Chapter 12

Action Research with Internet Database Tools

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Learning Objectives

1. Distinguish between “learning objects,” “learning resources,” “instructional devices,” and “instructional artifacts.”
2. Distinguish between student vs. teacher-made artifacts.
3. Summarize in your own words the current market on jobs in artifacts in your area.
4. Classify primary from secondary artifacts, social artifacts and idea artifacts.
5. Describe the identifying characteristics of the multipurpose frame as an instructional artifact.
6. List four factors that contribute to the mental restructuring of knowledge.

Abstract

This chapter will discuss and present examples of Internet database tools, typical instructional methods used with the tools, and implications for Internet-supported action research as a progressively deeper examination of teaching and learning.
Action Research and the SCORM

Perhaps nowhere is the Internet database tool more critical today than in upgrading military readiness. Since 1997, the United States Department of Defense has supported the Advanced Distributed Learning Initiative to maintain military readiness where armed forces and their support activities need to be highly adaptive to address threats effectively and rapidly. The SCORM (Sharable Content Object Reference Model) was developed to achieve this goal. The SCORM is a set of implementation guidelines and requirements for bridging the gap between needs of training developers and providers and developers of Internet database tools. The technical specifications in the SCORM enables the possibility of re-usable learning objects, resources, instructional devices and artifacts. For reasons of clarifying action research with these tools, it is important to describe some of the characteristics of these different Internet database tools, namely: “learning objects,” “learning resources,” “instructional devices,” and “instructional artifacts.”

Instructional Artifacts

Most educational and psychological researchers prefer to describe “artifact” without actually defining it, explaining its origin in the world, nor even who designed it. For example there are two profound articles by Deborah Nelson about what children know and want to know about “artifacts” (Nelson et al., 2004) and the observations that two-year-olds name artifacts by their functions (Nelson et al., 2000). Both never actually define “artifacts,” explaining their origin, how they were obtained, or who designed them. Similarly, for Waltz (2004) “artifact” is described as another way of objectifying educational technology and subjectifying the children that use it. No mention of what it an “artifact” is, no explanation of where it came from, how it can be obtained, nor even who designed it. Haryu and Imai used the term in a recent experiment.

*In Study 1, three 12-year-old children were tested to determine whether they had interpreted a new noun associated with a familiar artifact to be a material name, or a new label for the object.* (Haryu & Imai, 2002, p. 1378)

Although these and many other researchers describe “artifact” without actually defining it, they all ascribe importance to the term “artifact.” Its widespread use begs certain questions that arise for us in conducting Web-based educational research with or about artifacts. What is an “artifact”? Is an “artifact” something concrete or can an “artifact” be imagined, or felt, or an idea? Can we ascribe qualitative criteria to an “artifact,” such as “well-preserved,” or “rare,” or “unique”? Is it something developed by a student, by the teacher, or generated from system activity?
Student- and Teacher-Made Artifacts

Teacher/Designer-Made Artifacts

Some educational researchers classify “artifacts” as products developed by a teacher, instructional designer or software developer. Bannan-Ritland (2003) says that “artifacts” are things designed by the teacher or researcher “…to engineer and construct effective learning environments (using software and other artifacts) that allow teachers and learners to make these propositions actionable” (p. 21). Bannan-Ritland’s conceptualization of “artifacts” as teacher- or designer-made devices is consistent with “resource-based teaching,” the second phase of online teaching (Mann, 2000, 1999a, 1999b).

Student-Made Artifacts

Other educational writers describe “artifacts” as products of research, developed by students during a qualitative case study, again without saying what the products are exactly (Oliver & Hannafin, 2001). This coincides with the American Heritage Dictionary (2000), which offers a definition of “artifact” as a noun, as in “the apparent pattern in the data was an artifact of the collection method.” The usage of “artifact” as a noun shows-up in the educational research as well, “Thus it is not possible that the lack of gender effect was an artifact of sample size” (Sharps et al., 2002, p. 479). This description is close to the fourth of four dictionary definitions, namely: “An inaccurate observation, effect, or result, especially one resulting from the technology used in scientific investigation or from experimental error: The apparent pattern in the data was an artifact of the collection method” (American Heritage Dictionary, 2000).

