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Making Learning Mobile: Using Mobile Technologies to Bring GIS into the Geography Classroom

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Making Learning Mobile: Using Mobile Technologies to Bring GIS into the Geography Classroom

Summary
Physical geography as a discipline is deeply rooted in field-based and technique-based courses where students are expected to learn through lectures and hands-on laboratories (Allen, 2007). Unfortunately, research has shown that just having students 'do' geography using step-by-step instructions may not be contributing to deep learning or long-term retention of knowledge (Armstrong and Bennett, 2005; Scheyvens et al., 2008). One way in which this learning model can be improved is by adopting the constructivist model in which learning is student-centred and teachers act as expert guides and instructors (Day, 2012; Keengwe et al., 2009; Sheng et al., 2010). One area of physical geography that can be improved with this model of teaching is Geographic Information Systems (GIS). GISs are systems that allow us to visualize, analyze, and interpret spatial data and are a ubiquitous tool in geography (Sanders et al., 2001). Unfortunately, GIS software programs are often expensive, complex, and have steep-learning curves. As a result, students are often provided pre-selected datasets and stepwise instructions for completing assignments. They are rarely given the opportunity to collect their own data, develop their own projects, or link their practical field experiences with the theory learned in lecture. This workshop will introduce participants to using simple mobile GIS technologies, such as Google Earth and Collector for ArcGIS, as an active learning tool for teaching undergraduate Geography students. Specifically, participants will have the opportunity to experience data collection with mobile GIS technology firsthand while also engaging in discussions about technology integration with their peers. By the end of the workshop, participants will be able to integrate mobile GIS-based technologies as an active learning tool into both lectures and laboratories in undergraduate geography courses.

Keywords
mobile GIS-based technologies, active learning, physical geography courses

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Making Learning Mobile: Using Mobile Technologies to Bring GIS into the Geography Classroom

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SUMMARY

Physical geography as a discipline is deeply rooted in field-based and technique-based courses where students are expected to learn through lectures and hands-on laboratories (Allen, 2007). Unfortunately, research has shown that just having students 'do' geography using step-by-step instructions may not be contributing to deep learning or long-term retention of knowledge (Armstrong and Bennett, 2005; Scheyvens et al., 2008). One way in which this learning model can be improved is by adopting the constructivist model in which learning is student-centred and teachers act as expert guides and instructors (Day, 2012; Keengwe et al., 2009; Sheng et al., 2010). One area of physical geography that can be improved with this model of teaching is Geographic Information Systems (GIS). GISs are systems that allow us to visualize, analyze, and interpret spatial data and are a ubiquitous tool in geography (Sanders et al., 2001). Unfortunately, GIS software programs are often expensive, complex, and have steep-learning curves. As a result, students are often provided pre-selected datasets and stepwise instructions for completing assignments. They are rarely given the opportunity to collect their own data, develop their own projects, or link their practical field experiences with the theory learned in lecture. This workshop will introduce participants to using simple mobile GIS technologies, such as Google Earth and Collector for ArcGIS, as an active learning tool for teaching undergraduate Geography students. Specifically, participants will have the opportunity to experience data collection with mobile GIS technology firsthand while also engaging in discussions about technology integration with their peers. By the end of the workshop, participants will be able to integrate mobile GIS-based technologies as an active learning tool into both lectures and laboratories in undergraduate geography courses.

KEYWORDS: mobile GIS-based technologies, active learning, physical geography courses

LEARNING OUTCOMES

By the end of this workshop, the participants will be able to:

- identify the advantages of using mobile GIS-based technology as an effective tool for teaching and data collection in physical geography;
- collect spatial data using two mobile GIS apps; and
- design a lesson plan that integrates mobile GIS-based technologies as an active learning tool in physical geography classrooms and laboratories.

REFERENCE SUMMARIES

Allen, T. R. (2007). Digital terrain visualization and virtual globes for teaching geomorphology. *Journal of Geography, 106*, 253-266.

