ABSTRACT
OssaBEST is a three-year NSF-funded project to prepare middle and high school teachers and students to use advanced information technologies and integrate them into daily classroom activities. The project comprises two information technology tracks, namely, a sensors track and a multimedia track. The activities and deliverables of both tracks are centered on Ossabaw Island, Georgia’s third largest barrier island and the state’s first heritage preserve. The ultimate goal of the project is to motivate and enable a larger number of students to pursue computing careers such as information technology, computer science or related science, technology, engineering and mathematics (STEM) fields.

Categories and Subject Descriptors

General Terms
Human Factors, Documentation, Management.

Keywords

1. MOTIVATION AND BACKGROUND
Mastering information technology (IT) skills, especially those related to the cyber infrastructure, is vital for individuals to take advantage of current and future IT career opportunities. In its latest report, the US Bureau of Labor Statistics continues to project strong demand for IT related jobs through 2014. Moreover, it is now a well known fact that a strong science and technology foundation for all citizens is paramount to the prosperity of any developed country in an age of continuing globalization. Policy makers also realize that a higher percentage of the population needs to attain higher levels of education in order to provide a solid basis for economic growth. This view takes an added importance in the US where recent studies have found that wages of holders of college degrees are 80% more than those with terminal high school degrees. Problem solving and critical thinking skills, motivation, and self-confidence to learn new skills are all required from both teachers and students in order to attract and prepare future IT-proficient professionals. With evidence emerging that the effective use of technology combined with inquiry-based teaching and learning can positively impact student academic outcomes, we can enable teachers and students the opportunity to transcend subject-specific classes by offering them contextualized, hands-on learning for a range of information technologies that is embedded in ongoing field work and supported by well designed educational materials. Ossabaw Island is one of the Georgia Coast's barrier islands located seven miles south of the Savannah and accessible only by boat (Figure 1). Designated since 1978 as Georgia’s First Heritage Preserve, the island is reserved exclusively for educational, cultural, and scientific purposes, with facilities for both residential and day trips. Our project led by faculty from Armstrong Atlantic State University (Armstrong) prepares teachers and students to use a rich array of integrated information technologies using the unique regional marine environment afforded to us.

2. OSSSABEST
OssaBEST: Ossabaw E-exploration for Students and Teachers is a three-year (2008 - 2010) comprehensive NSF-Funded ITEST project to prepare 90 teachers and 120 students from grades 7th through 10th to use advanced information technologies in the context of wider education [1]. The project theme is centered around creating guided electronic exploration of Ossabaw Island – located seven miles south of Savannah, Georgia, and accessible only by boat, it is Georgia’s 3rd largest barrier island. To appeal to
a diverse population of students and teachers, the project adopts a two-track approach to provide inquiry-based instruction using a range of state-of-the-art information technologies. The first track enables the observation (firsthand) of physical phenomena and events occurring on the island via real-time transmission of [in situ] sensor data from a meteorological station, water sensors, and digital cameras that are placed on the island. The second track engages teachers and students in electronically documenting and presenting data collected during field trips to Ossabaw during the summer. Through a series of workshops, summer camps, and year round activities, participating teachers and students will be introduced to underlying computer concepts and information technologies, and, through classroom work, learn how to analyze, catalog, and display the data. Lesson plans that are based on the data collected and that implement the recently adopted Georgia Performance Standards (GAPS) [3] will be co-developed through a collaboration between participating teachers and the project staff during Summer Institutes in order to support learning and teaching within the context of the core curriculum in subsequent school years, and for broader dissemination statewide and nationwide. All project activities and its deliverables are also the subject of ongoing formative evaluation to assess the project’s effectiveness and impact, and to provide ongoing feedback to all stakeholders. The project is the result of ongoing collaboration between faculty as well as undergraduate and graduate student assistants from Armstrong Atlantic State University, teachers and staff from the Savannah-Chatham Public School System, researchers from the Skidaway Institute of Oceanography, The Ossabaw Island Foundation, The Ossabaw Island Education alliance, and Georgia Tech’s Center for Education Integrating Science, Mathematics and Computing.

