

Selecting Virtual Museum Exhibits to Support Classroom Teaching

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Abstract: The use of computers and the Internet is becoming ubiquitous in classroom teaching. Among the wealth of information sources available, one can find many award winning virtual exhibits on museum Web sites. These, with many other museum sites, are intended for use as resources for classroom learning. One question that arises is which criteria teachers use in selection of these sites for classroom use. This paper reports on a study of teachers' and pre-service teachers' selection criteria for evaluating science museum Web sites to support their classroom teaching.

Introduction

There is a traditional meeting place between classroom education and museums that has included student field trips to museum sites and/or visits by museum personnel to the classroom. Museums also offer educational materials and/or projects that teachers can adapt for their students. Museum material may be of a general, informational character or be explicitly tied to the classroom curriculum. During the past 10 to 15 years, much of this material has become available through virtual exhibits published on museum Web sites. This greatly expands the geographical reach of museums and the wealth of informational resources for the educational community.

Since the Web provides a supplemental information source for teachers, it is important to study how this on-line museum material is selected, i.e. the criteria used for selection and inclusion of virtual exhibits as educational resources. Though anyone with access to the Internet is a potential user and learner from museum sites (Haley Goldman & Dierking, 2005), we have focused our work on the selection criteria used for inclusion into classroom teaching. We anticipate that this information is particularly important to the designers and developers of educational Web sites.

Virtual Museum Resources

Museums see a major part of their mission as educating the public about their collections. E. Everett (1969) wrote 40 years ago that: "Computerized information systems that encompass the full spectrum of museum resources will create the opportunity of restructuring the museum environment itself... [and museums] must be prepared to ... marshal and disseminate information pertaining to [their] collections" (p. 29). Since the advent of the Internet, museums have been placing informational materials on the Web regularly. A critical question is if this material is reaching its intended audiences.

Virtual museum resources can be classified according to their support for learning activities (Nordbotten, 2005). This classification can be aligned with an adaptation of Alexander's (2000, 2003) stages of developing expertise/learning as illustrated in Table 1. This classification can be fruitful as a basis to test perception of Web-exhibit utility and thus as a selection criteria for formal education environments.

Learning Task (Alexander, 2000, 2003)	User Communication	Virtual Museum Resource
Knowledge Acquisition	Museum \Rightarrow User	Virtual Exhibit
Developing Competence	Museum \leftrightarrow User	Interactive Exhibit
Extended Knowledge Development	Museum(s) \Leftarrow User	User-Defined Information Gathering

Table 1. Virtual Museum Resources Aligned with Learning Tasks

Educational Use of Museum Materials

What are educational uses for museum materials? Generally, teachers select information resources to gain or update personal knowledge, supplement or update textbooks and to encourage their students to expand their knowledge bases, through projects and reports. Prior research shows that teachers rate museums highly as quality information sources (Klemm, Iding & Speitel, 2001).

With respect to museum materials, student/learner activities include reading for general information gathering and for focused information gathering to answer questions, gathering specific assigned information (i.e., project work), problem solving, (Alexander, 2003) and/or browsing for *free-choice learning* (Haley Goldman & Dierking, 2005). The emphasis on these different activities is determined at least in part, by the knowledge level of the student. Alexander (2000, 2003) describes learning stages in which initial acclimation to a discipline is characterized by the use of “surface-level strategies”, based on reading available texts, while later competence is associated with both surface and “deep processing strategies” like posing questions. Selection of materials to support these activities is determined by the level of the learner, the task objective and not least by availability of appropriate learning materials.

Finally, museums are a known source of quality educational materials (Klemm, Iding & Speitel, 2001). These resources are often accessed through field trips to museums and museum locations. Today, these field trips can be extended into the virtual world. For example, students can study Egyptian history by visiting the tombs of the Valley of the Kings in Egypt at <http://www.thebanmappingproject.com/>, study the art collections in the Russian Hermitage Museum at <http://www.hermitagemuseum.org>, and discuss scientific questions on the BLOG of the Science Museum of Minnesota at <http://www.sciencebuzz.org/blog>, all in the course of a day. The assumption of course is that the teacher(s) have selected these sites as relevant for their educational objectives.

The use of on-line museums has not received much attention in educational research. In one study, Wetterlund (2007) discussed teachers’ reasons for selecting or not selecting to incorporate information from on-line museums in teaching. These reasons typified general reasons for including technology including time limitations, and technology constraints. Wetterlund (2007) also mentioned teacher difficulty in finding the museum resources. The question we seek to determine assumes that the teacher has found a museum site and is reviewing it for potential use. Our question is thus: Which characteristics of Web sites influence teachers in their selection of museum resources as educational materials to support their classroom teaching?

