

Pre-service and Beginning Teachers Rate the Utility of Virtual Museum Exhibits

MARIE IDING

University of Hawaii, USA

miding@hawaii.edu

JOAN NORDBOTTEN

University of Bergen, Norway

joan@infomedia.uib.no

This study investigated criteria that 91 pre-service teachers used to evaluate award-winning virtual museum exhibits for future use in teaching. Individual differences affected ratings, including teaching experience, age and gender. A categorization of participants' reasons for selection included audience level, site design and information quality. Implications for further research and incorporation of virtual museum resources in teaching are described.

Introduction

Over the past 20 years, movements away from textbook-oriented instruction have coalesced into various constructivist-influenced approaches, particularly in science education. As a result of this movement, teachers are encouraged to incorporate Web-based information resources into their teaching. However, it has been shown that credibility determinations regarding Web-based resources can vary dramatically, even among university students rating the same Web sites (Iding, Auernheimer, Crosby & Klemm, 2009). Despite these differences, an area where teachers and scientists concur is on the consistently high quality of instructional materials in museum resources (Klemm, Iding & Speitel, 2001).

Museums are increasingly placing materials on-line, which has dramatically increased their audience. The advantage is that more users can gain information about museum exhibits and collections, as well as gain access to digitized resources, such as virtual exhibits and/or the underlying digital collections. Additionally, virtual museums publish high quality instructional materials. These resources may be underused by educators, due to lack of awareness of their existence and tendencies to regard museum resources as “enrichments” associated with fieldtrips, or “extras” for gifted students rather than potentially valuable sources of instructional materials for all students (Eakle, 2009) or as educational experiences to be followed up on in the classroom.

Further, the opportunities to provide learning and engagement may not fully be utilized by museums themselves. As Prosser and Eddisford (2004) contend, “Many museums are failing themselves and their users by creating a digital pastiche of the physical museum rather than seizing the opportunity to extend and enhance the museum learning experience offered by effective use of ICT” (p. 294).

In this paper, we define and describe roles of virtual museums and on-line museum collections, review relevant research, and describe a series of studies in which we examined pre-service teachers’ (i.e., teachers in training) and practicing teachers’ criteria for selection of on-line museum resources for their students. We begin with basic definitions.

Virtual Museums

An on-line museum can be thought of as referring to any form of museum presence on the Internet including web sites that provide hours of operations, calendars for in-house exhibits and events, simulations of visiting a physical museum and the museum e-store, as well as virtual exhibits, access to digital collections and extensive educational resources. Though the concept of *virtual museum* (VM) is sometimes used synonymously for on-line museums, we restrict the concept to the latter elements, particularly to cover virtual exhibits, access to digital collections and to accompanying digitized educational resources.

Purposes of Virtual Museums

In addressing the purposes of virtual museums, it is important to acknowledge changes that have taken place in the museum world, or “new

museology,” over the past 30 years (Srinivasan, Boast, Furner, & Bekvar, 2009). As Srinivasan et al. (2009) explain,

At the core of the new museology is the assumption that the museum is neither a center of research nor primarily a collecting institution, but it is in fact an educational instrument. The goal of the new museology was, and largely still is, the transformation of the museum from a collection of singularly expert accounts to a site of different educational engagements (p. 266).

They further describe the “inherently social” (p. 266) aspect of knowledge acquisition situated in various discourses or narratives and embedded in dynamic cultural contexts and state that:

The intellectual control over the informational content of the museum, its catalog of objects has largely remained in the hands of the museum and its staff of elite experts. The extension of the new museology into museums, over the past 30 years, has introduced a regime where the educator and the marketing manager control the voices of the museum’s presentations for a relatively narrow, selective view of ‘public’ interest. The maintenance of the museum as academic gatekeeper has been replaced by the museum as educational gatekeeper... (p. 267).

In the virtual museum realm, partnerships have been created with educational institutions. For example, Christal, de Montano and Resta (2004) describe a collaboration between the Smithsonian National Museum of the American Indian and teachers, students and others in 19 American Indian Schools. Students interviewed elders and created virtual museum exhibits (http://www.nmai.si.edu/exhibitions/all_roads_are_good/). The authors viewed the project as a way for students to celebrate and draw upon native culture, work with authentic cultural objects in hands-on cooperative ways, and interact with museum experts and community elders in meaningful ways. Indeed, one of the student participants said, “I think that out of all of the school projects we’ve done here, I like this one best because it shows a lot about my heritage” (p. 2318).

