Using Portable Media Players (iPod) to Support Electronic Course Materials During a Field-based Introductory Geology Course

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ABSTRACT

Electronic course materials, such a videos, PowerPoint presentations, and animations, have become essential educational tools in classroom-based geoscience courses to enhance students' introduction to basic geological concepts. However, during field trips, the ability to offer students these electronic conceptual supports is lacking where students and faculty are often without access to the electrical grid. The video iPod offers an inexpensive and reliable means by which to provide students access to a wide range of electronic course materials during field trips. GeoJourney, a nine-week field-based interdisciplinary introductory geoscience program at Bowling Green State University, is the first geology field program to use the entire range of the video iPod's capabilities to support electronic course materials while in the field. A video iPod was issued to each student at the beginning of the program, along with a battery back-up and a DC charging cable which was plugged into a custom wiring harness installed in the transport vehicles. Students were able to use the iPods during travel time, in the field on hikes and projects, and in their tents at night. Types of materials included videos, still images, animations, text, audio files, and enhanced podcasts. Students' response to the use of the iPods is overwhelmingly positive and suggest their use on GeoJourney also reduces 'novelty space'.

INTRODUCTION

It is common practice in introductory-level campus-based geoscience courses to use electronic visual aids such as educational documentaries, animations, and PowerPoint presentations to teach geologic concepts such as geologic hazards, paleogeography, tectonic events, and marine transgressions/regressions. Electronic visual aids have been shown to be effective learning tools in both classrooms and field experiences (Hesthammer et al., 2002, Libarkin and Brick, 2002, Kelly and Riggs, 2006, Thompson et al., 2006 Urbano, 2006). However, students on field trips have limited to no access to the electronic visual aids and course materials useful to teach introductory-level concepts. Moreover, geoscience field trips have been shown to be an integral part of a geoscience student's learning experience and well-designed field trips have great potential to enhance students' conceptual gain in introductory geoscience courses (Orion and Hofstein, 1994, Elkins and Elkins, 2007). How can we successfully integrate the benefits of classroom-based technologies, namely electronic visual aids, into the critically important field experiences for geoscience students?

Recently, integration of electronic visual aids into field-based curricula has come primarily in the form of portable electronic devices such as laptops, Palm Pilots, and iPaQs. Saether, et al. (2004) used flight simulator software and laptops as electronic visual aids in a field setting, but hand-held devices were not used and had limited application in actual field settings. Guertin's (2006) use of the Palm Pilot is an excellent example of how to successfully utilize hand-held computers in introductory geoscience courses for the collection of data for field projects and to play a limited selection of video. Frizado and Onasch (2001) used the iPaQs during geology field camp primarily as a data entry device. Despite these examples, Guertin (2006) emphasizes that it is unclear how ubiquitous the use of handheld electronic devices is in student geoscience investigations because only a few instructors have shared their experiences with using portable electronic devices. Those who have reported their use focus on data entry for field projects in the training of students who have already mastered the basic concepts in geology; use of portable electronic device for introductory-level field experiences is much rarer (Guertin, 2006).

To address the lack of electronic visual aids for introductory geoscience students in the field, the author developed a stationary, but removable, video-playing assemblage installed in vehicles to show students educational documentaries and PowerPoint presentations during travel time on long field trips (Elkins and Elkins, 2006). Although the device worked well at preparing students for upcoming field stops and student feedback was positive, the logistical limitations of the device, specifically having to rotate students through the one vehicle equipped with device, prompted further investigation of ways to bring electronic visual aids to students.