3. INFORMATION TECHNOLOGIES

In order to appeal to a diverse population of students and teachers, the project adopts a two-track approach to provide inquiry-based instruction using a range of state-of-the-art information technologies. The project will enable teachers and students to observe physical phenomena on the island via real-time transmission of data collected by in situ sensors. Data measurements will emanate from the following sensors placed on the island:

- a meteorological station: comprising temperature, barometric pressure, rain gauge, and wind direction sensors,
- water sensors: for both subsurface and ground level water, and
- digital video camera: streaming video to monitor the beach and the north dock.

Field data and video streams will be provided to the project through collaboration with researchers from the Skidaway Institute of Oceanography (SkIO) and The Ossabaw Island Foundation (TOIF) (no major equipment purchase will be made using grant money). All data will be transmitted over a local area network to a server on Ossabaw (electricity has been provided to the island only in 2000 through a grant from Georgia Power) and then transmitted off the island (Figure 2).
3.1 IT Track 1: Sensor Data Streams
We prepare teachers and students to use and understand the concepts behind the many state-of-the-art information technologies needed to retrieve the field measurements of natural phenomena from in situ sensors and the digital camera on Ossabaw Island, and to transmit the data to desktop computers in their classrooms. These technologies include:

- Electronic transducers: An electronic transducer is the device that makes a measurement of the physical quantity of interest (e.g., temperature or atmospheric pressure) and transforms it to an electrical quantity that can then be digitized for storage on a memory chip and/or for transmission to a remote computer. Therefore, sensing is an ideal pedagogical platform to teach students physical principles of energy conversion that are at the basis of operation of various kinds of transducers, along with related conservation of energy principles – central to many science curricula for middle and high schools.
- Data Acquisition: Sampling of continuous physical quantities and converting the samples to a digital (binary) representation.
- Data Streams: The preparation and transmission of data streams made out of data packets.
- Wireless Communications: The wireless transmission protocol used for sending data taken by in situ sensors to the server.
- TCP/IP: The protocols used to transmit the sensor data from the server on Ossabaw to a server at Armstrong on the Internet.
- Database Concepts: The storage of sensor data on all computers, namely: the servers at Ossabaw, SkIO, and Armstrong, as well as the client computers in schools.
- Data Analysis and Presentation: Extraction of data from the database for analysis and for presentation using a variety of charting techniques – involving different time scales and units.

3.2 IT Track 2: Multimedia Field Guide
We are developing a living and evolving web guide of Ossabaw, for which teachers and students will play an active and on-going role. The purpose of this work is to use IT to support a variety of studies being conducted at Ossabaw, and to involve students and teachers in electronically documenting the scientific and cultural work at Ossabaw. Students and teachers will work in groups for the field guide, supervised by Armstrong faculty. Studies show that female and minority students prefer to work in groups. To appeal to a wide range of cultural and educational backgrounds and interests of both boys and girls, collaborative and supportive aspects of IT team work will be emphasized, balanced with individual authorship of the guide entries. The guide will be crafted by project personnel specifically to enable students and teachers to contribute at various levels of ages and sophistication. It will support all and be the focus for some of the classroom project activities during the school year. Participants will follow both tracks, although they may select to concentrate on one.

A project website/portal that incorporates both the work from the track-one sensor data, and all other project-related information and deliverables is being created and maintained at AASU [2]. An important group task is to make available via the guide the data and presentations emanating from Track 1, enabling our developed lesson plans to use real, relevant, and changing “close-to-home” data. The Ossabaw residential educational coordinator will help cross-fertilize the work with publicly available data and information that is continually being generated by the cultural and scientific projects at Ossabaw, as well as other sources such as data from NOAA and SkIO. Teachers and students will be shown how to contribute to the repository as well as to document their interaction and experiences via a project wiki with information to be entered and used directly by the teachers and students from computers in their classrooms. The technologies and competencies to be transferred are:

1. web development tools,
2. wiki mechanisms for collaborative authoring
3. multimedia: an interactive multimedia-based map of the island, using Adobe’s Flash® with Geographic Information System (GIS) data based on Google maps and marked with actual coordinates collected firsthand by students using Global Positioning System receivers. The handheld receivers are part of the IT infrastructure that will be made available for the project participants by the Department of Computer Science at Armstrong (per the Facilities, Equipment and Other Resources section of the proposal),
4. databases - both fundamentals of design and implementation as well as use, and
5. self confidence through effective team-work and “IT-savvy” communication skills.