In addition to VM use as a way to share, document and engage cultural communities, VM’s can provide ways to foster the participation of students who might not have access to brick and mortar museums, such as students who are geographically remote, or students who do not have access due to disabilities. For example, Bouck, Okolo, Englert and Heutsche (2008) contend that some children with disabilities do not receive social studies in-

struction. They cite research by Patton Polloway and Cronin (1987) which indicated that 50% of special education teachers did not teach history. Also, when history is taught, it is frequently textbook-based which can be difficult for students with learning disabilities, and less interesting than more active approaches. Finally, Bouck et al. argue that current trends are likely to indicate less social studies instruction because it is not counted toward Adequate Yearly Progress in NCLB. In response to this need, they carried out a study in which children with disabilities used a Virtual History Museum environment to learn to “think and act like historians” (p. 21), utilizing multiple points of view, working with virtual exhibits, and being apprenticed as emerging historians.

Educational benefits of Virtual Museums can extend beyond k-12 schools and into the realm of free choice learning or learning throughout the life span. The yearly Museum and the Web conference, <http://conference.archimuse.com>, is a meeting place for museum and related professionals interested in the development of Virtual Museums. Each year this organization selects top Web sites. For 2010, the site is MOMA’s dementia project, a Web site created as an educational resource for adults with dementia, <http://www.moma.org/meetme/index>. The introduction to this site is provided by Dr. Richard Taylor a psychology professor who describes his own experience as a person with dementia and dispels the prevalent notion that people with dementia cannot learn or appreciate the art world.

Finally, Chen (2007) provides a useful summary of the purposes of virtual museums:

First, museums are important places to gather store and display the artifacts of cultural heritage...Museums are cultural protectors...places in which “living memory” is displayed ...Museums therefore are communicators and interpreters of culture and memory...museums are bridges between formal and informal education...Lastly, museums are partners with their communities (p. 424)

Virtual Museum Research and Teachers

There has been a dearth of research examining teachers’ roles in the facilitation of students’ learning from virtual museum resources. One exception is the work of Sayre and Wetterlund (2002, 2007). In 2002, they described a successful partnership between 2 art museums in Minnesota that created an on-line museum resource and worked with statewide teacher

training networks to provide in-services incorporating general technology training and training on the use of the specific on-line museum resource. A later study (Wetterlund (2007) examined teachers' rationales for decisions to use or not use materials from virtual museums in teaching. These reasons included time and technology constraints as well as difficulty in finding the materials.

Overall, we noted that museums have moved far from the dark musty repositories of bones and artifacts from long-dead civilizations that many readers can remember to dynamic interactive and vibrant on-line communities. However, there appears to be a gap between teachers who typically may not utilize virtual museum resources, and the museum and design communities, who intend for resources to be used. Therefore, in the present research, we target pre-service and practicing teachers with limited teaching experience, as we believe these are the newest wave of technology experts who will determine how to make use of museum resources in their classrooms. We provide them with award-winning virtual museum Web sites and have them rate them on various dimensions, so we can determine what their selection criteria are. This work contributes to an understanding of how to best develop virtual museum resources that teachers determine to be useful for their students and how to best connect these resources to their intended audiences.

The Study: Determining Criteria for Virtual Museum Use

This project was focused on eliciting criteria that could predict use of virtual museum exhibits in classroom education. Pre-service teachers were included under an assumption that they would be most familiar with the technology and Web-site presentations. Since site usage criteria will vary according to learning objectives, sites for evaluation were chosen from the same field of knowledge, in this case, sites that present scientific information. Survey data from 91 practicing and pre-service teachers were collected in 4 different sessions, the first in 2006, is described in detail in Iding and Nordbotten (2010).

THE EVALUATION SURVEY

The survey was designed to extract virtual exhibit usage criteria in response to evaluating specific virtual museum Web sites. Questions were included that typify general Web site evaluation instruments (Neilson, 2000;

Schneiderman, 1998) and museum Web site evaluations (Trant, 2006). We added questions to elicit evaluations of sites for educational use. The survey content was modified slightly for follow-up surveys. A significant change was made for execution of the final survey. In the 1st 3 sessions, respondents were asked to evaluate 1 site, while the final survey asked the respondents to compare 2 sites. The differences in the survey design were made in the final section. Each survey form consisted of the following 4 sections:

Section 1 includes an introduction, instructions and requests for *demographic information* from the respondent. This section also elicited educational background of the respondent, and plans to teach at the elementary or secondary levels.