In the last several years, the capabilities of hand-held electronic devices, such as the iPodTM (Apple Inc, 2007), to provide individual, portable, and reliable access to audio and video materials has dramatically improved. Some universities have explored the utility of the iPod as an educational tool. Both Duke University and Georgia College and State University have established academic initiatives on their campuses that utilize the iPod MP3 player in playing educational audio files (music and podcasts) for a wide variety of courses (Duke University, 2007 and Georgia College & State University, 2007). However, neither of these institutions utilize the iPods in a geoscience course or in a field setting. Indiana University-Purdue University at Indianapolis developed field exercises for an introductory geology classes using

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MP3 audio files on MP3 players. Students in the IUPUI course complete self-guided field trips in state parks while listening to the audio files in conjunction with using a set of directions and a worksheet. This course used the MP3-supported field trip in conjunction with on-line computer assignments as part of a geology distance learning course (Thomas and Nelson, 2006 and IUPUI, 2007). This study focuses on the implementation of the video iPod as a means of supporting a wide variety of electronic course materials in various field settings during GeoJourney, an entirely field-based geology course for introductory-level students. The extensive and under-utilized travel time on GeoJourney became an opportunity for instruction and an opportunity to prepare students for upcoming field stops.

The ability to introduce students to concepts and landscapes associated with the upcoming field stop has implications for reducing novelty space. Novelty space (Orion and Hofstein, 1994), is the theoretical space representing a student's degree of distraction from the learning objectives of the field trip. Novelty space is comprised of three novelty domains: cognitive (the degree of familiarity a student has with the subject matter being covered on the field trip), psychological (the degree of familiarity a student has with the itinerary and logistics of the field trip), and geographic (the degree of familiarity a student has with the geography and climate of the field trip locations). Orion and Hofstein (1994) suggests that reducing student novelty space prior to and during field trips can significantly enhance a student's learning while on the field trip. Reduction of novelty space can be accomplished in a myriad of ways, including introduction of subject matter prior to the field trip, provision of detailed field trip itinerary to the students, and discussion of field conditions and terrain prior to going into the field.

THE SETTING FOR USE OF THE VIDEO iPod

Bowling Green State University's GeoJourney (http://www.geojourney.org) is an entirely field-based introductory-level geoscience field program that travels across the United States during the fall semester. The courses taught on the program include an introductory physical/historical geology sequence, an introduction to critical thinking course (Brown and Keeley, 1997), an environmental studies course, and a course on the cultural chronologies of Native Americans. The courses are taught concurrently in an interdisciplinary format as part of a nine-week, 23,345 km expeditionary field trip to 29 national parks and public lands. The itinerary for this program is designed to use landforms and outcrops at national parks, museums and visitor centers, and industrial sites as the basis for teaching introductory-level geoscience concepts. The expedition moves every few days to new campsites near national parklands including: Badlands, Yellowstone, Glacier, Mt. St. Helens, Yosemite, Grand Canyon, and Great Smoky Mountains. GeoJourney students are typically college freshmen and sophomores with no prior college experience, though many of them are in the BGSU Honors Program. For virtually all of the GeoJourney students, the geology courses are their first exposure to the geosciences at the college level (Elkins et al., 2007).

The video iPod is a portable personal media device that is capable of supporting videos (.mp4 files), PowerPoint slides (converted to .jpg images), and podcasts (.mp3 files). In addition to their popularity among students, their small size, affordable cost, large memory storage capacity, and compatibility with a wide range of after-market accessories make iPods an ideal candidate for use on field trips. In the Fall of 2006 each student on GeoJourney was provided with a fifth-generation, 60-gigabyte iPod, a ruggedized carrying case, a DC charging cord, a 9-volt external battery back-up, and an arm strap to attach the iPod to the students' arms during field exercises. In order to keep the iPods charged, the GeoJourney vans were outfitted with a custom, removable DC recharging wiring harnesses that placed two DC receptacles (cigarette lighters) in each bench seat for plugging-in the iPods' DC charging cords. The wiring harnesses were designed to be removable because the GeoJourney vehicles are rented and we wanted to use the harnesses again in future field seasons. Extra 9-volt batteries and the external battery packs were used in field situations where the iPods would be used away from vans' recharging harnesses for extended periods of time such as geological mapping projects or for students to use in their tents at night to study. A MacBook Pro laptop computer served as the platform for converting existing electronic course materials into formats suitable for the iPod, such as converting educational documentaries on DVD's to .mp4 formats, PowerPoint slides to .jpg format, and audio books on CD to .mp3 format. With software such as GarageBand and iMovie, new course materials were created such as lecture podcasts and photo flipbooks of paleogeography. When GeoJourney was over, the iPods were collected. It is important to note that students did not have access to computers nor did they have any means of transferring the files on the iPods to other devices; the iPods were purchased by BGSU, the DVD's and CD's that were converted to .mp4 and .mp3 were the property of BGSU.

