Technological Applications in the Teaching of Archaeology

Dr. Basil Reid
Lecturer in Archaeology
The Department of History
The University of the West Indies
St. Augustine
Trinidad and Tobago

ABSTRACT

Archaeology seeks to document the lifeways of past communities through the judicious use of technology. Applying total stations, global positioning systems (GPS) and geophysical equipment in surveying and mapping can reveal important aspects of the past. Aerial photography, photogrammetry, cartography, geographical information systems (GIS) and remote sensing can also be usefully incorporated into both the teaching and active learning of product and idea technologies. Not only do they guide research agendas but they also facilitate more targeted excavations within particular areas of interest. This paper presents a medley of techniques that have either been used or can be used in teaching archaeology students at The University of the West Indies, St. Augustine (Trinidad and Tobago). The major thrust of the paper is the increasing role of these technologies in archaeology pedagogy both in the classroom and field settings, as well as their growing importance in helping students to better appreciate the rich cultural tapestry of their archaeological heritage. Also discussed is the tacit role of multiple intelligences in conducting students' assessments in U.W.I.'s archaeology program.

Keywords:
Archaeology Technology Multiple Intelligences

INTRODUCTION

Archaeology seeks to document the lifeways of past communities through the judicious use of technology. By employing them in surveying and mapping exercises, total stations, global positioning systems (GPS) and geophysical equipment have all played an integral role in revealing important aspects of the past. Aerial photography, photogrammetry, cartography, geographical information systems (GIS) and remote sensing can also be usefully incorporated into both teaching and active learning. Not only do they guide research agendas but they also facilitate more targeted excavations within particular areas of interest. It is within this context that this paper presents a medley of techniques that have either been used or can be used in teaching archaeology students at The University of the West Indies, St. Augustine (Trinidad and Tobago). The central theme of this paper is the appropriate utilization of educational technology in archaeology pedagogy towards more student-centered teaching. The following discourse highlights the ways in which archaeology students, through practical technological applications, are encouraged to become agents of knowledge construction, and active learners of their archaeological heritage.

ACTIVE LEARNING

At the outset, it is important that the discussion be framed within what constitutes good teaching as well as the proper role of technology in pedagogy. While there have been may attempts to describe what constitutes good teaching, it is possible to define good teaching quite simply as that which supports effective learning (Inglis et. al. 2002) [1]. In other words, teaching must be student-centered rather than instruction-centered where an instructor manages the presentation and practice of predetermined and preselected content (Hooper and Rieber 1995) [2]. Among many educational goals, three cognitive outcomes are that students should be able to remember, understand, and use information (Perkins 1992) [3].

Piaget, Bloom and Gagné, and Vygotsky are well-recognised theorists in the area of learning theory. Piaget (1952) [4], in addition to his contributions in the area of cognitive development in students, makes an important case for experiential learning, which can be defined simply as learning by doing (Picciano 2006) [5]. Bloom (1956) [6] and later Gagné (1977) [7] established taxonomies of learning that related to the development of intellectual skills and stressed the importance of problem solving as a higher order skill critical to the learning process. Vygotsky (1978) [8] also posited that problem solving and construction of knowledge were the essence of the learning process. He described the learning process as the establishment of a 'zone of proximal development' in which exists the teacher, the learner, and a problem to be solved. The teacher provides an environment in which the learner can assemble or construct the knowledge necessary to solve the problem (Vygotsky 1978; Picciano 2006). [9) [10]

Evolving from Piaget, Bloom, Gagné, and Vygotsky is a constructivist theory of learning that stresses the importance of experiences, experimentation, problem solving, and the construction of knowledge (Hooper and Rieber 1995) [11]. Constructivism draws on the experience of the learner. Applying this to instructional technology translates into providing the materials, media and the informational resources needed to solve the problems (Hooper and Rieber 1995) [12]. Clearly therefore, if learning involves the acquisition and application of tacit and theoretical knowledge, then teaching must include the creation of opportunities for the development of knowledge construction by students. In this regard, technology, if used appropriately, can provide myriad opportunities for active learning, including knowledge construction, by students.

