Assessing the Usefulness and Usability of Online Learning Activities: MapStats for Kids

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Abstract

MapStats for Kids is concerned with the development of online learning activities based on data from the FedStats web portal. The development of these web applications requires that the tools will be useful and usable for students, grades 4-8. In order to assess web applications developed according to the above requirements a range of usability testing methods will be applied within the project.

Introduction

The goal of the *MapStats for Kids* project is to design and provide online learning activities to students (grades 4-8) that support their statistical, graphic/cartographic, and domain literacy. The project is a Digital Government pilot project (a subproject within the *Quality Graphics for Federal Statistical Summaries Project)* and specifically dedicated to exploring how online learning activities can facilitate the use of MapStats products by schoolchildren. All MapStats for Kids activities will be made available through the FedStats web portal. FedStats is a cross-agency Internet portal designed to help all Americans find statistical facts for making personal or business decisions, conduct research on a myriad of topics, and participate in public policy debates. Through the Bureau of Labor Statistics (BLS) and other linkages, the GeoVISTA Center is part of a Digital Government-wide set of activities, e.g. the GovStat Project (http://ils.unc.edu/govstat/) with common high-level goals of improving citizens' use of statistical information.

Within the *MapStats for Kids* project, three online activities have thus far been designed. Before these web applications are published for public use, their usefulness to and usability by target users needs to be assessed. Usability testing techniques applied will include questionnaires, expert (teacher) reviews, classroom and individual observations of children engaged in the activities.

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Online learning activities

In the course of the pilot project three online learning activities were designed. The first prototype application is a map-painting instructional game that focuses on several core aspects of statistical, graphical/cartographic, and geographic/civics literacy. Children who play the game learn about the relationship between

Figure 1: “Paint the Map”

bar charts and numbers, state names and locations, the winner-take-all nature of state-level voting in presidential elections, and a variety of representational concepts (e.g., color-coding used to depict categories on the map, bar height to depict magnitudes). Building on feedback provided by FedStats Task Force collaborators, the initial game was redesigned to be more generic (see figure 1). The current version can accept any comparable data set in which totals (or percents) are provided by state for a small number of categories (2-5). Examples include number of individuals employed in different economic sectors or dominant land use types. This and subsequent applications have been designed to be extensible and to accept input data in XML format. Experiments have been conducted using both Java Server and Servlet technologies that offer the potential for direct database connections (Steiner, et al. 2001).

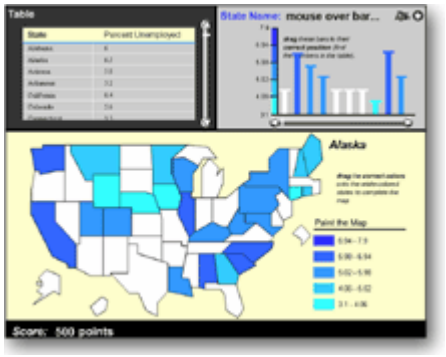

Figure 2: Linked Representation Tool

The second web application is a linked representations tool (see figure 2). The primary goal of this application is to foster an understanding of typical summary statistics through tabular and graphical representations of data. The linked representations tool concentrates on demonstrating and exploring the connections between three alternative ways to visualize information: the table (spreadsheet), the map, and the graph.

The third application (see figure 3) uses a network travel map as the base for addressing a range of learning objectives associated with use of summary statistics in decision-making (again using a game-like format to engage the interest of children who use it through the FedStats web site). Decision-making is an important skill, one that requires keeping the final goal in mind while satisfying constraining conditions. The initial module for this application complements the election map developed as the first application. In this network application module, a "player" uses data presented in a map, table, graphs, and other forms to plan an efficient and effective campaign trip, starting from a randomly generated state capital. Players are responsible for planning a trip that meets a set of constraints (e.g., maximizing the potential audience for campaign stops while minimizing cost/distance). The learning objectives focus on understanding topological relationships and developing problem solving strategies to support spatial decision-making.

Figure 3: The Network Challenge

Usability Assessments

The need to support effective and efficient interactions between humans and computers has fostered the development of a research field for user interface design: human computer interaction (HCI) (Shneiderman 1998, Preim 1999). HCI involves the design, implementation and evaluation of interactive systems in the context of the user's tasks and domains (Helander, et al. 1997). A still-emerging but increasingly significant sub-discipline within HCI is that of software usability. Nielsen (1993) and Shackel (1991) developed usability parameters for software engineering. These usability parameters provide clues about whether the designed software or user interface is (1) easy to learn, (2) efficient to use, (3) easy to remember, (4) preventive of user errors and (5) pleasant to use (Nielsen 1993). Usability has also been defined as an ISO standard; it is "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO 9241-11 1998). Usability can be seen as an overall property of a system, where

- effectiveness defines the extent to which the intended goals are achieved,
- efficiency describes the time, money and mental effort put into reaching goals and
- satisfaction relates to whether the user finds the systems performance acceptable (ISO 9241-11 1998).