This article will be fundamental for the instructor of the workshop while facilitating the 'Integrating Mobile Learning into Geography Classrooms' discussion. Not only does the paper provide examples of successful classroom activities using Google Earth, but it also highlights some of the specific tools and software programs available that would be relatively simple to incorporate into a university classroom. Furthermore, this paper can be used for material during the 'Introduction to Mobile GIS Technologies' presentation because it emphasizes the benefits of using digital terrain data and virtual globes to enhance student learning and spatial thinking. In the paper, Allen states that with the increasing availability of geospatial data, teachers and professors have a responsibility to effectively incorporate GIS tools and techniques into all courses in physical geography. Additionally, with a host of tools and software programs, professors have the opportunity to reach multiple levels of Bloom's taxonomy. For

example, using virtual globes such as Google Earth, students can expand their knowledge and comprehension of geospatial ideas and processes. More complex terrain visualization software, such as ArcGIS, allows students to construct maps, analyze data, and compare physical processes. Finally, Allen reports that students felt excited and engaged in the subject matter and appreciated the skills (e.g. using online tools and techniques, GIS, designing projects etc.) they gained with the integration of simple GIS technologies. While this article is not focused on mobile technologies specifically, many of the themes and concepts are directly related to the learning outcomes of the workshop.

Armstrong, M. P., & Bennett, D. A. (2005). A manifesto on mobile computing in geographic education. *The Professional Geographer, 57*(4), 506-515.

Armstrong and Bennett define MoGeo as using mobile computing in geographic education, and they believe MoGeo has the ability to improve the way we teach geography. This paper will be provided to participants of the workshop before the beginning of the workshop for two reasons. First, the paper outlines the state of geographical education and the need for teachers to implement mobile technologies. This will provide participants with some background on the problem the workshop is trying to address. Second, Armstrong and Bennett provide a conceptual diagram for creating and assessing MoGeo-based exercises and activities. In additon, they outline nine principles for MoGeo system design which can help guide participants in the workshop while they design their own lesson plans/activities during the 'Integrating Mobile Learning into Geography Classrooms' portion of the workshop. Finally, having read the article, participants may be better able to provide feedback to their peers during the discussion periods.

Patterson, T. C. (2007). Google Earth as a (not just) geography education tool. *Journal of Geography, 106*, 145-152.

This paper will be a valuable resource for the instructor of the workshop to prepare for questions about Google Earth and to facilitate the workshop discussions on integrating Google Earth into lesson plans. This paper is also provided as a valuable resource on the discussion handout. In the article, Patterson suggests that technology, such as Google Earth, can be used in geography classrooms to improve student learning, spatial thinking skills, and critical thinking skills. While the paper is geared to using Google Earth at an elementary and secondary school level, the themes can be directly applied to an undergraduate program and this workshop. For example, Patterson states that Google Earth is a valuable resource for addressing and exploring the major themes in Geography including location, place, movement, regions, and humans' relationships with place. In addition, different exercises in Google Earth can reach the higher levels of Bloom's taxonomy of cognition and can meet all of the National Geography Standards set by the American National Council for Geographic Education. The author highlights some of the limitations to implementing GIS techniques in a geography classroom including data collection, learning the software, cost and time.

Sanders, R. L., Kajs, L. T., & Crawford, C. M. (2001). Electronic mapping in education. *Journal of Research on Technology in Education, 34*(2), 121-129.

This paper will help facilitate the discussions on the advantages and disadvantages of mobile technologies as well as the workshop discussion on integrating mobile learning into Geography classrooms. Sanders et al., clearly define GIS and outline some of the ways in which it can improve student learning and reach higher-order skills such as problem solving and synthesizing. The authors also argue that GIS electronic maps are not only a valuable tool for implementing a student-centred

constructivist teaching model but that effective integration could have far reaching benefits for school administration as well. For these reasons, this article will be helpful for the workshop instructor to introduce the workshop and develop their presentation for 'Introduction to Mobile GIS Technologies.' In addition, the authors discuss the major limitations to implementing GIS into classrooms, specifically cost (hardware, software, and training), training (teacher, student, and support staff), and time (to implement and train).

Scheyvens, R., Griffin, A. L., Jocoy, C. L., Liu, Y., & Bradford, M. (2008). Experimenting with active learning in Geography: Dispelling the myths that perpetuate resistance. *Journal of Geography in Higher Education, 32*(1), 51-69.