TECHNOLOGY AND ACTIVE LEARNING

Increasingly, educators are using the term *educational technology* rather than *technology in education*, as the former does not only refer to hardware and software but rather to sets of principles used in designing materials (Hooper and Rieber 1995; Reynolds and Vince 2008; Reeves and Hedberg 2003) [13] [14] [15]. Educational technology, also called *learning technology*, transcends the mere delivery of information but ensures that the information being transmitted is structured in particular ways to achieve optimal educational purposes. The two main types of educational technologies are *product technologies* and *idea technologies*. *Product technologies* include: hardware, or machine-oriented, technologies. In archaeology, examples include total stations, global positioning system (GPS) receivers, magnetometers, resistivity meters and computer hardware and software. On the other hand, *idea technologies* are the outcomes of the application of *product technologies* of which maps, field surveys, excavations, computer generated predictive models and simulations are primary examples. In educational technology, technological adoptions should not place an inordinate focus on the mastery of tools and equipment, but through cooperative learning, students should be allowed to innovatively use the product technologies to generate a welter of outcomes that can facilitate knowledge construction. A key component of constructivism is cooperative learning in which students work together as a team with each member contributing to the completion of the task or project.

Educational technology also relates to theories of brain functioning and learning theory, especially those that pertain to sensory stimulation and multiples intelligences (Armstrong 2000) [16]. In both teaching and student assessment, different intelligences should be taken into consideration, an issue discussed in detail by Howard Gardner in his seminal publication, ***Frames of Mind***. Gardner (1983; 1993) [17] [18] identified eight basic or multiple intelligences that all humans possess to some degree or another; but only five will be mentioned here:

1. **Linguistic intelligence** involves sensitivity to spoken and written language, the ability to learn languages, and the capacity to use language to accomplish certain goals.
2. **Logical-mathematical intelligence** consists of the capacity to analyze problems logically, carry out mathematical operations, and investigate issues scientifically.
3. **Bodily-kinesthetic intelligence** entails the potential of using one's whole body or parts of the body to solve problems. It is the ability to use mental abilities to coordinate bodily movements.
4. **Spatial intelligence** involves the potential to recognize and use the patterns of wide space and more confined areas, and
5. **Interpersonal intelligence** is concerned with the capacity to understand the intentions, motivations and desires of other people. It allows people to work effectively with others.

Gardner's theory has been questioned and debated, particularly as to whether he has really expanded the concept of intelligence or simply extended it to long-recognised talents and aptitudes (Picciano 2006; Klein 1997) [19] [20]. Despite this, his theory makes a good case for using multimedia and other multisensory techniques in teaching and active learning. The application of both product and idea technologies within the context of archaeology should be premised on all five intelligences, as articulated by Gardner. As shall be demonstrated later in the discussion, these approaches are tacitly used in assessing archaeology students at The University of the West Indies, St. Augustine in their various practical and written exercises.

ARCHAEOLOGY PEDAGOGY AT U.W.I., ST. AUGUSTINE

Resuscitated in 2001 after a 13-year hiatus, the archaeology program at The University of the West Indies, St. Augustine (Trinidad and Tobago) has witnessed a steady growth in student enrolment numbers from 40 in 2001/2002 to over 100 in the 2007/2008. The number of course offerings has also increased from two to four. Courses presently offered are *Introduction to Archaeology*, *Research Methods and Techniques in Archaeology*, *Pre-Columbian History of the Caribbean* and *A Survey of World Prehistory*. The first three courses were re-engineered in 2006 to more adequately reflect their strong practical applications, with 60% of overall marks for students being allotted to field and laboratory exercises. Concerning Research Methods and Techniques in Archaeology, students are required to be engaged in at least seven to ten days of archaeology field work.

In order to ensure that students become fairly competent at both product and idea technologies, at the beginning of each major field activity the Archaeology Lecturer spends time showing students how to set up and use various equipment such as the total station, GPS receiver and the resistivity meter. Students are subsequently subdivided into small groups of 5 and directed by the Archaeology Lecturer to set up and utilize the various equipment on their own (Reid 2006) [21]. This type of cooperative learning differs from traditional instruction where the teacher controls the flow of information to students for most of the class. Instead, students teach each other in small groups of between two and five members, thereby making students responsible for each other's learning (see Hooper and Rieber 1995) [22]. Students must ensure that every member of their group achieves the lesson's objectives. These experiences appear to benefit students of all abilities (see Hooper and Rieber 1995) [23]. More able students gain from the cognitive restructuring associated with teaching, and less able students benefit from the personalized attention available from group members (see Hooper and Rieber 1995) [24]. The tangible manifestations of field participation based on cooperative learning are maps, plans and profiles of the archaeological site which constitute idea technologies. It is important to note that field participations accounts for 15% of the overall marks of the Research Methods and Techniques in Archaeology course.