Section 2 includes *general usability* characteristics frequently used for Web site evaluation (Neilson, 2000; Schneiderman, 1998). This section is included to determine whether general usability characteristics influenced site usage.

Section 3 includes *educational value* characteristics. This section is central to the goal of our study, which is to find out which educational characteristics are important for site usage.

Section 4 elicits an evaluation of *anticipated usage* of the Web site, both for the respondent's students and for themselves. Participants were also asked to specify potential uses for the site, for example to introduce a topic, or as a research resource.

The 1st study contained a numbered 5th section which sought 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.

Following analysis of the data from the 1st survey a revised survey layout was implemented.

1. For the 2nd and 3rd surveys, questions from the original section 5 were included in section 4.
2. In the final study, the section 4 improvement questions were replaced by comparative questions including which site the respondent preferred for teaching and the reasons for this choice.

Sections 2-4 (5) included a comment area for each evaluation point. Respondents were also encouraged to add comments at the end of the survey. Though the survey layout varied somewhat for the different administrations, the core content was the same, allowing data aggregation over the 4 data collection sessions.

TEST SITE SELECTION

Because the objective of this study was to elicit criteria that teachers used to select a virtual exhibit to include in their own teaching and not to compare exhibits, award-winning exhibits for educational quality were used. Awards were given by the Museums and the Web conferences (Museums and the Web, n.d.)¹. To delimit our focus further, we selected sites that focused on scientific information. Thus we hypothesized that general usability evaluations would be positive for the selected sites, and that most differences that would emerge would be in educational value. Though all exhibits have been developed by science museums, their primary focus audience differs, as indicated in Table 1. It was felt that this could be an advantage in determining general selection criteria. The 4 virtual exhibits selected for this study are given in Table 1. The current version of the exhibits at the time of the study were used.

Table 1
Selected museum sites

Site url	Presenter	Primary audience	Date of award ¹
Ology http://www.ology.amnh.org	American Museum of Natural History AMNH	Elementary school	2002
Making of the Modern World http://www.makingthetmodernworld.org.uk/	Science Museum, London, UK	High school – adult	2006
Science Buzz http://www.sciencebuzz.org/	Science Museum of Minnesota	Middle school	2006
Exploratorium http://www.exploratorium.edu/	Museum of Science, Art and Human Perception. San Francisco, CA	Middle school – adult	1997

Committees who judge these awards consist of people working on the design or development of museum Web sites, including museum and school

¹ The list of all MW award winning sites can be found at http://conference.archimuse.com/page/best_web_awards.

educators. The sites received similar comments associated with their awards as illustrated below (Museums and the Web, 2002, 2006) and as described in Iding and Nordbotten (2010):

- *... contains an array of projects that easily lend themselves to use in a formal teaching environment.*
- *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.*
- *... seems to draw users into finding out more about the various subjects. ...inviting students to probe further,*
- *learning while keeping the user engaged...*

Thus, though the sites vary in terms of intended audiences and formats, each is determined to be a good choice for inclusion in teaching and is therefore also useful for eliciting usage criteria.

PARTICIPANTS

We have assumed that including new technology in classroom teaching will most likely be done by teachers familiar both with the technologies and the information types available on the Internet. We have further assumed that these characteristics would be most evident in new teachers and pre-service teachers (i.e., teachers in training). The respondents for this study came from 8 sections of a required course for elementary and secondary teachers-in-training, *Psychological Foundations of Education*, given in 4 different terms by the College of Education, University of Hawaii at Manoa and taught by the same instructor. Note that the data for the 3rd study was collected from students of this course taken in American Samoa, a U.S territory. Note also, that each respondent in the 4th study submitted evaluations for 2 sites. Table 2 gives the distribution of the respondents.

Table 2

Survey sessions

Survey session	Date/place	Site-1	Respondent surveys	Site-2	Respondent Surveys
1	2006; UH	ology	14	Modern World	13
2	Sp2009; UH	ology	11	Science Buzz	7

Table 2 continued

Survey session	Date/place	Site-1	Respondent surveys	Site-2	Respondent Surveys
3	Summer 2009 AmSamoa	ology	5	Exploratorium	13
4	Fall09; UH	Ology	18	Exploratorium	18
	Totals		48		51

There were a total of 99 respondent surveys, from 73 females and 26 males in this study. Thirty-six of these are from practicing teachers (although they are working on requirements for initial licensure). The average age was 25.5, ranging from 18 to 55 years, with all but 23 younger than 25. Less than half of the respondents indicated their goal teaching level. Of those who did, 31 indicated- pre or elementary school teaching and 13 indicated middle or high school teaching. 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.