4. EDUCATIONAL MATERIALS
Georgia educators are in the process of developing lesson plans to conform to newly adopted K-12 Georgia Performance Standards [2]. These standards are designed to be relevant to students in the 21st century. They move away from a prescriptive, content and performance-based standard specifying a list of topics to be covered. Rather, they are a set of guidelines for instruction and assessment for teachers and students based on best practices. A key principle is inquiry-based learning. Field-based, data-driven, inquiry-oriented, Technology, Science, and Mathematics lesson plans that address Georgia Performance Standards (GAPS) through an Annenberg/Marzano format will be co-developed by Armstrong College of Education Professors, district teachers, and their students. A template is included in the appendix. These lesson plans are outputs of our summer institutes, and subsequent implementation by teachers provides a basis for two of our measurable outcomes: (i) use of network and web technologies and sensor data for inquiry-based learning, and (ii) students engaged in learning information technology. The focus of the development of these plans will be learning and teaching in a technology-rich environment, within the context of the core curriculum, based on student needs. The highly integrated aspect of this instruction will intentionally remove the rigid separations between science, mathematics, and technology curricula, while placing performance-based environmental or engineering issues at the conceptual core. A primary concept will be how GAPS’s and their assessment through Georgia State Criterion-Referenced Competency Tests (CRCT) [3] are in fact better served through in
depth, inquiry based learning rather than the current practice of recitation as preparation for the assessment.

As illustration, one of the mathematics standards (MA3P4) requires that students will make connections among mathematical ideas and to other disciplines, and one of the sciences standards (SCSh5) requires that students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable science expectations. Themes to address these standards (among others) based on sensor data, transmitted from Ossabaw and presented via the web, will form the basis for lesson plans to engage students. These include:

- Measurement of rain fall and establishing a correlation between rain fall over the island and water level in its ponds. Of particular interest is the water level in ponds that support nesting by migrant storks.
- Studying temperature trends based on the daily high, low and average temperatures, relative to historic temperature data.
- Observing the drop in barometric pressure associated with the passage of hurricanes and tropical storms, either directly over Georgia or to the south over Florida during the hurricane season (June-November).

There are several advantages for grounding our pedagogy with the Georgia Performance Standards. Teachers are required to "unpack" these recently adopted standards, and to apply them to the development of their lesson plans. This "standards as focus" approach is a significant departure from the previous "textbook content recitation" practice common to education for the previous 50 years. The collaboration between project staff and participants and, importantly, the emergent lesson plans will result in significant benefit for the teachers. This will aid us to recruit teachers to the project. The lesson plans will be developed continuously. The plans and their creators will form a systemic capacity to continue this unique learning process beyond the length of the project. Measurable success of our outcomes will be a substantial step towards ensuring that current and future students will be engaged by IT-enriched curricula, and indeed, by information technologies themselves. Such engagement is necessary to attract more Middle Level and High School students, including urban minorities and women, into IT careers.

5. SUMMER INSTITUTES FOR TEACHERS AND STUDENTS

Through a series of workshops, summer camps, and year round activities, participating teachers and students will be introduced to the technologies and concepts underlying both IT tracks, and shown how to make use of the sensor data streams and multimedia-based map of Ossabaw in the classroom for a range of professional contexts. The resulting Ossabaw Field Guide will also be made available online. The project design ensures over 120 contact hours per participating teacher per project year, broken down as follows:

- Ten-day Summer Institute for teachers:
  - Part 1: Three days residential camp at Ossabaw.
  - Part 2: Two-day workshop at AASU immediately preceding or following the residential camp.
  - Part 3: Five days (weeklong) workshop at AASU.
- Biweekly follow up meetings with teachers: A total of 42 hours based on biweekly school visitations with an average duration of two hours. The objectives of the visitations by the ITEST faculty from Armstrong include:
  - helping teachers with the implementation of the lesson plans during the school year, and
  - working with the teachers to evaluate the impact of the project activities and deliverables on teachers, on students, as well as on classroom instruction and activities that benefited from the project.

Similarly for participating students, the project includes the following activities per project year:

- Five-day Summer Institute for students:
  - Part 1: Three days residential camp at Ossabaw.
  - Part 2: Two-day workshop at AASU immediately preceding or following the residential camp.

