. With the development of wireless technology, many handheld computers provide the learners with platform and resources to interact, collaborate, and share ubiquitously. The purpose of this research is to explore the potential application of mobile technologies in supporting elementary students' learning in the field trip. By recording the path of traversing, the GPS and GIS offer hyperlinked to the information on the Internet for further learning after the trip. The result indicates that the mobile technologies can be used to provide an adaptive learning support to the zoo visitors. Teachers could integrate teaching material well for further instruction.

1   Introduction

The use of handhelds become popular right after the rapidly-changing development of technology. PDA, Personal Digital Assistant, owns the advantages of highly portable, individual, available anywhere and communicate with others easily, especially the adaptable to the learner's evolving skills and knowledge that make it possible to be an important tool of lifelong learning[4].

GPS, Global Positioning System, is a highly technologically advanced version of the magnetic compass. Features of GPS receivers, first, the decreasing cost and continually gathers real-time data from satellites for which it calculates a person's speed, location, altitude, and direction of travel. Second, for the technology gives students the opportunity to use the environment around their daily life. Third, moderately displaying their location on live maps, plotting a route to a destination and downloading data into a GIS or other computer program. Therefore, GPS and GIS become an application tool in teachers' instruction[3].

This research combines the characteristics of PDAs, the tracking and recording functionality in GPS devices and relevant software of GIS offer to elementary students' learning in the field trip. To analyze the learning route into learning path diagram then display on GIS interface. The result indicates to integrate students'

learning activities, the teachers' teaching material preparation, and provides a convenient reference for teachers offering follow-up relevant learning information.

2   Related work

From the following two examples, we can see the main advantages when traditional learning evolved into technology-integrated activities and know how GPS and GIS work coordinately as an instructional tool.

2.1   A campus geology walking tour

Daniel J. Weiss & James C. Walters integrated GPS technology into geology course activities. They used the tracking functionality as a campus walking tours to give students the opportunity to investigate geologic features. The learning activities go with the paper maps and use GPS tracking functionality to reach next points, they can have better direction awareness experience.   Furthermore, the decreasing of cost and the recording accurate with the error being less than 15 meters, raised the possibility of instruction purpose. The result indicate that students enjoyed an activity that allowed them to get outside and do something new, they liked work on the activity by their own or with a small group with their classmates, they especially expressed a surprise that there is so much geology on campus and that had previously thought was concrete. All of those benefits are in addition to the obvious benefits of teambuilding and hands-on learning[2].

2.2   Cultivate students' multiple intelligences

Herbert W. Broda & Ryan E. Baxter indicated the unique combination of technology make it possible to integrate both indoor and outdoor experiences, rather than removing students from the real world but in the computer world. New technology helps them explore, experience, and analyze their surrounding in a direct and engaging format in the application of teaching. Because students use a GPS device to locate points of interest around the surroundings they live, GIS and GPS activities provided highly interactive and creative increasing compatible with higher-order thinking skills and own multiple intelligences. Additionally, when they located points of interest around the school or community, they should gather, explain, and classify data quickly. It makes them improve higher-order thinking and incorporated linguistic, logical/mathematical, spatial and interpersonal intelligences. The technologies integrated into courses influence them to have an adaptive support in their life. Quite naturally, it makes a young adolescent with a naturalist proclivity to record and analyze data in very powerful formats[3].

3   Purpose

To sum up the related work, students not only interactive, communicate, and exchange information with group members well but also perform well individually. They will have higher motivation and gain excellent learning experiences when incorporated GIS and GPS into learning activities. Additionally, the increasing functionality of the handhelds and GPS provide but the decreasing of cost, it become a convenient learning tool. Consequently, this research use GPS and mobile technology in students' field trip learning but assistant use, and provide a tool to help teachers integrate teaching resources well, then providing an adaptive learning support for students. The result indicates to improve the preparation of teaching materials and the learning outcome when use GIS and GPS in the educational environment. The purpose of study shown as follows:

> ➢ Analyze the visiting route of latitude and longitude coordinates from PDA records and generate a learning path diagram from a Flash Action Script program.
> ➢ Provide a tool aiming to the staying time of visiting and use Flash Action Script to analyze the learning path diagram and sort the animals of students' interest.
> ➢ Provide a tool to make adaptive learning information (hyperlink) on the Internet for students' individual need as the possible interested animals.

4   Instruments

PDAs, GPS devices and navigation software in PDAs, Desktop Computer with Windows system, images processing software (such as Photoshop) and Macromedia Flash are required for this research.

5   System Design

5.1   Preparation

Go to the zoo first for gathering all the animals' location and coordinates, a PDA and the GPS devices for tracking and record the locations or points by pens are required. After that, get ready to students' field trip. Each student bring a PDA and GPS device for tracking route then save as a text file on the field trip visiting.

5.2   Design & analysis

For recording the learning route in PDA, transfer the text file into windows system (See Fig. 1). Then analyze the context and pick up only the coordinates into another text file, it can use for coding Action Script program (See Fig. 2).

Fig. 1. Tracking route record text file

Fig. 2. Coordinates text file

After gathering coordinates, how to perform the coordinates into a windows form? We found the coordinate performing method of the navigation records from GPS is latitude and longitude coordinates(See Fig. 3), different from the actual coordinate of windows form, also the width and height were discordant. In order to perform the coordinates well on the form, to convert the coordinate records is inevitable. After left rotated the latitude and longitude coordinates through 90°, the form shown in Fig. 4.