Archaeological pedagogy, based on educational technology, can also guide research agendas, including facilitating more targeted excavations. In August 2003 at the Saladoid site at Marianne Estate in Blanchisseuse, north Trinidad, approximately 10 students under the guidance of their Archaeology Lecturer used a total station to grid the site for field walking. The total station, which is a theodolite and electronic distance measurer (EDM) combined, facilitated the efficient gauging of both horizontal angles and horizontal distances on the site. The results of the field walking exercise factored heavily in the archaeology crew's decision to set up an excavation unit in the area with the heaviest concentration of surface pottery. In March 2002, global positioning systems (GPS) receiver was used to comprehensively map the fairly large pre-Columbian sites of La Fortunee and Gandhi village in south Trinidad. Limited excavations were subsequently conducted in the most archaeologically productive zones of La Fortunee and Gandhi Village. These examples clearly demonstrate the value of both product and idea technologies in the teaching of archaeology at U.W.I., St. Augustine. Not only did they expand the students' breadth of knowledge, enhance their motor skills and generate useful databases through knowledge construction and active learning, but the practical applications helped to reinforce many of the theoretical concepts taught in the classroom, thus making the teaching and learning of archaeology much more meaningful.

Resistivity surveys and GPS are considered standard geoinformatics technologies that are presently utilized in the teaching of archaeology at U.W.I., St. Augustine. However, there are several other geoinformatics technologies that can also be usefully incorporated in archaeological pedagogy at U.W.I., namely, geographical information systems (GIS), remotely sensed satellite imagery, aerial photography, photogrammetry and cartography (see Reid 2008) [25]. It is proposed that the Archaeology Unit in collaboration with the Department of Surveying and Land Information at U.W.I., St. Augustine provide a course in which the full panoply of geoinformatics technologies are used to create predictive models, designed to more effectively identify, interpret and analyze archaeological sites and landscapes (Reid 2008) [26]. Through active and cooperative learning in a laboratory setting, archaeology students will be able to use geoinformatics to identify and study significant features such as plazas, geographical boundaries of chiefdom societies, historic trails, cultural landscapes as well as combine contemporary and historic maps to achieve better understandings of archaeological areas of interest (Reid 2008) [27]. Follow-up visits to sites to conduct field verifications of computer-generated maps should also be considered essential to experiential learning.

STUDENT ASSESSMENT

As earlier indicated, at least three archaeology courses at U.W.I., St. Augustine have recently been restructured to reflect the greater practical emphasis that ought to be placed on archaeological undergraduate training. To illustrate, prior to its re-engineering in 2006, Introduction to Archaeology (HIST 1801) was based on the following student assessment:

In-course Mid-Term Test	15%
Coursework Essay	25%
Final Examination	60%

Introduction to Archaeology students are presently evaluated as follows:

Online Assignments	10%
Laboratory Exercises	20%
Coursework Essay	25%
Class attendance and Tutorial Participation	5%
Final Examination	40%

The second year course, Research Methods and Techniques in Archaeology, was also restructured in 2006 to more adequately reflect the fieldwork requirements in its overall student assessment. Before its restructuring, the course was assessed as follows:

Field Participation	10%
Field Notebooks	25%
Research Design	5%
Final Examination	60%

Students enrolled in the course are presently evaluated as follows:

Online Assignments (based on short answer questions relating to Field Methodology)	15%
Research Design	5%
Field Participation	15%
Field Notebooks	25%
Final Examination	40%

In both courses, an attempt was made to place greater emphasis on practical applications, knowledge construction and active learning with less emphasis on the final written examination. The role of technologies in archaeology pedagogy is especially significant in Research Methods and Techniques in Archaeology. In the restructured course, field participation, the writing up of research designs, the writing up of field notebooks and online assignments (on field archaeology) would encourage students to develop theoretical and practical knowledge of technologies both in the classroom and the field. Information learned in the classroom would be reinforced through practical applications in the field, which would be further reinforced through the meticulous documentation of plans, profiles and maps in field notebooks. A research design provides a brief *modus operandi* of an imaginary archaeology project in which issues of appropriate technologies, staffing, financial support and schedules are taken into consideration. By undertaking this assignment, students become active agents of knowledge construction and innovative thinking.