TYPES OF COURSE MATERIALS

Educational Documentaries

Educational documentaries, segments of television programming and some movies were converted into .mp4 files from DVD using software called "Handbrake", a GPL'd multi-platform, multithreaded DVD to .mp4 ripper/converter (http://handbrake.m0k.org/). The .mp4 files were then stored in the iTunes library of the MacBook Pro laptop before being downloaded onto the video iPods under the "Videos" menu. Educational documentaries were used to prepare students for field activities and to introduce students to geologic concepts. For example, en route to New Orleans, Louisiana students viewed video footage of the impact of Hurricane Katrina before they arrived in the city to conduct a geological hazard exercise. Similarly, during an eight-hour drive to Seattle from Glacier National Park, students were able to study video footage on volcanic hazards and documentaries about the May 18, 1980 eruption of Mount St. Helens. Additional educational documentaries from

the "Earth Revealed" series (Annenberg Media, 1992) included programs on plate tectonics, the rock cycle, evolution, and the history of life which were not directly tied to specific field stops, but were general concepts common to an introductory-level geology sequence. These latter documentaries were offered as optional assignments to chapters in the student's textbooks; the students could choose between reading the textbook or watching programming that covered identical concepts.

Educational documentaries relevant to the Native American Studies course and the Environmental Studies course were also loaded onto the video iPods. In particular, the educational videos often provided a meaningful bridge between courses. For example, in a study of the role of *Bison bison* to all aspects of Plains Indians' lives, everyone on GeoJourney was involved in skinning a bison and tanning the hide, working with stone tools in the style of the Lakota Indians. Neither the instructional staff nor the students, had any prior experience with this. In preparation for the novel experience, the staff and the students watched a video on their iPods of two Oglala Sioux performing the task giving the participants a better idea of what to expect and how to go about it. At Yellowstone National Park, educational documentaries were used to emphasize interdisciplinary concepts of the Greater Yellowstone Ecosystem including wolf re-introduction and their impact on trophic cascades, the volcanism associated with the Yellowstone caldera, the forest fires of 1988, and the Sheepeaters Indian tribes.

Enhanced Podcasts

Enhanced podcasts were used to teach the critical thinking course. With the help of an undergraduate who has extensively studied critical thinking, we created a series of enhanced podcasts using PowerPoint presentations (visual) and recorded lectures (audio) to deliver the introductory lectures on critical thinking terminology and process. Students applied the critical thinking skills they were learning in the enhanced podcasts to dissect arguments from selected articles and video clips about water resources, Native American rights, and global warming stored on their iPods. The podcasts were created by starting with a PowerPoint file of the text, images, and script of the intended lecture/ podcast. The script was read and the 'lecture' recorded using software called "GarageBand" to create the audio track of the .mp3 file. The PowerPoint slides were converted to .jpg images and synchronized with the .mp3 file using GarageBand. The finalized 'enhanced podcast' was exported to iTunes.

Text

The video iPod can support text documents. On GeoJourney, this function was used to store focus questions for various course materials, particularly educational documentaries. Additionally, instructions for completing the critical thinking assignments pertaining to videos and passages of text were created in MS Word documents, saved as .txt files, and stored in the "Notes" function of the iPod under the "Extras" menu. Longer .txt documents could be turned in to linked .txt files (effectively creating a single digital text document) by uploading the file on iPod Ebook creator (http://www.ambience.sk/ipod-ebook-creator/ipod-book-notes-text-conversion.php). In this way, whole articles of text could be stored electronically on the video iPod.

