Mobile Technology in Management of Field-Based Learning in Geography: An Analysis of NIEmGeo

Geography

Dr. Kalyani Chatterjea   Associate Professor, National Institute of Education, Nanyang Technological University

ABSTRACT *Field-based research in any field-based discipline involves recording of huge datasets, multiple researchers. There is a need for an integrated platform that allows seamless data recording and post-field data analysis, using context-rich and spatially-coded data. This research analyses the operations of a mobile application, NIEmGeo, that integrates field-based data recording and integrates post-field quantitative analysis and spatial mapping on one single platform. The application has been used by more than 2000 students for field-based research so far, allowing opportunities to teachers to venture out with large numbers of students, otherwise impossible.*

INTRODUCTION

Fieldwork is an essential component of learning in Geography and is acknowledged to provide comprehensive understanding of the environment. Such fieldwork, when tied with in-depth inquiry-based learning exercise in the field, completes the circle of learning, which is often initiated in the classroom. While fieldwork has been enhancing geographic understanding for a long time, the advent of several technological affordances have opened up new avenues and possibilities to enhance the way learning can be complimented and energized. Several mobile applications in affordable platforms such as the ubiquitous mobile phones now-a-days provide simple yet useful instruments to assist geographical and environmental analysis. Each of these applications comes with its own niche features, targeting specific areas of learning. However, to make a geographical fieldwork seamless, to weave in field data collection as well as post-field data analysis, in order to deliver a complete geographical understanding, the application needs to have specific learning objectives in mind. This research analyses a mobile application specifically designed for assisting geographic learning through context-rich, spatially cognizant data collection and post-field data analysis and collaborative knowledge building. The application, NIEmGeo, is developed primarily to work on iOS platforms, although use on Android phones is also possible, if required. The application has been used so far by more than 2000 geography students for fieldwork in remote locations, with post-field analysis using the University server. The paper discusses the design features that make this application useful for detailed fieldwork, as well as for data analysis and map work.

FIELDWORK AND INTEGRATION OF MOBILE TECHNOLOGY: CURRENT RESEARCH

While fieldwork is aptly considered an integral part of Geographic learning, mobile technology can be considered an affordance essential for today's out-of-the-classroom learning situation. [1], [2], and [3] discussed the issue of users authoring information in context, while [4], [5], [6], and [7] discussed the use of mobile devices for collaborative fieldwork, using geo-referenced locations and mapwork, to enhance field observation and field-based learning activities. [8] and [9] investigated how mobile phones can be used to engage learners in collaborative learning, while [10] described how students of archeology used mobile devices to do their fieldwork. All these studies looked at the building of customized location-aware context that suited specific learning objectives. Usefulness of teamwork in data acquisition, ease and familiarity of the mobile device are aspects that researchers found to be essential for achieving effective learning outcomes. The features and affordability of smart phones, as well as their popularity among the present generation make mobile technology the logical choice as a learning platform. However, many researchers mention the problems faced by the data plans, high charges, and the non-availability of such facility especially in remote field locations. Additionally,

[11] laments that although there is much said on support and enhancement of learning by use of mobile devices, examples are still lacking to support that it can be used for collaborative learning and for learner-specific goals. It is also true that fieldwork becomes cumbersome with multiple data recording devices. Thus although there is consensus that fieldwork is essential and that IT devices assist in making it more effective, there seem to be some need to have an integrated system for facilitating not just data gathering, but also collaborative data acquisition, and data analysis, with adequate geo-referencing and site and learner specific customization.

OBJECTIVE AND SCOPE OF NIEmGEO

As [12] suggests, fieldwork should be integrated into the structure and learning objectives of a course. In line with this, the courses in Geography at National Institute of Education, Singapore have fieldwork woven in closely in several Physical Geography courses. Field-based research projects usually contribute 50% of the course grades, allowing students to get deeply involved in long periods of field-based inquiry. Data collection and subsequent data analysis, therefore becomes an important part of the process. Traditional fieldwork, with several measuring and recording devices, pen and paper records, camera for photographic records usually result in many handling mistakes, cumbersome practices and several instances of data loss. To minimize such problems and also in response to current research findings indicating the need for an efficient field assistant, the mobile application, NIEmGeo, was developed to be used on iOS and subsequently, also on Android platforms, to assist, facilitate collaborative, geo-referenced, data collection that allows the learners to add need-specific spatial context, conduct data acquisition without the requirement for internet connectivity. Going beyond just data acquisition, NIEmGeo allows data-development and data-sharing though subsequent learner negotiation and finally mapping of data and locations. Specifically aimed at geographical learning, NIEmGeo design requirements are set to provide:

1. Geo-spatial referencing of field sites
2. Photographic records of field evidences and relevant features
3. Ability to record large amounts of both quantitative and qualitative data
4. Customizable data fields
5. Ability to annotate locational photographs, to emphasize observations
6. Ability to add field sketches to record learner observation, specific to learning objectives
7. Ability to record learner responses and comments related to the work
8. Ability to add annotations and demarcate features through on-screen inputs
9. Feature to upload all observed and recorded data to the

server, for future collation, addition, and sharing
10. Post-field data analysis from collectively recorded data
11. Automatic tabulations and quantitative data analysis using MS Excel
12. Automatic mapping, using Google Earth, for locating study sites and data points, along with photo insets