Although not officially enunciated by The University of the West Indies as a benchmark for student evaluations, Gardner's multiple intelligences are tacitly reflected in the assessment of archaeology students at U.W.I., St. Augustine. This is especially the case for Research Methods and Techniques in Archaeology. As earlier indicated, this course is assessed as follows:

Online Assignments (based on short answer questions relating to Field Methodology)	15%
Research Design	5%
Field Participation	15%
Field Notebooks	25%
Final Examination	40%

Linguistic intelligence can be determined by students' performance in their online assignments as well as writing up their field notebooks, research designs and final examinations. However, the foregoing exercises, particularly the writing up of field notebooks and research designs, would also require logical-mathematical intelligence in which students analyze problems logically and investigate issues scientifically. Spatial intelligence would be required for the production of accurately drawn maps, plans and profiles to be included in field notebooks and research designs. Field participation, which involves group activity, would be heavily skewed towards interpersonal intelligence – an intelligence that allows students to work effectively with others. Manual dexterity, logical thinking and a sense of spatial relationships in field participation are needed to operate equipment such as the total station, the GPS receiver and the resistivity meter for the purposes of site surveys and site mapping. In this regard, logical-mathematical, bodily-kinesthetic and spatial intelligences among students would be key.

Determining the success rate of these technological applications in the teaching of archaeology is predicated on (a) lecturer's evaluations by students and (b) students' grades. Since the archaeology programme was reinstituted in 2001, both (a) and (b) have been positive. However, given that the restructuring of selected archaeology courses was recently undertaken, it is difficult to determine whether this exercise has made any appreciable difference in relation (a) and (b) since 2006. Analyzing (a) and (b) may be more productive if done over a 10 year period. In order to make the archaeology program increasingly relevant and student-centered, the restructuring exercise will, of necessity, be ongoing. Research Methods and Techniques in Archaeology, as presently constituted, requires 7 to 10 days in the field. However, this number is inadequate if students are to properly develop all of their technological competencies. There may also be the need to place more weighting on the writing up of research designs. Research designs facilitate knowledge construction by students and as such the marks allotted should be increased to 10% from the current 5% of the overall marks.

CONCLUSION

Given the quantum leaps in technological advancements worldwide, the use of state-of-the-art technologies in archaeology pedagogy is fast becoming the norm rather than the exception. However, it is essential that instructors encourage their students to become active learners of both product and idea technologies. Assessments should also place much greater emphasis on practical applications designed to better evaluate the multiple intelligences of students. A much more student-centered approach is required if the teaching of archaeology is to provide a suitable framework for greater creativity, originality and innovative thinking by students.

REFERENCES CITED

[1] Alastair Inglis, Peter Ling and Vera Jooste, **Delivering Digitally: Managing the Transition to the Knowledge Media,** Kogan Page Limited., 2002.

[2] S. Hooper and L. P. Rieber, Teaching with technology, In **Teaching: Theory into Practice,** edited by A. C. Ornstein, 1995, pp. 154–170. Needham Heights, MA: Allyn and Bacon.

http://www.colorado.edu/MCDB/MCDB6440/Hooper-Rieber-Tech.pdf
Accessed on April 21, 2008.

[3] David Perkins, Technology Meets Constructivism: Do They Make a Marriage? In **Educational Technology,** Vol. 31, No. 5, 1992, pp. 18–23.

[4] J. Piaget, **The Origins of Intelligence in Children,** New York: Norton, 1952.

[5] Anthony G. Picciano, **Educational Leadership and Planning for Technology**, New Jersey: Pearson/Merrill Prentice Hall, 2006.

[6] B. S. Bloom, **Taxonomy of Educational Objectives Handbook: Cognitive Domains,** New York: David McKay, 1956.

[7] R. M Gagné, **The Conditions of Learning,** New York: Holt, Rinehart & Winston, 1977.

[8] L. Vygotsky, **Mind in Society: The Development of Higher Psychological Processes,** Cambridge, MA: Harvard University Press, 1978.