Audio

Traditional Native American songs, geologic audio tours, and audio books were converted from CD to .mp3 and stored in iTunes. Audio books, such as Jared Diamond's "Guns, Germs, and Steel," created opportunities for highlighting the interdisciplinary nature of the course topics and were especially useful for students who had difficulty reading in the vans.

Photos

Paleogeography images from Dr. Ron Blakey's website of the University of Northern Arizona were particularly useful in creating the "electronic flipbook" of paleogeography (http://jan.ucc.nau.edu/~rcb7/RCB.html). By putting the images in a folder from oldest to youngest tectonic event, the students could control an electronic 'flipbook' of paleogeography. Images were imported into individual PowerPoint slides and labeled using the text tools in PowerPoint. The slides were then converted to .jpg files and managed in the laptop's "iPhoto" library. The paleogeography electronic flip book was animated by the students at their own pace while in the field, standing at the outcrop.

WHERE THE iPod WAS USED

The variety of electronic course materials developed and loaded onto the video iPods reflects the places the iPods were used on GeoJourney as well as the curricular goals, particularly the interdisciplinary nature, of GeoJourney.

In the Vehicles

The primary place that students used the iPods was in the vehicles during travel time between field stops. On GeoJourney, time spent in the vehicles traveling between field sites is approximately 233 hours over the nine-week program; regularly time in vehicles consists of stretches of 2-4 hours drive time. Students typically utilized these hours in transit to view materials on their iPods. Those materials included primarily educational documentaries related to upcoming field stops or documentaries selected to synthesize the interrelatedness of the subjects taught on GeoJourney. Additionally, students viewed enhanced podcasts of critical thinking topics as well as reviewing material available in any of the video iPod menus. The iPods were easily kept charged in the vehicles with the use of the charging harnesses available to each student.

In Camp

Secondarily, the students also used iPods to replay and review introductory materials in their tents or elsewhere in camp in the evenings. The battery back-ups allowed students to use the iPod whenever they were away from the vehicles for extended periods of time.

In the Field

We developed and experimented with several unique iPod-based exercises at various field sites in the Colorado Plateau. The second half of the GeoJourney itinerary supports historical geology with much of our academic focus on the geologic development of the North American continent. Students at this point have had five weeks of rock and mineral identification and are comfortable with topographic maps. Our field-based activities in the Colorado Plateau focus on interpreting paleoenvironment, eustatic changes in sea level, and uplift in the western U.S. Several topographic exercises, hikes, and a geologic mapping project are completed during this time and are designed as exercises for students to practices their skills. The video iPod was particularly useful at Grand Canyon National Park where the students conducted a geologic mapping project of the Bright Angel Trail. For example, students scrolled through PowerPoint-created .jpgs of the paleogeography of the Colorado Plateau while examining the geology of the Bright Angel Trail. While standing at the outcrop students could view the paleogeography images, animate the flipbook to see the tectonic events responsible for the changes in rock types they were seeing along the Bright Angel Trail, and connect the changes in rock types they were seeing on the trail to changes in paleoenvironment.

STUDENT RESPONSES

GeoJourney students are college undergraduates, most of which (approximately 80%) are incoming freshmen, freshman, or sophomores. Most students on GeoJourney are not geology majors (although the program has been successful in converting students to geology majors as a result of their GeoJourney experience). The general education designation of the GeoJourney courses attracts participants from a wide variety of backgrounds and intended majors. Most GeoJourney students are residents of the state of Ohio and come from working middle class families. All of the students in this study indicated their racial identity as 'white'. Twenty of the 27 students on GeoJourney in the fall of 2006 were female.