PROCEDURE

As indicated above and in Table 3, the surveys were administered 4 times, in 4 different semesters. Each study was executed during a regular university-level Psychological Foundations class session. A typical class session meets once per week for 2.5 hours and covers basic educational psychology topics important for teachers. The survey was administered during a regular class session.

Each study included evaluation of 2 science sites one for an elementary school audience, the other for a middle/high school audience. The respondents were asked to evaluate their assigned virtual exhibit from the perspective of determining whether they would actually use this site 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. Evaluation of the site characteristics were given according to a 5-point Likert scale ranging from 5 (strongly agree/highest quality) to 1 (strongly disagree/poorest quality).

In the first 3 studies, the 2 exhibits were given to alternate participants, i.e. in an A,B,A,B,A, sequence. In the 4th survey, each participant was asked to examine two exhibits. They were then asked to select the exhibit they felt

would be most useful for educational purposes and to give the selection criteria used. The 4th study participants received 1 of 2 exhibit sequences for this study; elementary school audience then middle school audience or the reverse. Note that the Ology exhibit, whose primary audience was for elementary school students, was used in all studies.

Participants were free to choose to submit their surveys for the study. In all, we received 99 completed surveys. As shown in Table 2 above, evaluation data were collected for 4 different science sites: Ology (48 respondents), Exploratorium (31 respondents), Modern World (13 respondents) and Science Buzz (7 respondents). In the final study, 18 respondents evaluated both the Ology and Exploratorium sites, 7 evaluating the Ology site first and 11 evaluating the Exploratorium site first. In the following, only the Ology and Exploratorium data will be used, as there were too few data for analysis of the last 2 sites.

RESULTS AND DISCUSSION

The test exhibits address 2 potentially overlapping audiences – elementary and middle school students. The evaluators included pre-service and active teachers planning for and teaching students from preschool through high school.

Exhibit evaluation for elementary school students

Before aggregating the data collected for the Ology site evaluation, a comparison of the evaluations from the different groups was made. It was discovered that there appeared to be a significant difference ($p=0.000012$) in the 4th study between the evaluations done as the first site and as the second site. Since the respondents in studies #1-3 only evaluated 1 site, it was determined to include only the 1st site evaluation from study 4. This gave evaluation data from 37 respondents. These data were analyzed to determine if there were significant differences between members of the overlapping sub-groups: teacher-student, male-female and young (<25)- older (>25). The average ratings² for site characteristics, given by members of each respondent group are shown in Table 3 below. Note that the “usefulness” rating is the average of scores given to the questions:

“Please rate the likelihood of your actually using materials from this Web site with your students in conjunction with a relevant lesson.” And

2 Using a Likert scale 1-5, in which 5 represents the ‘best’ rating.

“Please rate the likelihood of your actually using materials from this Web site for yourself in teaching a relevant class”

Table 3
Ology evaluations -a site for elementary school students

Group	N	General site design	Educational quality	Usefulness
All respondents	37	4.2	4.1	4.0
Teacher	10	4.0	3.7	3.5
Student	27	4.3	4.2	4.3
Male	10	4.0	4.0	3.6
Female	27	4.3	4.0	4.3
Age <25	29	4.3	4.0	4.2
Age >24	8	4.1	4.2	3.8

There are some significant differences³ between the members of the above groups in their evaluation of the elementary school site.

- Practicing teachers were significantly more *reserved* than pre-service teachers in their evaluations of both general site design and educational quality, rating them less highly $p=0.0116$ and $p=0.0028$ respectively. It is possible that respondents with some teaching experience had more stringent standards for these characteristics than their less experienced counterparts.
- Males gave significantly *lower* ratings for general site design than females; $p=0.00087$, while there was no significant difference in their evaluation of the educational quality.
- Older respondents (mostly practicing teachers) gave significantly *higher* ratings for educational quality, than younger (predominantly pre-service teachers) respondents; $p=0.0164$, while evaluation of the site design was equivalent for these 2 groups.

For all groups, there were too few evaluation criteria to calculate sig-

3 Calculated using the Excel t-test

nificant differences for the “usefulness” questions. However, it appears that students, young respondents and females found this site more useful than teachers, older respondents and males. Those who found the site more useful might have been more captivated by a site that was aimed at a younger audience, providing an interdisciplinary approach to natural science that incorporated a great deal of social science influence.