[9] L. Vygotsky, **Mind in Society: The development of higher psychological processes,** Cambridge, MA: Harvard University Press, 1978.

[10] Anthony G. Picciano, **Educational Leadership and Planning for Technology**, New Jersey: Pearson/Merrill Prentice Hall, 2006.

[11] S. Hooper and L. P. Rieber, Teaching with Technology, In **Teaching: Theory into Practice,** edited by A. C. Ornstein, 1995, pp. 154–170, Needham Heights, MA: Allyn and Bacon. http://www.colorado.edu/MCDB/MCDB6440/Hooper-Rieber-Tech.pdf
Accessed on April 21, 2008.

[12] S. Hooper and L. P. Rieber, Teaching with Technology, In **Teaching: Theory into Practice** edited by A. C. Ornstein, 1995, pp. 154–170. Needham Heights, MA: Allyn and Bacon. http://www.colorado.edu/MCDB/MCDB6440/Hooper-Rieber-Tech.pdf
Accessed on April 21, 2008.

[13] S. Hooper and L. P. Rieber, Teaching with Technology, In **Teaching: Theory into Practice,** edited by A. C. Ornstein, 1995, pp. 154–170. Needham Heights, MA: Allyn and Bacon. http://www.colorado.edu/MCDB/MCDB6440/Hooper-Rieber-Tech.pdf
Accessed on April 21, 2008.

[14] Michael Reynolds and Russ Vince, **Handbook of Experiential Learning and Management Education**, New York: Oxford University Press, 2008.

[15] Thomas C. Reeves and John G. Hedberg, **Interactive Learning Systems Evaluation,** Educational Technology Publications, 2003.

[16] Thomas Armstrong, **In Their Own Way: Discovering and Encouraging Your Child's Multiple Intelligences**, Rev. and Updated ed., New York: Tarcher, 2000.

[17] Howard Gardner, **Frames of Mind: The Theory of Multiple Intelligences,** New York: Basic Books, 1983.

[18] Howard Gardner, **Frames of Mind: The Theory of Multiple Intelligences,** 10th ed., New York: Basic Books, 1993.

[19] Anthony G. Picciano, **Educational Leadership and Planning for Technology**, New Jersey: Pearson/Merrill Prentice Hall, 2006.

[20] Perry D. Klein, Multiplying the Problems of Intelligence by Eight: A Critique of Gardner's Theory, **Canadian**

Journal of Education, Vol. 22, No. 4, pp. 377–394, Fall 1997.

[21] Basil Reid, Returning to Gandhi Village, In **Bulletin Humanitas**, Vol. 8, No. 7 (March 2006). http://www.mainlib.uwi.tt/divisions/humanities/bulletins/2006/bulletinmar2006.doc Accessed on April 24, 2008.

[22] S. Hooper and L. P. Rieber, Teaching with technology, In **Teaching: Theory into Practice** edited by A. C. Ornstein, 1995, pp. 154–170. Needham Heights, MA: Allyn and Bacon. http://www.colorado.edu/MCDB/MCDB6440/Hooper-Rieber-Tech.pdf Accessed on April 21, 2008.

[23] S. Hooper and L.P. Rieber, Teaching with Technology, In **Teaching: Theory into Practice,** edited by A. C. Ornstein, 1995, pp. 154–170. Needham Heights, MA: Allyn and Bacon. http://www.colorado.edu/MCDB/MCDB6440/Hooper-Rieber-Tech.pdf Accessed on April 21, 2008.

[24] S. Hooper and L. P. Rieber, Teaching with Technology, In **Teaching: Theory into Practice** edited by A. C. Ornstein, 1995, pp. 154–170. Needham Heights, MA: Allyn and Bacon. http://www.colorado.edu/MCDB/MCDB6440/Hooper-Rieber-Tech.pdf Accessed on April 21, 2008.

[25] Basil A. Reid, **Archaeology and Geoinformatics: Case Studies from the Caribbean,** Tuscaloosa: University of Alabama Press, 2008.

[26] Basil A. Reid, **Archaeology and Geoinformatics: Case Studies from the Caribbean,** Tuscaloosa: University of Alabama Press, 2008.

[27] Basil A. Reid, **Archaeology and Geoinformatics: Case Studies from the Caribbean,** Tuscaloosa: University of Alabama Press, 2008.