○ - △   (tax , tay) – (tbx , tby)

(tbx , tby) =
(24.999032000, 121.591192000)

·
(ax, ay)

(24.992000000, 121.580000000)
= (tax , tay)

Fig. 3. Latitude and longitude coordinates expression

○ - △   (pxmin , pymin) – (pxmax , pymax)

(50,100) = (pxmin , pymin)   (750,100)

·
(mx, my)

(50,500)   (750,500) = (pxmin , pymin)

Fig. 4. Coordinate expression on windows form

Use the latitude and longitude coordinates into Macromedia Flash and program an Action Script code to generate learning path diagram. The background layout will be appeared, then draw the base maps of all areas and animals blocks in the zoo and suit them into the path diagram. Additionally, the program will count the near and similar points (frequencies points) and sort animals by staying time (See Fig. 5 or Fig. 6). Through these forms, teachers would know students' interest. According to the learning route and staying time of learning path diagram demonstrated. Teachers can offer these two different kinds of hyperlink information aim for students' individual need. But there should be hundreds of animals in the zoo that generate a webpage for each animals would spend much time, we also provide a simple tool to edit and

manage the hyperlink pages, shown in Fig. 7 and Fig. 8. After editing the hyperlink, the learning webpages will be different, see the left portion of Fig. 9 and Fig. 10.

Fig. 5. Learning path / Sort by staying time (Sample 1)
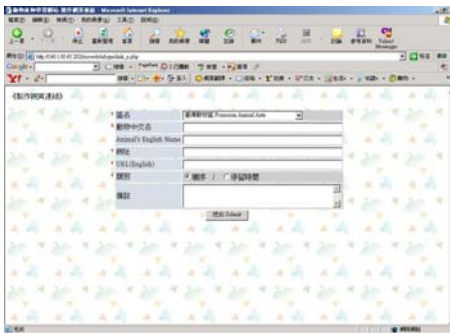

Fig. 6. Learning path / Sort by staying time (Sample 2)

Fig. 7. Add animal hyperlink
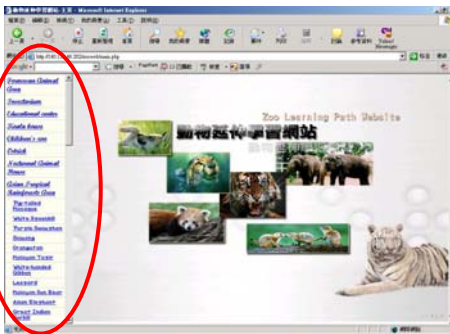

Fig. 8. Browse animal hyperlink

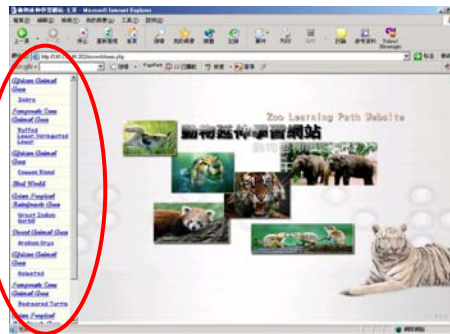**Fig. 9.** The hyperlink sorts by visiting path

Fig. 10. The hyperlink sorts by staying time

5.3 Problems and Solutions

Because the path diagram program was a non-sense procedure, it couldn't judge the coordinates from GPS were right or wrong. But we can obviously see the sharpness and jaggedness in the diagram, and they make the results incorrect. In order to reform the bias, we added some code statements to get rid of the non-use points and lines. To express the concept with a magnify diagram shown in Fig. 9. After reforming, the learning path diagram shown in Fig. 10, the noise points were gone.
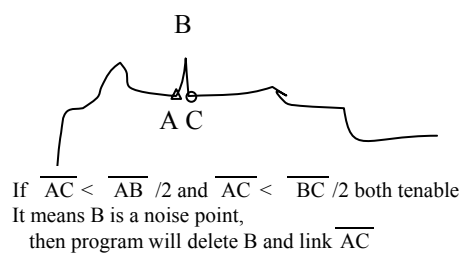

If $\overline{AC} < \overline{AB}/2$ and $\overline{AC} < \overline{BC}/2$ both tenable
It means B is a noise point,
  then program will delete B and link $\overline{AC}$

Fig. 9. The expression for deleting the noise points

Fig. 10. The learning path after deleting noise points (Sample 1)

6 Results and Discussion

It is not reachable for expecting learning outcomes in the field trip, but if integrated technology in teaching procedure and analyze the learning route, teachers can know students possible interest through the learning path diagram, and offer different hyperlinks for students' individually need. It was totally different from the traditional learning of skimming visiting. Teachers couldn't know the students' interest. Aimed at the interest and designed detailed-introduction learning information lead a student-central instruction not only a learning support for each student but also a reduction of guessing the students' learning interest while integrating technology into education. Therefore, associate techniques to give an adaptive guide for further instruction to reinforce learning and redeem instruction.

7 Practical use of learning path analysis application

How to use the learning path diagram which this research provided to analyze? First, evaluate the students' motivation and make sure they were interested in animals. Second, make sure the amounts of mobile devices and GPS receivers provided. Third, inform students about the main purpose of mobile devices were as a assistant and they

wouldn't use it as a learning tool. Fourth, have a field trip and make sure the tracking functionality was in place as recording the coordinates. Fifth, after the field trip, rearrange the coordinates records in text file and use the program that learning path diagram provides, it will generate each students' individual learning forms. Sixth, use the results and hyperlink management function to make the of hyperlink webpages.

8   Conclusions and Future work

This research expects the route analysis program benefit teachers' instruction. Students can not only learn impressive but find out their interest, teachers can improve teaching quality even more. In the further work, we will focus on application of teaching effect next. Find participants and raise an empirical case study, analyze the attitude and knowledge status before learning, in learning proceed, and after learning. Indicate to know whether the revolution of mobile technology integrate into instruction effect learners learning situation and provide a reference to instruction in field trip learning activities or not.

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