Artifact Jobs

There are even job descriptions in the IT sector that contain the word “artifact” without actually defining it. Aspray and Freeman (2002) for example, outline four such job titles, associating the term “artifact” with a different each time.

Conceptualizers are those who conceive of and sketch out the basic nature of a computer system artifact…. Developers are those who work on specifying, designing, constructing, and testing an information technology artifact…. Modifiers/Extenders are those who modify or add on to an information technology artifact…. Supporters/Tenders are those who deliver, install, operate, maintain, or repair an information technology artifact. (Aspray & Freeman, 2002, p. 1)

Notice that in the above statement, if you are a Conceptualizer, you’re responsible for “computer system artifacts”—whatever they may be. If you are either a Modifier/
Extender, a Developer or a Supporter/Tender you are responsible for the more narrowly-defined “information technology artifacts”—whatever they may be.

**Kinds of Artifacts**

For some researchers, an artifact can be classified by its purpose. Primary artifacts are tools, such as computers, printers and the Internet. “Secondary artifacts” are cognitive tools such as language and number, the representations of the primary artifacts which enable the agent (child, in this case) to imagine and plan how to use them (Pearson & Somekh, 2003).

**Primary and Secondary Artifacts**

- **Primary artifacts**: While this seems to be a comfortable accommodation offered by Pearson and Somekh, those of us conducting our own educational research on the Web will need an even better description of “primary artifact as tool.” Our dictionary has several definitions of “tool.” The Computer Science definition of “tool” for example is “an application program, often one that creates, manipulates, modifies, or analyzes other programs.” In this sense then, the primary artifact is a computer application that creates, manipulates, modifies, or analyzes other programs. Is that so? Or is actual primary artifact only the business end of the computer application, the cutting part that does the creating, manipulating, modifying, or analyzing? On the Web, maybe the primary artifact is the Web tool inside the Web-based communication system - like instant text messaging tool, an FTP tool or e-mail tool.

- **Secondary artifacts**: These are cognitive tools such as language and numbers, the representations of the primary artifacts which enable the agent (a child, in this case) to imagine and plan how to use them.

**Social and Idea Artifacts**

- **Social artifacts**: Some educational writers consider an “artifact” to be something unique, a socially-relevant object embedded in an individual and cultural world (Hung, 2002). This explanation is Stoskopf (2001) for example, saying that an “artifact” is an historical piece examined by students with associated diaries and old newspaper clippings, without saying what the products are exactly. Lawrence (2002) described “artifacts” as printed ephemera, such as posters and advertisements that offer historical insight into culture just as photographs, sound, as well as leaflets and cards depicting students learning a trade in the Indian boarding schools in different parts of the United States.” According to Billett (2002), there is something called a “workplace artifact,” a catch-all term for “objects, signs, tools,
and symbols that provide access to the knowledge required for performance.” This description is close to the first of four dictionary definitions, “An object produced or shaped by human craft, especially a tool, weapon, or ornament of archaeological or historical interest” (American Heritage Dictionary, 2000). In any case, in all descriptions, the quality of the “artifact” is not at issue nor disputed.

- **Idea artifacts:** For some (Hung, 2002), an artifact can also be a “psychological tool for internalizing concepts” (p. 197), apparently developed on an e-mailing software and manifested as a written log of student verbal memory. Artifacts are “ideas that mediate social discourse” (Hung, 2002, p. 201). Metaphorical ideas can serve as artifacts mediating between the social-activity-community level and the individual-activity-personal level. A rich understanding of the historical evolutions of the metaphorical ideas within a community of practice would lead to greater appreciation of that practice. Students and learners can develop ways of seeing.

### The Multi-Purpose Web Site Frame as an Instructional Artifact

The perspective of “artifact” presented in this chapter is adapted for purposes of explanation from Hung’s (2002) rough interpretation of an artifact as a “psychological tool for internalizing concepts,” that ideas are powerful psychological (or cognitive) tools (or artifacts) that can be recognized as aids for developing and controlling higher order functions and behaviors from the social level and subsequently influencing the individual level.