Student interviews were conducted to qualitatively assess the effectiveness of the video iPod in the GeoJourney courses. Videotaped student interviews were recorded by a non-instructional staff member and were conducted during the last two weeks of GeoJourney. Students were interviewed individually in camp away from ongoing in-camp activities. The interview space was set up with two folding chairs facing each other about four feet apart. The tripod-mounted mini-DV video camera and a portable propane lantern were set-up next to the interviewer. The students were asked questions intended to inspire descriptions of their experiences using the iPod on GeoJourney. Below are sample comments that typify student comments:

Student 1: "The iPod gives us different ways to learn. The videos were probably the most helpful part for me, they were a good way to prepare for the day. It was a nice way to get the information across and an alternative to reading. There is a great deal of reading with the course, and the iPod provided a variation on that."

Student 2: "Because I get car sick, so I would much rather watch movies, and movies are much more interesting and they made the concepts more real than the text."

Student 3: "I think the iPod helps out a lot. When you're in the van I find it hard to read because I talk to everyone else and I get distracted. So watching the iPod you can tune everyone else out and watch the video and it kind of gets you prepared for what you are going to go see. When you read something, its all what you imagine, but when you watch the iPod, you get an idea of what you are going into so when you get there it is more interesting because you have a background about it. So I really like the iPods, and it helps at night cause reading can be difficult. A lot of us will all watch the iPod together at night. We will just share the headphones and then talk about it."

Student 4: " I couldn't really imagine this trip without the iPod so I do really enjoy the mix between our readings and the iPod. Just having a multimedia effect, you are more likely to absorb more of the information. It also cuts down on how much stuff we have to carry around: an iPod vs. four or five books. It is also supplementary. Some people learn better from the geology textbook while other people watch the video and learn more than they ever could reading the geology text book. I don't think anyone would complain about having the iPods although maybe some people prefer to read, but in the end you might just pickup the iPod and watch a video that has not been assigned yet."

A questionnaire about the iPod was given to the students to which they made written responses. Most comments were positive regarding the use of the iPod. Student responses that included comments with more than "yes" are included below:

Was the iPod a useful device academically?

- Yes, it provided an easier way to absorb information while in the vans. It was also a good reference to go back to – a teacher you can play and pause.
- Yes, it provided background information for many of the sites visited and topics discussed. Also, it was a key source of resource for projects and geologic field stops.

Did the course materials on the iPod relate well to the topics that were discussed or to field stops?

- Yes. It was helpful having background info before the stop as to best utilize field time.
- Yes, because it was a video that was easy enough to understand, the stops were easier.
- Yes! Most of the time I knew and understood the material at the field stops prior to stopping because of watching the iPod.
- Yes, it was seeing before we got there; prepared us for what we are to see and learn – "general idea giver".
- Yes – we could see actual pictures of where we were going before we got there, we knew what to expect.
- Yes, gave a good history behind field stops; I felt like I was one step ahead because I already knew the basics.
- Yes, they gave a good heads-up/preview as to what was coming up at stops – allowed us to participate in lecture more actively.
- Yes, provides alternative for slow readers like myself.

DISCUSSION

While assessments of students' conceptual gain in the geosciences as a result of field experiences demonstrate

the importance of field experiences in learning geoscience concepts (Elkins and Elkins, 2007), students in the field can potentially benefit from the electronic visualizations that have been successful in the classroom. In the instances when electronic visual aids have been integrated into the field setting in geoscience courses, students reported that they were better able to understand the processes responsible for the occurrence of rocks and landforms as they are observed in the field (Elkins and Elkins, 2006). Guertin (2006) also reports that the students in that study of the use of PalmPilots found hand-held electronic devices very useful. In this study, using the video iPod as a means to disseminate multiple forms of electronic educational materials to students on GeoJourney was highly successful. The iPods were reliable, easily portable, user-friendly electronic devices that students reported to be integral to their conceptualization of geologic processes and preparedness for upcoming field stops.