The Study: Determining Selection Criteria for Virtual Museum Use

The principle objective of this project was to elicit criteria used by teachers for selecting virtual exhibits for classroom use. Since it is known that educators trust the quality of museum information (Klemm, Iding & Speitel, 2001), we limited this study to selection criteria for virtual museum exhibits. Further, since site selection criteria will vary according to learning objectives, we have chosen to use sites from the same field of knowledge, in this case, sites that present scientific information. We then employed a survey technique designed to elicit the evaluation criteria used by practicing teachers’ in determining whether to use a virtual museum exhibit site in their science teaching.

Our initial study and this paper follow the general framework of survey development, test site selection, selection of respondents from the educational community, data collection and analysis.

The Evaluation Survey

Our survey was designed to elicit Web site selection criteria in the context of evaluating specific Web sites. In addition to queries typical of general Web site evaluation proposals (Neilson, 2000; Schneiderman, 1998) and evaluation criteria for museum sites (Trant, 2006), we have added queries intended to evaluate a site for educational use. The current version of the survey consists of 5 sections:

1. Section 1 includes an introduction, instructions and a request for demographic data about the respondent. For this study, it was important to determine the respondent's educational background and the position that he/she has or is seeking in the educational system, in particular, if the respondent is focused on elementary or secondary education.
2. Section 2 includes *general usability* characteristics commonly used for Web site evaluation (Neilson, 2000; Schneiderman, 1998). The motivation for this section was to determine the extent that general usability characteristics determine site selection compared to the educational characteristics.
3. Section 3 includes *educational value* characteristics. This section is central to the purpose of our study, which is to determine which educational characteristics are used for site selection.
4. Section 4 seeks to elicit an evaluation of anticipated own usage of the site. This section is intended to provide more information about the reasons for site selection.
5. Section 5 seeks improvement recommendations for the site for educational use. The intent of this section was to capture site characteristics that may not have been included in the previous sections of the survey.

Web Site Selection

Since the objective of this survey was not to compare specific sites, but to study the evaluation criteria used by educators to select sites for use in classroom teaching, we decided to use sites that had won an award as a quality educational site. To further focus the study, we chose sites presenting scientific material. Thus we anticipated that the general usability evaluation would be very good for each site, the usage area would be reasonably consistent, and that differences would be in evaluation of the educational value.

Two virtual museum sites were selected from sites that have been awarded "best educational site" (Museums and the Web, n.d.)

Site A: *Ology*, by the American Museum of Natural History at <http://www.ology.amnh.org> and

Site B: *Making the Modern World*, developed by The Science Museum, London, UK, at <http://www.makingthemodernworld.org.uk/>

The judging committees for the competitions consisted mainly of persons working with the design and/or development of museum Web sites and included both museum and school educators. Both sites received similar commentary with their award. Excerpts from the commentary (Museums and the Web, 2002, 2005) include:

- Usage: Site A: ... *contains an array of projects that easily lend themselves to use in a formal teaching environment.*
Site B: *Learning Modules are an exemplary illustration of what a museum can do with its collections to support specific educational usages for the K-12 educational system.*
- Educational value: Site A: ... *seems to draw users into finding out more about the various subjects. ...inviting students to probe further,*
Site B: ... *learning while keeping the user engaged...*
- Interest: *I have visited this site several times. I have found it to be interesting and engaging with a wealth of information behind the visually pleasing interface.*

Though the sites differ in their intended primary audience with Site A addressing younger/introductory level students, and Site B for more advanced learners, we anticipate that both are good candidates for use in classroom education and thus well suited for eliciting selection criteria.

Participants

The inclusion of new technology into classroom teaching will most likely be done by teachers familiar with both the technologies and the information types available on the Internet. We have assumed that these criteria would be most apparent in young teachers and teachers in training (i.e., pre-service teachers). Our respondents came from 2 sections of a required course for elementary and secondary teachers-in-training, Psychological Foundations of Education, given at the College of Education, University of Hawaii at Manoa and taught by the same instructor.

There were 27 (21 females and 6 males) respondents in this study, including 6 persons identifying themselves as having teaching experience. The participants' average age was 24, ranging from 19 to 50 years, with all but 5 younger than 25.

Procedure

The survey was executed during a regular university-level Psychological Foundations class session. A typical class session meets once per week for 2.5 hours and incorporates whole group discussions, small group activities, and brief lectures on psychological topics important for teachers. As noted above, 2 science sites were used. These were given to alternate respondents, i.e. in an A,B,A,B,A, sequence, such that 14 respondents reviewed site A for their evaluation, while the remaining 13 evaluated site B. Participants were asked to examine "their" Web site and complete the associated surveys.

The respondents were asked to evaluate the Web sites from the perspective of determining whether they would actually use them in their own classroom instruction. They were then asked to describe if and then how they would incorporate (parts of) the site into their teaching. The respondents used from 30 to 60 minutes for their evaluations. The evaluation statements in the survey were evaluated according to a 5-point Likert scale ranging from 5 (strongly agree/highest quality) to 1 (strongly disagree/poorest quality).