5.1 Summer Camps at Ossabaw Island

During the first year of the project, summer camps at Ossabaw Island are planned for teachers and students during the week of July 28th-August 1st and the the week of August 4th-August 8th, 2008. A total of 30 teachers and 40 students will participate in three-day summer institutes each project year (for a total of 90 teachers and 120 students over the three-year duration of the project). Given the capacity limitation of the current residential facilities on Ossabaw, the teachers and students will be divided into four groups of 22-24 project participants, comprising teachers, students and project staff, each. The program is identical for all groups. Participants will gain the knowledge needed for them to link Ossabaw to their classrooms via both IT tracks. Planned activities for teachers and students are centered around hands-on activities using all available information technologies developed by both IT tracks of the project, their integration into GAPS-based lesson plans, and how to access these information technologies from the classrooms. The summer camps will also include tours of the island.

5.2 Faculty and Student Workshops at AASU

Four daylong workshops (for a total of 32 hours) are planned for teachers and students during each project year. The workshops will be developed and led by the OssABEST leadership team and project personnel. They will involve a substantial amount of hands-on activities and group work, and will be held at AASU on Saturdays, as follows:

- Workshops for teachers that will take place at the computer laboratories of AASU:
  - two workshops will be held prior to the Summer Institute (February-May) to familiarize the teachers with the project, with the information technologies for both IT tracks, and with the development and implementation of lesson plans using those information technologies, and
  - the other two workshops will take place after the Summer Institute (September-November) to ensure
that teachers are able to implement the lesson plans in their classrooms.

- Workshops for students that will take place in computer laboratories at AASU:
  - Two workshops will be held prior to the Summer Institute (February-May) to familiarize the students with the information technologies for both IT tracks, specifically: programming, networking concepts, and data transmission over the Internet during one workshop, and database principles and multimedia in the second workshop, leading them to develop an interactive web site using state-of-the-art web development applications (e.g., using Adobe’s Dreamweaver®, Flash®, and Fireworks®), and
  - The other two workshops will take place after the Summer Institute (September-November) to give students additional hands-on experience with additional motivating computing technologies, specifically: robotics in one workshop and game development/media computation in the other.

Activities for Teachers and Students during the School Year will reinforce and support the topics and hands-on covered during the Summer Institute and school year workshops described above.

5.3 Teacher Professional Development
The nature and direction of professional development for the teachers recruited through this project have two primary elements. The first element is to improve teacher classroom performance in general by guiding them through a standards-based, performance-oriented lesson plan development. The second element is to improve teacher awareness of and their ability to engage and motivate students in Information Technology relative to STEM. The teacher cohort will engage with their University partners in a

6. CONCLUDING REMARKS AND FUTURE STEPS
Ossabest is the result of regional collaboration in Southeast Georgia involving stakeholders from: Armstrong Atlantic State University, the Savannah-Chatham County Public School System, the Skidaway Institute of Oceanography, The Ossabaw Island Foundation, and the Creative Coast Technology Alliance. It also uses our regional surroundings to the benefit of all stakeholders in the community, a characteristic of successful ITEST initiatives as documented by the ITEST Learning Resource Center [4].

An overarching aspect for the project management is to ensure the creation of an OssaBEST learning community comprising all participating middle and high school teachers. The objective of such a community is to ensure the sharing of best practices, lessons learned and resources among all teachers and schools. The necessary IT infrastructure for a web-based repository and an online forum to support such a learning community will be created and maintained at Armstrong. This support is especially important to enable the sharing of experiences from the first year cohort of teachers with the second and third year cohorts, and similarly between the second year cohort and the first and third year cohorts. This collaborative infrastructure can also be used for wider dissemination and can then be sustained beyond the duration of NSF funding.

In 2006, the International Society for Technology in Education (ISTE) began work on the next generation of National Educational Technology Standards (NETS) for Students, which focuses more on skills and expertise and less on tools. Released in 2007 [5], these standards specifically point to the following key skills: creativity and innovation, communication and collaboration, research and information fluency, critical thinking, problem solving, and decision making, digital citizenship, as well technology operations and concepts, all of which are integral to the activities and deliverables of our project to the benefit of middle and high school students in our service area.

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8. REFERENCES