In accordance with Hung’s view, a multipurpose frame is at once an “instructional artifact” and an “instructional aid for developing and controlling higher order functions and behaviors,” the latter term (“instructional aid”) frequently used in the instructional design literature (Dick et al., 2004). Consistent with this view of “artifact,” the instructional aid (a “to do” list or “post-it note” next to your computer) is meant to replace instruction. The student is not taught from the list or note. Rather the student refers to the list or note as a guide or reminder. Similarly, the multipurpose frame serves to provide a platform for active discussion and debate about the content. Prior knowledge activation is accomplished through debate around the frames. The multipurpose frame becomes the medium for student writing, drawing, and discussing ideas, and procedural questioning from the teacher can be used to facilitate constructivist thinking. The frames are necessary but insufficient to activate prior knowledge. Reading and socialization are considered necessary yet insufficient to activate prior knowledge. It is the combination of reading, socializing and the frame that activates prior knowledge and relates it to the new content (Brown & Mann, 2001). In Hung’s terminology, the multipurpose frame is a metaphorical idea-artifact that mediates between subject (students) and object (which is the objective of understanding elementary concepts). Mediating between individual-subject and the social-community (teachers and students), we have actions facilitating their meaning constructions. In this case, the action is to work out different inter-
relationships and associations between the proposed metaphor and the concepts to be presented by the students. Mediating between the community and object, we have the division of work processes which are the generating, negotiating, and situating processes which are needed. “Teachers facilitate and scaffold the above three processes. Accomplishing the activity leads to the outcome” (Hung, 2002, p. 210).

Brown and Mann (2001) further isolated four factors that appear to contribute to successful mental restructuring of a body of knowledge through design and construction of Web site using this artifact:

- The teacher’s belief that student knowledge is socially constructed from experience through discovery.
- Minimal teacher intervention to ensure students engage in the construction themselves, not merely mimic the teacher’s constructs.
- Structured guidance during the Web-site programming process (e.g., a template or organizing artifact).
- The product that is both good and good looking—the message as well as the medium is properly represented.

Action research should explore its affordances of the instructional artifact, that is, how the artifact provides instruction or permits the instructor or student to do so. If a student uses the instructional artifact, it should be considered a self-instructional artifact or “auto-didactic system,” and the student initiating the self-teaching process, an “auto-didact.”

Learning Resources

Like Bannan-Ritland’s conceptualization of “artifacts,” Web-based learning resources, can be a document in any format, namely: text, pictures, video clips; and of any knowledge type declarative, procedural and/or strategic knowledge for subsequent retrieval by students. I have argued in this book and elsewhere that Web-based learning resources are reminiscent of the conventional resource-based learning categories described in (Mann, 1999a, 1999b, 2000):

1. To provide content (i.e., online notes, online reader, or an online resource pack)
2. To support a learning activity (i.e., online manual, online lab guide, a seminar guide, a fieldwork guide; online projects facts guide, or an online work placement guide)
3. To support a learning process (i.e., online skills guide, skills profile, or an online student log)
4. To build on other resources (i.e., online textbook study guide, online readings guide, or an online lesson outline)
The mindset for resource-based teaching is similar to that of storing and retrieving materials in a media repository or school library. In this way, an instructor’s use of Web-based resources for teaching and learning reflects his or her phase of Web-course behavior (Mann, 1999a, 1999b, 2000).

Resource-based teaching may require a re-definition of pedagogical goals, restructuring of curricular offerings, provision for educator training and support material, and sufficient online tools for the collection of student data. Terms like “stockpiling,” “massing,” “stacking,” “accessing,” and “accumulating” might well define the linguistic framework of the resource-based teaching phase. At Ed.gov in the United States, there are plenty of learning resources for school teachers, students, parents and administrators. MERLOT is also a repository of learning resources but designed primarily for faculty and students in higher education. Links to online learning materials are collected with peer reviews. MERLOT membership is free. GEM (Gateway to Educational Materials) matches educators with repositories of learning resources found on various federal, state, university, non-profit, and commercial Internet sites. GEM is also free. These are two of many repositories of resources for educators. These or other similar Web sites can provide the materials from which to conduct an action research study with your students.