For our analysis, the respondents were assumed to come from the same population, based on the fact that all were at the same level in the same educational program.

Results and Discussion

After providing demographic information, the respondents were asked to review "their" site for *general usability* and *educational quality* (the 2nd and 3rd survey sections respectively). Thereafter, we asked the respondents if and how they would use "their" site (survey section #4).

There were 10 site characteristics in each of the general usability and educational quality sections, listed in Tables 2 and 4 below. The average ratings for these criteria for Site A and Site B were 82 and 73 (of 100), respectively. Somewhat unexpectedly, these scores show a significant difference between the site evaluations ($p=0.008$).

Since both sites had received awards for educational quality, we expected that they would be rated highly for classroom use. In fact our respondents split on this. Site A was highly rated, receiving a score of 4.5 out of 5 points for likelihood of selection for classroom use, while Site B received a middle rating of 3.0. The difference is significant at $p=0.005$.

Site characteristic	Site A	Site B
1. Interesting	4.6	3.2
2. Engaging	4.5	3.4
3. Motivating	4.5	3.0
4. Complete	4.3	4.0
5. Up-to-Date	4.2	3.8
6. Design/Presentation	4.7	3.5
7. Easy Navigation	4.6	4.0
8. Usability	4.6	4.0
9. Clear	4.2	3.9
10. Distracting	2.1	2.5
Total (on a scale to 50)	42.3	35.3
Average (mean)	4.2	3.5

Table 2. General Usability Ratings For Web Sites A and B

Since site evaluation appears to be correlated to selection for use, it is interesting to determine if any specific site characteristics can predict usage selection.

General Usability

A comparison of the total ratings for general usability, 42.3 for Site A versus 35.3 for Site B and educational value 39.4 versus 37.5 shows that the difference in site evaluations lies in our survey’s general usability section, where the difference is significant ($p=0.012$). The 10 general usability characteristics included in our survey and their average ratings (based on a 1-5 (highest/best) scale) for the 2 test sites, are shown in Table 2 above. Note that a low score for “*distracting*” is actually a ‘good’ score.

Our list of usability characteristics can be divided into 2 sections: characteristics #1-5 describe the site content, while characteristics 6-10 address aspects of the site layout. An analysis of these 2 groups shows that there is a significant difference in the evaluations of Sites A and B for the site content characteristics at $p= .0006$, while the differences for the design characteristics are not significant. Characteristics #1-5 are known to be important characteristics for learning materials.

Looking more closely, the characteristics with significantly different evaluations were: *interesting*, *engaging*, *motivating* and *design*. A potential problem for our analysis is that the characteristics: *interesting*, *engaging* and *motivating* are highly inter-correlated, as shown in Table 3. Interestingly, the *design* characteristic is only moderately correlated to the interesting/engaging/motivating characteristics.

	Interesting	Engaging	Motivating
Interesting	1		
Engaging	0.71	1	
Motivating	0.87	0.81	1
Design	0.38	0.49	0.50

Table 3. Usability Characteristic Correlations

Educational Quality

The educational quality characteristics focus on 3 educational needs: *information content* (characteristics 11-13), *learning aids* (characteristics 12-14) and *learner level* (characteristics 17-20). Though *site-B* received somewhat lower scores for *information content* and *learning aids*, as shown in Table 4, these were not significantly different from the educational scores given for *site-A*, $p=0.17$.

Characteristic	Site A	Site B
11. Information Content	4.5	4.2
12. Depth of Information	4.2	3.8
13. Links to Related Material	3.6	3.6
14. Teacher Support	3.9	3.9
15. Teacher-Student Support	3.9	3.9
16. Student-Student Support	3.9	3.1
17. Grade K-6	4.5	2.8
18. Grade 7-9	3.9	3.9
19. Grade 10-college	2.9	4.0
20. General public	3.9	4.4
Total	39.4	37.5
Average (Mean)	3.94	3.75

Table 4. Educational Quality Characteristics of Sites A and B

Evaluation of grade appropriateness coincided with and extended beyond the site authors' stated target groups. Interestingly, both sites were rated equally appropriate for the middle school students. It is also an interesting observation that the teachers-in-training believe that the general public would find the children's site so interesting, (mean 3.9).

Own Use

Following the general review of the systems, we asked our respondents our 2 primary questions (in survey section 4): Firstly, would they use "their" site in their teaching, i.e. recommend it for their students? Secondly, would they use "their" site themselves?