Evaluation of an Exhibit for Middle School Students

It is interesting to determine if site evaluation is similar across sites addressed to different educational levels. In an attempt to study this, we’ve chosen the Exploratorium site as a representative for sites which present material focused towards middle school students. Table 4 presents the summary evaluations for the evaluator groups.

Table 4
Exploratorium evaluation – a site for middle school students

Group	N	General site design	Educational quality	Usefulness
All respondents	31	4.1	4.2	4.2
Teacher	13	4.3	4.2	4.3
Student	18	3.8	4.2	4.1
Male	10	4.2	4.3	4.6
Female	21	3.9	4.2	4.1
Age <25	21	3.9	4.2	4.2
Age >24	10	4.3	4.2	4.3

It appears that all respondents viewed this site as more useful than the site focused on elementary school students. They also agreed on its educational qualities. This may well be due to the added depth and breadth of information contained in this site aimed at an older user audience.

None-the-less, there are some significant differences between groups in their evaluation of the Exploratorium site.

- Practicing teachers were significantly more *positive* than pre-service teachers in their evaluations of the general site design, $p=0.0125$, while there was no difference in their evaluation of educational quality.
- Males gave significantly *higher* ratings for general site design than females; $p=0.0333$, while there was no significant difference in their evaluation of the educational quality.
- Older respondents (mostly practicing teachers) gave significantly *higher* ratings for site design and content than younger (predominantly pre-service teachers) respondents; $p=0.0067$, while there was no difference in their ratings of the educational content.
- Students, young respondents and females found this site *less* useful than teachers, older respondents and males. This is the opposite of the evaluations for the site for elementary school students and may reflect the respondents' own images or "mental models" of "students" as those that they plan to teach.

As anticipated, site design and content were rated highly; generally > 4.0 on the Likert scale. Notably all groups rated the educational quality of the middle school site highly. The high ratings for this site could have been due at least in part to the more advanced level of science presented. In contrast, there was more variation in the evaluations of site design and content for both sites and in educational quality for the elementary school site. Table 5 shows the direction of the ratings between the respondent groups in their evaluation of the two sites, here labeled E: for elementary school site and M: for middle school site.

Table 5
Variations in site evaluation

Group	N		General Site Design		Educational Quality	
	E	M	E	M	E	M
Teacher	10	13	-	+	-	=
Student	27	18	+	-	+	=

Table 5 continued

Group	N		General Site Design		Educational Quality	
Male	10	10	-	+	=	=
Female	27	21	+	-	=	=
Age <25	29	21	=	+	-	=
Age >24	8	10	=	-	+	=

It is interesting to note that males and teachers had similar ratings for the sites. The overlap between these two groups is less than 1/3.

Selection criteria for student use

The respondents were asked if they would use ‘their’ site in their classroom teaching. These evaluations were correlated with the site design and educational quality characteristics in an attempt to determine site characteristics that trigger selection for student use. The results varied widely. Tables 6a and 6b give the top 3 correlation criteria for each group for the elementary and secondary school sites. Note that the characteristics “engaging, interesting and motivating” are internally correlated.

Table 6

Summary of correlation between site characteristics and “selection for student use”

By respondent category

Table 6a

Ology - for elementary school students

top site characteristics	M	F	T	S	age >25	age <25	#groups
Use for yourself	0.950	0.795	0.800	0.891	0.967	0.787	6
Information content	0.894		0.781		0.841		3
Up-to-Date	0.907			0.795			2

Table 6a continued

top site characteristics	M	F	T	S	age >25	age <25	#groups
Engaging			0.784			0.514	2
Interesting		0.655			0.851		2
Teacher support		0.621					1
Student-student support				0.550			1
Motivating						0.492	1
<i>Strength</i>	<i>2.752</i>	<i>2.071</i>	<i>2.365</i>	<i>2.236</i>	<i>2.660</i>	<i>1.792</i>	

Table 6b

Exploratorium - for middle school students

Top site characteristics	M	F	T	S	age >25	age <25	#groups
Use for yourself	0.899	0.569	0.458	0.768	0.395	0.761	6
Interesting presentation	0.668			0.751		0.625	3
Free from distractions	0.580		0.553		0.424		3
Clear purpose		0.506		0.786		0.651	3
Student-student support			0.452		0.561		2
Teacher support		0.503					1
<i>Strength (sum)</i>	<i>2.147</i>	<i>1.579</i>	<i>1.462</i>	<i>2.304</i>	<i>1.380</i>	<i>2.037</i>	

The last row of the table shows the “strength” of the indicators for each group. Males and respondents over 24 years had relatively strong correlations between site characteristics and selection for student use for the elementary school site. The correlations were less strong for the other groups and the middle school site.