This paper focuses on the importance of using active learning techniques in Geography courses at the university level. Scheyvens et al., are able to provide simple examples of active learning techniques including small-group work, simulations, data collection, and analysis that can be implemented into the Geography classroom. Therefore, this paper was used to help design the activities and organization of the workshop by encouraging small-group work, data collection and participant interaction. Furthermore, this paper outlines some of the common myths to incorporating active learning in a Geography classroom such as 'Just 'doing' is Active Learning.' The value of dispelling this myth is that even in a field- or techniques-based course students may only achieve surface learning when following step-by-step instructions rather than the more desirable deep learning. This theme will be important to empahsize when participants of the workshop develop their own lesson plans and activities. Finally, Scheyvens et al. emphasize that students need time to reflect on all active learning activites and be able to describe how the activities contributed to their learning in order to see the value in the activities. This idea has been incorporated into the workshop by providing participants time to reflect on their data collection experiences in the form of discussions.

CONTENT AND ORGANIZATION

Duration (min)	Subject	Activity	Purpose
5	Introduction to the Workshop (Presentation)	The workshop instructor will introduce themselves and the workshop. This involves introducing the learning outcomes and workshop schedule.	Set the tone of the workshop as activity and discussion based. This introduction will also inform the participants of the objectives, schedule, and expectations of the workshop.
5	Pre-assessment (Discussion)	Pre-assessment: 'Tell me what you've heard about…' The instructor has participants provide examples and share experiences of the electronic technologies they have encountered or used. The instructor should create a list of responses on a board or poster.	Allow participants to explore and share their current knowledge and past experiences. This discussion and the list of responses will also be valuable during the discussions after the scheduled break.
15	Introduction to Mobile GIS	The instructor presents some of the reasons that using GIS-based technology in	Present the relevant literature, in PowerPoint

	Technologies (Presentation)	geography classrooms is beneficial for the student and can be used as an active learning tool. The instructor will introduce Google Earth and Collector for ArcGIS and demonstrate how to use the mobile apps.	format, on using mobile technologies to improve student learning. This presentation should provide the necessary background information for discussions on advantages and implementation. Participants are encouraged to follow along as the instructor demonstrates how to use the mobile apps so that they can be more confident during the data collection period.
45	Data Collection (Activity)	See Activity Handout: Data Collection In pairs or small groups, participants will have an opportunity to implement a data collection scheme and collect the spatial data using Google Earth and Collector for ArcGIS. The instructor will be available in a central location to answer questions and troubleshoot.	Provide an opportunity for participants to experience the data collection process using the mobile apps. This firsthand experience will allow the participants to evaluate the apps in the discussion after the break.
5	Break	Rest	Provide participants extra time to return to the workshop room after data collection if necessary.
20	Assessing the Advantages and Disadvantages of Mobile Technologies (Discussion)	Participants identify some advantages and disadvantages by answering the following questions (See reverse side of Activity Handout): 1) If you were to do the activity again, what would you do differently? 2) Did you have any problems collecting the data? How did you solve those problems? 3) Which app did you prefer using? Why? 4) What are some of challenges to implementing these apps into your course? 5) What are other advantages/disadvantages to using mobile technology in Geography?	Give participants an opportunity to reflect on their data collection experience and share with other participants. This discussion will address some of the challenges with integrating GIS-based technologies that participants will consider when developing their own project ideas in the next discussion.
20	Integrating Mobile Learning into Geography	Using a Think-Pair-Share model, participants develop a lesson plan or activity that incorporates GIS-based mobile	Develop an activity or assignment that participants could use in his or her

	Classrooms (Activity)	technology. The instructor should encourage participants to prepare one activity or assignment that requires mobile GIS technologies. In pairs or small groups, participants will share their ideas and get constructive feedback from peers. When providing feedback, participants should consider: 1) Does the activity/assignment contribute to student learning? 2) Is the activity/assignment feasible in an undergraduate class? Why or why not? If time permits, each pair will share their ideas with the larger group. The instructor should have a PowerPoint slide summarizing the guiding principles set out by Armstrong and Bennett (2005) on display.	course. Participants will have an opportunity to provide and receive feedback on their activity/assignment design. This workshop activity helps participants synthesize what they have learned about mobile technologies and apply that knowledge to their own teaching. By having the guiding principles on display, participants can easily refer back to the list and try to incorporate as many principles as possible into their lesson design.
5	Summary and closing remarks (Presentation)	In the summary the instructor emphasizes the benefits of using technology to keep learning student-centred and to provide students with valuable skills in GIS. The summary should end by directing participants to notable resources on active learning, Google Earth, and Collector for ArcGIS (See Activity Handout).	Highlight the main topics from the workshop and direct participants to additional resources and support.
Total Time: 120 minutes			