1. Recommendations for Student Usage

Since both sites had received awards for educational quality, we expected that they would be rated highly for classroom use. In fact our respondents split on this. Site A was highly rated, receiving an average score of 4.5 out of 5 points for the question 1 above, while Site B received an average rating of 3.0. The difference is significant at $p=0.005$. The evaluation group for Site B (13 respondents) split into 3 groups in their anticipated use of site B: 5 persons gave the middle/neutral score of 3, while 4 gave strong positive recommendations (4 or 5) and 4 gave negative responses (1 or 2).

The most cited anticipated usage for Site A was for topic introduction and extra "reading", while the anticipated use for Site B was as a supplementary resource or for research projects.

2. Anticipated Own Usage

Mean scores were 4.2 and 3.2 for sites A and B respectively, which are not significantly different. Site B was seen as a research oriented source that could be used as background material and secondary information source, while Site A was mainly anticipated as a source for examples.

Site Selection Characteristics

Our goal was to identify site characteristics that can indicate site selection for classroom usage. Comments to this survey indicate that the respondents found Site A "fun" and "enjoyable", while Site B was often labeled "not appealing" or "boring". While these may be reasons for selecting a site for educational use, it would be more helpful if somewhat more objective site characteristics could predict the usage evaluation.

Table 5 shows the correlation between the site characteristics in our survey (without the grade level indicators) and the selection evaluation for classroom use, ordered by decreasing correlation after evaluation for "own use." It is interesting to note that the correlation between own use and student use is not stronger than .7.

As might be expected, characteristics from the *educational quality* and *site content* sets appear as the 5 most correlated to selection of the site for classroom use, while the general usability characteristics appear to be less important for usage selection.

As noted earlier, there is some linear correlation between some of the characteristics, most notably: *interesting, engaging and motivating* as shown in Table 3 followed by *Information content to information timeliness and depth* with correlations of .65, .69, respectively. Surprisingly, *site completeness* is not correlated with *information content*, ($r=0.34$). If we select the strongest indicator from these 2 groups of characteristics and consider only characteristics correlated with selection for classroom use $>.50$, we get *Information content* and *interesting/motivating* as the most indicative characteristics for site selection. It needs to be noted that these are also correlated at 0.74/0.84, which indicates the obvious that a site must have interesting content, presented in a way that motivates/engages the user in order to be selected for classroom use.

Sites A,B	Student Use
<i>Own Use</i>	0.70
1. Information content	0.90
2. Up-to-Date	0.76
3. Depth of information	0.63
3. Interesting	0.63
5. Motivating	0.61
6. Student-student support	0.51
7. Engaging	0.48
8. Easy navigation	0.42
9. Design/Presentation	0.38
9. Usability	0.38
9. Clear	0.38
12. Complete	0.32
13. links to related material	0.29
14. Teacher support	0.26
15. teacher-student support	0.10
16. Distracting	-0.38

Table 5. Correlations between site characteristics and site selection

Implications and Future Research

We believe that this work contributes to understanding how teachers make determinations of informational/educational value when they select virtual museum exhibits for their students' use. Further, we believe that this understanding provides valuable insight that can be utilized in the development of on-line museum exhibits for educational purposes.

Our participants attributed different uses for the two test sites, including introducing a topic (Site A) or as a supplementary source for research projects (Site B). It is unsurprising that the two sites were associated with potentially different uses, given different content on each site. However, inclusion of this duality in museum web sites could expand both audience range and usage areas.

Perhaps contrary to expectation, our study indicates that Web site design, in the form of layout features, does not appear to have a determining influence on the selection of museum exhibit sites for classroom use. Instead, participants reported that characteristics related to information content and to maintaining interest or motivation were most influential in museum Web site selection for classroom use. This indicates that some of the effort currently made in site layout design could be better utilized on developing engaging presentation and expansion of content. This is also encouraging because it indicates that our participants were more influenced by meaningful aspects of the sites and not purely affected by superficial design aspects.

We note that the evaluation of educational quality in this study was performed by relatively young, pre-service teachers who can be assumed to be familiar with many different Web site structures and are adept with Internet technologies, yet are not experienced teachers. In working with virtual museum web sites, this is our ideal target group since they are most likely to incorporate newer web technologies. We also note that the two different sites incorporated different contents that undoubtedly affected our findings. This would limit generalizability, yet the use of actual sites was chosen to ensure ecological validity. In future research, we plan to examine the determinations of participants with varying levels of teaching experience and with various science sites to test the generality of these results. We also plan to capture further information about museum Web site selection by allowing participants to compare sites, and by eliciting descriptive comments/narration from participants regarding their selection processes,

rather than by providing characteristics, as this could enable us to capture other characteristics in addition to the ones provided, that could affect their selection processes. Finally, detailed further research with teachers engaged in unit planning activities and classroom instruction utilizing museum Web sites would be important next steps, as would elucidating learning outcomes for students given different learning tasks, and collecting data from larger numbers of participants.

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