Logistically, the video iPods were easily integrated into the vehicles via the recharging harnesses installed in the rental vans. The harnesses reliably provided electricity to the students' iPods for charging and use in the vehicles. We found that the students' primary use of the iPods was in the vehicles during travel time between field stops, which had two advantages: 1.) By viewing introductory material en route to field sites, students were able to spend more time making observations and participating in activities in the field; and 2.) The extensive and under-utilized travel time on GeoJourney became an opportunity for instruction and an opportunity to prepare students for upcoming field stops.

The ability to introduce students to concepts and landscapes associated with the upcoming field stop has implications for reducing novelty space. Novelty space (Orion and Hofstein, 1994), is the theoretical space representing a student's degree of distraction from the learning objectives of the field trip. Novelty space is comprised of three novelty domains: cognitive (the degree of familiarity a student has with the subject matter being covered on the field trip), psychological (the degree of familiarity a student has with the itinerary and logistics of the field trip), and geographic (the degree of familiarity a student has with the geography and climate of the field trip locations). Orion and Hofstein (1994) suggests that reducing student novelty space prior to and during field trips can significantly enhance a student's learning while on the field trip. Reduction of novelty space can be accomplished in a myriad of ways, including introduction of subject matter prior to the field trip, provision of detailed field trip itinerary to the students, and discussion of field conditions and terrain prior to going into the field. The use of the video iPods on GeoJourney specifically addressed student novelty in the cognitive and geographic domains. For example, the documentaries about Hurricane Katrina and its effects on New Orleans prepared students by introducing the concepts of hurricane development and impact on coastal systems as well as providing students with dramatic images of what they would see once they were in the field in New Orleans. Students comment on this preparedness in their interviews and questionnaires.

Based on student comments, the iPods also seem to address those factors: cognitive and psychological and geographic novelty. Comments pertaining to 'preparing them for upcoming field stops' and ' as a general idea giver' indicate that viewing course materials supported by the iPods reduced their degree of novelty. Beyond the clear preference students have for viewing course materials on iPods over reading assignments, student comments indicated the iPods were helpful in reducing novel factors- the most formidable mental barriers to successful instruction on field trips. Interestingly, the questionnaire and interviewer did not specifically ask the students about novelty space or the utility of the iPod in preparing them for a field stop; students commented on these issues indirectly, without prompting.

Additionally, because of the interdisciplinary nature of GeoJourney, we selected educational documentaries to help emphasize interdisciplinary ideas in our particular field courses and to serve as nuclei for discussions in-route and in camp. The iPods stored both the documentaries and focus questions about the documentaries to guide the students' viewing of them in preparation for later discussions. This use of the multiple features of the iPod served the students well in their preparation for discussions. Student interviews suggests these electronic course materials informed their basic understanding of course concepts and the relationships between GeoJourney courses.

For the critical thinking course on GeoJourney, the video iPods supported all of the materials for the course in the form of enhanced podcasts. We found this to be a useful way to introduce students to the process and vocabulary of critical thinking on a field trip that already has a full itinerary. Without the iPods to provide students with access to the critical thinking curriculum during travel time, the time constraints on GeoJourney would have prohibited the course offering. With the students viewing the enhanced podcasts on their own time, we were able to spend time in camp in the evenings discussing and applying critical thinking skills to course materials in geology, American culture studies and environmental studies. The students all reported their experience with the critical thinking course was very positive.

Student comments about the use of iPods on GeoJourney were primarily positive. Many students specifically indicated that they preferred watching video content on the iPods to identical materials in the text book or other reading materials. They indicated the replay-ability of the iPod made it a useful study aid and was the focus of group study efforts in camp at night. They also indicated that having animation and moving images gave them a better understanding of the geologic processes responsible for formations they observed in the field. Students also remarked that they more often previewed materials that were coming up later in the field trip when they had spare time- the video equivalent of 'reading ahead'. For students that have difficulty reading while in moving vans due to motion sickness, having video content on the iPod allowed them to review course

materials that would have otherwise been inaccessible if only in text format. The portability, size, and individuality of iPods allow students to view and review media-based course materials as time permitted, at their own pace such as in their tents at night. The iPods allowed students replay ability of electronic course materials allowing those materials to serve a function similar to that of a traditional textbook.