PRESENTATION STRATEGIES

Presentation Style

Throughout the workshop the instructor should follow a constructivist model of teaching. Therefore, the instructor should act primarily as a guide while the participants construct their own opinions and knowledge surrounding GIS-based mobile technologies. To prepare, the instructor should have questions, comments, and resources to facilitate the discussions. The instructor should be trained in the Google Earth and Collector for ArcGIS so that they are prepared to answer questions and troubleshoot during the data collection period.

Workshop Room and Preparation

- Before the start of the workshop, all participants should be directed to the reading by Armstrong, M. P., & Bennett, D. A. (2005).

- This workshop requires a room with PowerPoint capabilities and if possible, movable chairs to help facilitate group discussions.
- The workshop requires a board (chalkboard, whiteboard or smart board) during the discussion periods. If the room is not equipped, the instructor should bring posters or chart paper on which to write.
- The room must have Google Earth installed and have Internet access. ArcGIS Online (compatible with Collector for ArcGIS) can be logged on to from any computer with Internet access.
- Weather permitting, data collection should be done outside. If possible, the workshop room should have easy access to the outside to save time, and participants should be reminded to dress appropriately.
    - The instructor should be familiar with the area (classroom, building, campus etc.) and choose data collection themes appropriate for the weather and time given.
- The instructor should be equipped with extra tablets for any participants that were unable to provide their own.

ADDITIONAL REFERENCES

Day, T. (2012). Undergraduate teaching and learning in physical geography. *Progress in Physical Geography, 36*(3), 305-332.

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Sheng, H., Siau, K., & Fui-Hoon Nah, F. (2010). Understanding the values of mobile technology in education: A value-focused thinking approach. *The DATA BASE for Advances in Information Systems, 41*(2), 25-44.

APPENDIX A: Making Learning Mobile - Activity Handout

In pairs or in small groups, use your mobile device (smart phone or tablet) to explore a designated area and collect spatial data points. Each group should be equipped with at least two devices so that one can be used to launch the Google Earth app and the other to launch the Collector for ArcGIS app.

1. Project design
    - Each group will be given a theme for their data collection by the instructor (e.g. signs, buildings, trees etc.).
2. Data collection (45 minutes)
    - Once in the designated data collection area, each group must locate 2-4 objects related to their data collection theme. For each object:
        i. Have one member of the group record the latitude/longitude and altitude of different locations related to your group's theme using Google Earth.
        ii. Have another member of the group create a new data point and try adding photos and notes to the point using Collector for ArcGIS.
    - Exchange devices between pairs of group members to ensure everyone has collected data points using both apps.

Group Theme: _____

Notes:

See reverse side

3. Analysis and reflection (20 minutes)
    - Return to the workshop room and look at the data your group has collected.
    - Consider the following questions:
        i. If you were to do the activity again, what would you do differently?
        ii. Did you have any problems collecting the data? How did you solve those problems?
        iii. Which app did you prefer using? Why?
        iv. What are some of challenges to implementing these apps into your course?
        v. What are other advantages/disadvantages to using mobile technology in Geography?

RESOURCES

ArcGIS Collector: http://doc.arcgis.com/en/collector/

Armstrong, M. P., & Bennett, D. A. (2005). A manifesto on mobile computing in geographic education. *The Professional Geographer, 57*(4), 506-515.

Allen, T. R. (2007). Digital terrain visualization and virtual globes for teaching geomorphology. *Journal of Geography, 106*, 253-266.

Google Earth: http://www.google.com/earth/

Patterson, T. C. (2007). Google Earth as a (not just) Geography education tool. *Journal of Geography, 106*, 145-152.