Usability is an issue that has become quite important to federal agencies, but to date limited attention has yet been given to usability issues of federal web sites in regard to children. Literature on usability tests involving children (Hanna, Risden & Alexander, 1997) indicate that while middle-school students such as we are targeting are mature enough and generally have sufficient computer skills to be given specific tasks to perform, researchers must be sensitive to children's need to explore, their need for frequent positive reinforcement, and the need to avoid any suggestion that their performance is being "tested" or evaluated in any way

This project includes work toward assessing the usability of the applications being developed and toward matching the applications with specific learning objectives. Specifically, the goals of the use and usability assessment include determining:

- whether the graphical user interface is generally suited for the particular age range (usability),
- whether children can use the application to understand the data represented in the applications (usefulness), and
- how the web applications might appropriately support school curricula (or how existing or new applications should be redesigned/designed to support curricula).

During the spring of 2003 two use and usability assessments will be conducted by team members from the GeoVISTA Center and the Bureau of Labor Statistics (BLS). The study at the GeoVISTA Center will have two parts, an online teacher questionnaire and a lab study involving observation of children (and their parents) working individually with the web applications. To complement the GeoVISTA assessment, a team member from the Bureau of Labor Statistics will organize a series of expert reviews involving teams of media specialists from Maryland counties as well as in-classroom observations of tool use in Montgomery County, MD schools.

Initial input on the use and usability issues will be solicited from elementary and middle schoolteachers. These participants will be invited to work with and review the prototypes on the GeoVISTA Center website and then will be solicited to fill out an online questionnaire. The web-based questionnaire will allow us to

- better understand and therefore match curricula requirements
- build the teacher's domain-specific knowledge into future prototype designs
- receive input from interested teachers throughout the entire U.S.

The teacher questionnaires will be used as a basis to revise the applications developed. The revision is followed by participant observations and interviews with students, grades 4-8. Participating students (accompanied by a parent) will be introduced to a prototype and asked to use the web applications to solve problems or perform tasks. While working with the software, students will be asked to verbalize their thoughts/strategies ("thinking aloud"). An example task of the network game would be to compare the elevations and amount of sunshine at each city (and the distance between cities) to plan a family vacation that begins at a random starting point. Parents will be allowed to assist their children, e.g. by answering their questions for solving the task. During the task-performance phase, verbal and non-verbal data such as gesturing, keystrokes and mouse movement will be collected through videotaping and screen capture. After completing the tasks the students will be interviewed through a structured interview designed to explore their understanding of the application and their understanding of the domain knowledge and related concepts that the application is focused on.

In a two-phase assessment involving the Maryland public schools, BLS will first conduct a series of expert reviews by panels of primary-middle school media specialists in 3-5 Maryland counties. Montgomery County school officials will assist with setting up these panels. These reviews will have two major goals:

- get expert opinions concerning multi-grade educational appropriateness of the applications (relative to such criteria as curricula and test content,) and
- get expert recommendations for modifications to the applications that will increase their attractiveness as teaching tools.

In the second phase of this study (which may not occur until summer-fall 2003), BLS will collect observational data on the manner in which teachers and students in Montgomery County (MD) schools make use of the *MapsStats for Kids* applications in classroom activities. These observational data will be supplemented with structured interview data about the educational value of the materials (from teachers) and the subjective evaluations of student users.

Expected results and outlook

The development of useful and usable online learning activities is the main goal of the *MapsStats for Kids project.* If our web-based applications meet these criteria, the online learning tools might be most likely adopted by teachers and incorporated into the school curricula. The proposed usability assessments will indicate the overall acceptance by teachers and students. In addition, the user studies allow gathering information about the degree to which the abstract cognitive skill set that these applications are oriented to impart is consistent with specific learning objectives that are increasingly imposed on schools by standardized achievement testing. In the present climate of emphasis on showing progress in terms of uniform standards, and in the face of diminishing school budgets, teachers or school officials will almost certainly not adopt, nor even endorse, educational tools that do not "pull their weight" in the classroom. We will strive through continuous involvement of actual educators and students in further development of these web activities to ensure their relevance and attractiveness for adoption and widespread use.

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