The strongest correlations between the site ratings indicate that the respondents selected sites for their students that they would use themselves. This held for both sites and thereby for both student levels. Thereafter, there was a divergence between the respondent groups in the site characteristics that correlated with selection for student use.

- Educational characteristics correlated most highly with selection for use for elementary-school students.
- Design characteristics correlated most highly with selection for use for middle-school students. Note though, that these correlations are not strong.

A somewhat different picture is given in the comparative study in which respondents were asked to select the ‘best’ site for student use and to give their reasons for their choice. There were 18 respondents in this survey, 5 of them (3 females and 4 who reviewed the Exploratorium site first) did not choose, but rather gave criteria they would use for selection of both sites. All respondents were pre-service teachers. The results are summarized in Table 7 below.

Table 7
Aggregated selection criteria

Respondent	N =23		Elementary School Site (11)		Middle School Site (12)	
	Male	Female				
Pre-Service Teachers	9	14	2	9	7	5
AD DA seq		23		11		12
	8	15	4	7	4	8
Aggregated reasons for selection	Count	Sum ²	Count	Sum	Count	Sum
Audience level	13	121	6	56	7	65
Design quality	11	105	6	58	5	47
Information quality	10	93	3	24	7	69
Interaction	7	59	5	45	2	14
Motivating	5	48	4	39	1	9
Educational support tools	4	31	1	7	3	24
Technological appeal	3	27	0	0	3	27

Due to the low number of respondents, it is not possible to study the respondent groups as done previously. However, some general observations can be made. The selection criteria mentioned varied quite a bit and differed from those determined through the correlation analysis above. Thirteen respondents (57%) noted relevant audience level as an important selection criteria (average score 9.3 on the scale of 1-10). Further:

- Design quality characteristics were given most often – 6 of 11 respondents (55%) – for selection for elementary school use, while
- Information quality characteristics were given most often – 7 of 12 respondents (58%) – for selection for middle school use.
- Interaction characteristics were highlighted by 1/3 of the respondents.
- Educational support tools were noted by 4 (17%) of the respondents.

CONCLUSIONS FROM THIS STUDY

As noted above, the site characteristics that correlate with site selection for student use are not the same as those given when respondents were asked to select a site and give their reasons for this selection. An ‘immediate’ conclusion could be that our survey was unable to elicit the ‘real’ reasons for site selection. An alternative conclusion could be that selection of a site is dependent on the reviewer’s current need, which may change over time.

However, we did discover some indicators that appear to be associated with reviewer characteristics:

- Practicing teachers tended to look for information content.
- Males tended to look for depth and coverage of information.
- Females and pre-service teachers tended to look for presentation quality, though this may be affected by the high overlap between these 2 groups.

We interpret these potential gender differences cautiously as we did not have a large number of male respondents.

IMPLICATIONS AND FUTURE RESEARCH

Our study indicates that teachers set different emphases on web-site characteristics for use at the elementary and middle school levels and can have different emphases depending upon user characteristics (individual differences, such as gender and amount of teaching experience) and immediate application goals. Future work should delineate aspects of these individual differences and user preferences of teachers as they design and carry out extended instruction such as unit plans utilizing virtual museum resources. The use of interviews and think-aloud protocols as teachers plan instruction and evaluate Web sites would enhance this work as well.

Thus, more studies are needed to confirm virtual exhibit selection criteria. However, we believe that this work does contribute to an initial understanding of how teachers evaluate virtual museum sites that they may consider using in classroom instruction. This area of research is also valuable in drawing attention to high quality museum resources that may be more widely made use of by educators. Finally, studies such as this can form useful bridges between classroom educators and virtual museum developers, as both audiences can benefit by understanding teachers' selection criteria in working with Web sites.

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Notes

1 Current versions of the sites were used for this study.

2 The reasons for selection were coded giving 10 points for the first reason, 9 points for the 2nd, 8 points for the 3rd, etc. The average number of reasons given by the respondents was 2.7, ranging from 1-4. The sum given in columns 3, 5 and 7 is the sum of the scores given for each selection reason.