As field instructors with no previous experience with the iPod or any other hand-held devices other than cell phones, the prospect of trouble-shooting a new technology that was going to be relied on heavily as a primary instructional aid in unpredictable field settings was daunting. However, the iPods turned out to be a no-hassle device. Once we handed out the iPods to the students on the fist day, we never had to deal with them again from the standpoint of technical difficulties, despite the fact our program is nine weeks long, and is entirely field-based. The iPods functioned at all temperatures, humidity conditions, and elevations on our itinerary. Giving students access to DC receptacles to recharge the devices when they needed was critical in keeping instructor attention on teaching and not on technical support and was a relief to instructors. Further more, the dependability and user friendliness of the devices kept the technology from being the focus and instead we were able to concentrate on the course materials and how those materials supported the course concepts. Students are well acquainted with the iPod and took to them immediately. Our previous system was not portable and limited the use of media-supported lesson plans to travel time in vehicles (Elkins and Elkins, 2006). By giving each student an iPod with the course materials, being in the van with the system set up in it was no longer an issue and resulted in an increase in the frequency in which the iPod-supported course materials were viewed by the students. We no longer had to have a long drive day in which to accommodate all the students rotating through the equipped van. Additionally, with the portability of the iPod, the electronic course materials could be reviewed in the field at the outcrop.

While the iPod is very good at supporting electronic course materials, it is a 'one-way' device; student use them to view prepared materials and do not generate their own files. Students' interaction with the iPod is largely passive, with the possible exception of the photo animations students can manipulate. The iPod, in essence, is an electronic multimedia textbook that is limited to a significant degree by the selection and quality of the electronic course materials.

For those considering incorporating iPods into field experiences I offer the following suggestions. Keeping the devices charged is essential. A 'dead' battery makes the device useless. Consider the environments in which you will be using them and how long the devices are likely to be used. I see the use of hand-held electronic devices as the next frontier in technology-assisted learning, not only as something just for field-based trips, but for classrooms as well because they support the broadest range of course materials and offer complete portability. With the development of hand-held devices that have the memory to store many media files, can connect to the cellular phone network, and have keypads for data entry I anticipate that more field work will be done with popular consumer electronics. Because students own these devices and the cost is relatively inexpensive, geology instructors (in both classroom and field) can focus on the production of files types and the utility of those files at improving learning, rather than focusing on a specific device.

CONCLUSION

Unlike campus-based classrooms where student exposure to visualizations is controlled by the instructor, the instructional materials on the iPod can be accessed at times when students prefer and can be replayed and paused as needed. Their portability also eliminates the limitation of instructional media as a vehicle-based learning tool. While I foresee travel time remaining a key context for the use of the iPod on GeoJourney, the portability of the iPods expanded the physical setting in which media-supported lesson plans occur to road cuts, museums, and on the trail. The iPods allow students to replay lectures and videos and provide them the flexibility to review electronic course materials in the environment of their choice (e.g. in their tents at night) The iPods eliminate restriction of instructional technology to vehicles and one-time viewing of electronic course materials dictated by instructors. The iPods also put students in control of the extent and access to electronic course materials in field settings.

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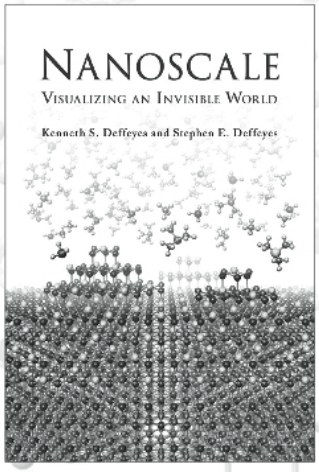

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