Typically, to perform the entire suite of fieldwork and data analysis, the learner needs to have an account with the server, specified by the teacher facilitator, a mobile device (either a phone or a tablet), and a login password. The application allows customizable data field, to suit all types of field investigation. The user is able to input both quantitative as well as qualitative data. This allows input of various types of field data, making it particularly useful in Geography which is a multi-disciplinary subject and may involve different type of data for different situations. As the facilitator, the teacher has the administrative rights to customize the quantitative data classes (in the form of response buttons), which are designed to accommodate six different parameters at any one set up. In case of additional data field requirements, NIEmGeo also offers the scope of filling in additional quantitative data in the 'Description' field, which is designed to accept both quantitative data as well as qualitative description. This allows full freedom to the field researcher to key in as much information as required. The development of NIEmGeo is based on a model discussed by [13], where the facilitator generates a hypothesis to initiate the learning process. The mobile application, NIEmGeo allows students to go through the entire process of learning where the experimental design is facilitated by the teacher, but subsequently student-centred processes focus on location-aware data collection in the field, context-rich data creation, data sharing, and subsequent data analysis, to produce a geo-referenced set of information that can be visually presented to provide spatial knowledge, with adequate data support to analyze the given hypothesis. The application also allows learning and knowledge creation through negotiation, building up from the comments generated by the collective user groups.

USE OF NIEmGEO FOR FIELD-BASED RESEARCH IN GEOGRAPHY

The features in NIEmGeo targeted to make fieldwork user-friendly, reliable, and useful for geographic investigation. It operates on a two-tiered framework: (1) field data collection, using the mobile device (either a mobile phone or a tablet), (2) post-field lab/ classroom-based analysis. The students are enrolled into groups. Currently there can be 11 groups, each characterized by a unique colour-coded pin and group ID for field data input, with login IDs and passwords for all students. Although the mobile application does not require internet connectivity, using GPS locations in the mobile equipment instead, students need to login with wireless connectivity and the relevant map needs to be loaded prior to the field outing, to ensure that the base map of the location is in the background. Figure 1shows the working platform during the fieldwork phase, with the data input interface. The quantitative data fields can be edited as required by the teacher prior to the field work. In addition, there are Description and Additional information sections where qualitative information can be inserted, making the application very useful as a field record platform. In the field, students are able to recall a photo taken and add their
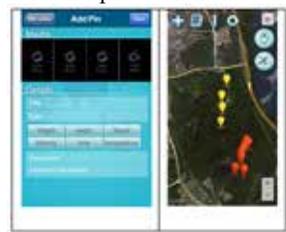
Figure 1: Data Input and Map Interface

Figure 2: Group data base and Automatic export to various formats for data management

own annotations, highlighting salient points of observation, to help them in further analysis. There is also scope for the student to draw field sketches, an important skill in Geographic learning, and annotate. The entire suite of data input fields are aimed at providing all-rounded field recording, which can facilitate not just data recording but also in-field understanding and assimilation via the annotations and sketches. The Post-field activity involves uploading of data to the server, using Wifi connectivity, which stores all data onto the server for further work. Fig 2 shows one such project where database was created through collective work. The quantitative data can be exported directly to MS Excel and automatically tabulated for further quantitative analysis, as required for the project. The locational information can be exported to .kml format and seen using Google Earth for easy mapping and spatial analysis.

Since the launching of the application, it has been used by more than 2168 students conducting fieldwork in Geography.

TABLE 1: Use of NIEmGeo for field-based research (2012-2014)

Used by	Total no. of students
Secondary School students	1903
University Students	265
School Teachers	82

Table 1gives a breakdown of users. In each case large number of students worked independently, developed huge databases, used these for post-field analysis and teachers had the opportunity of engaging these students in independent inquiry. In schools the application was used mostly for local outdoor fieldwork, while the university students conducted in-depth research in remote locations, both in Singapore as well as overseas, collected huge data bases and based their subsequent analysis using the tabulation and mapping facilities of NIEmGeo.
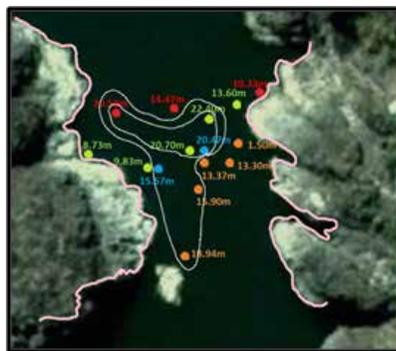
Figure 3: Isovels drawn from huge datasets using NIEmGeo

Fig.3 shows one such example where stream channel isovels were generated using NIEmGeo for both pre-as well as post-field segments of work. None of these students used GIS to generate the maps, and yet, by using NIEmGeo, they could develop cus-

tomized context-rich, location-aware data to enhance their re-search work.