Learning Objects

The fundamental idea behind learning objects is that instructional designers can build small (relative to the size of an entire course) instructional components that can be reused a number of times in different learning contexts. Additionally, learning objects are generally understood to be digital entities deliverable over the Internet, meaning that any number of people can access and use them simultaneously (as opposed to traditional instructional media, such as an overhead or video tape, which can only exist in one place at one time). Moreover, those who incorporate learning objects can collaborate on and benefit immediately from new versions. These are significant differences between learning objects and other instructional media that have existed previously.

A Taxonomy Learning Object Types

All learning objects have certain qualities (Wiley, 2000). It is the difference in the degree to which (or manner in which) they exhibit these qualities that makes one type of learning object different from another. The following taxonomy differentiates between five learning object types. Examples of these five object types are given below, followed by the taxonomy, which explicates their differences and similarities.

- **Fundamental**: For example, a JPEG of a hand playing a chord on a piano keyboard.
- **Combined-closed**: For example, a video of a hand playing an arpeggiated chord on a piano keyboard with accompanying audio.
- **Combined-open**: For example, a Web page dynamically combining the previously mentioned JPEG and QuickTime file together with textual material “on the fly.”
• **Generative-presentation:** For example, a JAVA applet capable of graphically generating a set of staff, clef, and notes, and then positioning them appropriately to present a chord identification problem to a student.

• **Generative-instructional:** For example, an EXECUTE instructional transaction shell (Merrill, 1999), which both instructs and provides practice for any type of procedure, for example, the process of chord root, quality, and inversion identification.

CAREO (Campus Alberta Repository of Educational Objects) at the University of Calgary is one example of a repository of educational objects. CAREO is free to anyone. CAREO users enjoy a variety of services including access to all sections of the Web site, personalized layouts and information delivery, and Interactive Subscriptions Services. At the time of printing, the CAREO repository contained 4,124 objects. Check out other references at the end of this chapter.

### Instructional Devices

#### Learning Method

Instructional designers Roger Hiemstra define “instructional device” as a vehicle appropriate to facilitate a certain learning method or technique. He describes three types of devices: (1) equipment (projectors, computers, etc.), (2) physical conditions (lighting, temperature, sound, etc.), and (3) social mechanisms or arrangements (appointed recorders of group discussion, arranging chairs in a circular format, etc.).

#### Ubiquitous Computing

Professor Chris Dede has found that handheld devices are now being used outside of classrooms to allow a vision of learning called “ubiquitous computing,” where the virtual world travels through the real world with you (Dede, 2004). This is in contrast to sitting at a desktop and interacting with a device. Students walking through their own community can take advantage of a digital-camera attachment, or a probeware attachment measuring temperature or pressure or motion, or a graphing calculator to help them to understand something that’s taking place within the community—and then bring that back inside the school setting. We’re just beginning to understand the possibilities that handhelds present inside and out of schools. (See the chapter by C. Paul Newhouse in this section.)
Digital Manipulatives

In math, devices are digital manipulatives. Meir and Meira (1998) conducted a study of mathematical sense-making of children as they use physical devices to learn about linear functions. The research consisted of videotaped problem-solving sessions in which pairs of 8th graders worked on linear function tasks using a winch apparatus, a device with springs, and a computerized input-output machine. The following questions were addressed: How do children make sense of physical devices designed by experts to foster mathematical learning? How does the use of such devices enable learners to access selected aspects of a mathematical domain? The concept of transparency was suggested as an index of access to knowledge and activities rather than as an inherent feature of objects. The data showed that transparency is a process mediated by unfolding activities and users’ participation in ongoing socio-cultural practices.

Exercise

1. Access Google and search each of the following Internet database terms for a definition:
   - “instructional artifact”
   - “instructional device”
   - “learning object”
   - “learning resource”
2. Make a table to compare:
   - how instruction differs in a “device” and an “artifact”
   - how learning differs in an “object” and a “resource”

References