CONCLUSION

Quantitative and qualitative field data and spatial information remain as the main stay of geographic understanding. While Geographic Information System (GIS) provides the power to analyse data and help present multi-layered information, many students in schools and even in the university do not attain the expected level of GIS proficiency to do in-depth geographical analysis. Moreover, while GIS provides the opportunity of in-depth spatial analysis, it does nothing to record all kinds of field data. Thus even a GIS proficient student does not have the tool that integrates all phases of geographical inquiry. From this perspective NIEmGeoendeavours to cater to the need for integrated field observation and analysis, by using a pervasive mobile device, and facilitating both field-based information creation as well as subsequent making sense of the information in a way that provides opportunity to develop an all rounded geographic understanding of a given problem or location. The ability to handle multiple users, with specific identification allows teachers the tool to use it for large groups of students and also allows for integration of data collected by large numbers of researchers, to analyze any given problem. This makes the application particularly powerful and effective in supporting inquiry-based learning.

REFERENCE

[1]Kaasinen, E. (2003). User needs for location-aware mobile services, Personal and Ubiquitous Computing, 7, pp.70-79. DOI 10.1007/s00779-002-0214-7 | [2]Pascoe, J., Ryan, N., Morse, D. (1999). Issues in developing context-aware computing. In Proceedings of the Conference on Handheld and Ubiquitous Computing (HUC '99, Karlsruhe, Germany), H.-W. Gellersen (Ed). Springer Lecture Notes in Computer Science. Springer-Verlag, New York, NY, 208–221. | [3]Baldauf, M. (2007), A survey on context-aware systems. International Journal of Ad Hoc and Ubiquitous Computing, 2 (4), pp. 263-277. | [4]Nguyen, Q. M.,Kim, T. N., Goh, D. H., Lim, E. P., Theng, Y. L., Chatterjea, K., Chang, C.H., Sun & A.,Razikin, K. (2009). Sharing Hierarchical Mobile Multimedia Using the MobiTOP System. in Kellenberger, P. (Ed.) Mobile Data Management 2009 (pp. 637-642). Institute of Electrical and Electronics: IEEE Computer Society. | [5]Puspitasari, F., Lim, E.P., Goh, D.H.L., Chang, C.H., Zhang, J, Sun, A., Theng, Y.L., Chatterjea, K. & Li, Y. (2007). Social Navigation in Digital Libraries by Bookmarking. In Goh, D.H.L., Cao, T.R., Slvberg, I.T. & Rasmussen, E. (Eds.) Asian Digital Libraries. Looking Back 10 Years and Forging New Fontiers (pp. 297- 306). Berlin: Springer. | [6]Razikin, K., Goh, D. H., Theng, Y. L., Nguyen, Q. M., Kim, T. N., Lim, E. P,Chang, C.H., Chatterjea, K., Sun, A. (2009). Sharing Mobile Multimedia Annotations to support Inquiry-based learning using MobiTop. In Hutchinson, D. et al. (Ed.) Proceedings Active Media Technology: 5th International Conference (pp. 22 - 24). New York: Springer. | [7]Theng Y.L., Tan, K.L.,Lim, E.P., Zhang, J., Goh, D.H.L., Chatterjea, K., Chang, C.H., Sun, A., Han, Y., Nam, H.D., Li, Y. & Vo, M.C. (2007). Mobile G-Portal supporting collaborative sharing and learning in geography fieldwork: an empirical study. In Rasmussen, E., Larson, R.R., Toms, E. & Sugimoto, S. (Eds.) Proceedings of the 7th ACM/IEEE joint conference on Digital libraries (pp. 462 -471). New York: Association for Computing Machinery. | [8]Ally, M. (Ed.) (2009). Mobile Learning: Transforming the Delivery of Education and Training. Athabasca University Press. | [9]Lim, K.; Hedberg, J.; Chatterjea, K. (2005). Peer-negotiated constructions of space and place using mobile telephony. in AACE, World Conference on Educational Multimedia, Hypermedia and Telecommunications (EDMEDIA) 2005 (Ed.) Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2005 (pp. 3961-3967). Montreal: EDMEDIA. | [10]Hall, M., Gray, P. (2004). Mobile Support for Team-Based Field Surveys. Lecture Notes in Computer Science, 3160. (pp. 431 – 435). University of Glasgow, UK. | [11]Clough, G., Jones, A.C., McAndrew, P. and Scanlon, E.(2008). Informal learning with PDAs and smartphones. Journal of Computer Assisted Learning, 24, pp. 359–371. | [12]Kent, M., Gilbertson, D.D. & Hunt, C.O. (1997) Fieldwork in geography teaching: a critical review of the literature and approaches, Journal of Geography in Higher Education, 21(3), pp. 313-332. | [13]Chatterjea, K. (2010) Using concept maps to integrate hierarchical geographical concepts for holistic understanding, Research in Geographical Education, 12 (1), pp. 21-40.