Youth as Design Partners: Age-Appropriate Websites for Middle and High School Students

By: Anthony S. Chow, Kathelene McCarty Smith, and Katherine Sun

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Keywords: Age-appropriate web design | Youth information seeking | Youth digital environments | Web design | Iterative design

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Youth as Design Partners: Age-Appropriate Websites for Middle and High School Students

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ABSTRACT

This study explored the impact of using best practices identified in previous studies in designing age-appropriate websites for middle and high school youth. Utilizing a mixed-method approach, 31 middle and 22 high school youth took part in six focus groups across four states. Participants were introduced to a website specifically designed for either middle or high school youth, asked to discuss their overall opinions of content and interface design, and then asked to rate their overall first impressions of the site. Satisfaction ratings for both groups increased for each design iteration (high school from 6.2 to 8.0; middle school from 6.7 to 8.25) and the results validate previous findings that unique differences exist between middle and high school user preferences. Chi-Square tests (p=.05) suggest middle school website ratings increased significantly while high school website ratings, which improved, remained inconclusive. The implications of the study include a youth website design checklist for both middle and high school youth and the introduction of a new construct, *concept actualization*, which reflects the need for designers to shift from adult to youth oriented paradigms when designing digital environments through close collaboration between adult and youth designers.

Keywords

Age-appropriate web design, Youth information seeking, Youth digital environments, Web design, Iterative design

Introduction

One of the principle web design challenges is designing an interface and information architecture that presents information to different user groups on an appropriate cognitive and affective level. In the fast paced world of information seeking on the Web, designers have only 25-35 seconds to capture and engage a user's attention (Nielsen & Loranger, 2006). While there are design guidelines to increase the likelihood that a user will find a site engaging, designing age-appropriate websites for youth is uniquely challenging because site developers are typically adults far removed from the perspective of the youth age-group they are trying to reach. As Scaife and Rogers (1999) note, "Kids are aware of aspects of the use of technology that we [adults] are not sensitive to and that we need to be told of" (Large, Beheshti, & Rahman, 2002, p. 79).

Children of today, born after the emergence of the Internet, are considered millenials (Considine, Horton, & Moorman, 2009) that have been born digital and raised as "Digital Natives" (Margaryan, Littlejohn, & Vojt, 2011; Prensky, 2001). Everyone else can be considered digital immigrants and, "As educators, we need to be thinking about how to teach both Legacy and Future content in the language of the Digital Natives" (Prensky, 2001, p. 4). According to Prensky (2009), the pervasiveness of digital devices and environments in our day-to-day lives coalesce into a *digital wisdom* characterized by two major facets: "He or she accepts digital enhancement as an integral fact of human existence, and he or she is digitally wise, both in the considered way he or she accesses the power of digital enhancements to complement innate abilities and in the way in which he or she uses enhancements to facilitate wiser decision making" (Prensky, 2009, p. 3-4).

Technology is a ubiquitous presence and as much a part of daily life for most children as going outside to play, riding their bike, or reading a book. It offers opportunities for exploration, interaction, and social collaboration. In fact, a recent 2011 study found that 97% of all virtual accounts are registered to users 25 years or younger and that 22% are age 5-10 and 46% are age 10-15 (Chow & Bucknall, 2011). Seventy-seven percent of all US households have Internet access (Internet World Stats, 2010); 92.3% of K-12 students use a computer at school (US Census Bureau, 2003) and over 77% of households with children ages 6-17 have Internet access (US Census Bureau, 2009).

Being a Digital Native, however, is not synonymous with information seeking expertise as, "their extensive use of ICT often creates a false sense of competency, as well as the misperception among many adults that contemporary youth are "media savvy." Hands on is not the same as heads on" (Considine & Horton, 2009, p. 472). While there is a growing body of literature on the cognitive, affective, and information seeking habits of children and adolescents, there is a scarcity of research on how to apply this information to the design of information portals for youth that are increasingly proliferating the web for social, educational, and entertainment purposes.

Theoretical framework

One of the greatest challenges for educators today is negotiating effectively the paradox of utilizing a work force of digital immigrants or teachers who have not grown up with technology (Margaryan, Littlejohn, & Vojt, 2011) teaching a generation of youth who are Digital Natives, those who have grown up with access to the Internet and a wide array of information and communication technologies (ICTs) (Considine, Horton, & Moorman, 2009). Social interaction and communication appears to be a key component in this paradox. Schools frequently ban social networking sites like Facebook, MySpace, and YouTube and restrict the Internet in general, failing to realize that these technologies are not only mere environments for play but also a fundamental way in which today's youth communicate, think, express themselves, and contribute and receive information. Such a disconnect represents an unexplored pathway to potentially vibrant resonance between educator and student: "If there is a crisis in today's schools, it probably has more to do with students' perceptions that school is boring and largely irrelevant to preparation for life outside school" (Considine, Horton, & Moorman, 2009, p. 473; National School Boards Association, 2007; Prensky, 2008a). Prensky (2008a) refers to much of the content being taught in today's schools as a "backup education"—content and knowledge of the past that is largely disconnected from preparation for the future. This educational paradigm paradox between Digital Immigrants attempting to prepare Digital Natives for a future in a digital world posits a seminal question to all educators: "What will serve our kids better in 20 years—memorized multiplication tables or fundamental knowledge of programming concepts? Long division algorithms or the ability to think logically and to estimate? The ability to write cursive handwriting or the ability to create meaningfully in multimedia?" (Prensky, 2008b, p. 3).

A paradigm shift is necessary for adult educators and information designers to understand the dynamics of this paradox; that spaces intended for youth must incorporate their unique, developing perspectives, values, and likes/dislikes. In order to design age-appropriate information spaces for youth it is critical to understand how they seek and process information and to what extent these differ from adults. Current literature suggests pronounced differences in information seeking behavior amongst adult users, high school students, and middle school students (Blowers & Bryan, 2004; Buckleitner, 2008; Cai & Zhao, 2010; Considine, Horton, & Moorman, 2009; Cooper, 2005; Large & Beheshti, 2005; Nielsen, 2005). For the purposes of this study, research on the similarities and differences between high school age users (15 to 18 years) and middle school age users (11 to 14 years) will be explored in order to conceptualize websites that meet the divergent needs, perspectives, and expectations of youth information seekers.

Children and adolescent web information seeking behavior: Age-specific cognitive and affective states

Blowers and Bryan (2004) define "children" as four discrete groups based on reading ability: pre-readers (age 3-5), beginning readers (age 5-8), intermediate readers (preteens age 9-12), and teen readers (age 13-17) (Dubroy, 2010). Piaget's theory of cognitive development represents a useful framework from which to understand children and adolescent cognitive abilities (Huitt & Hummel, 2003). Children younger than three are typically in Piaget's sensory motor stage where taste, touch, and motor coordination are the major cognitive challenges and therefore children in this age group are not likely to be able to use computers effectively (Cooper, 2005; Haugland, 2000). Children in the pre-reader (age 3-5) and beginning reader (age 5-8) groups are in preschool and early primary school. They considered to be in Piaget's pre-operational stage where ego-centrism is the primary lens in which the world is perceived (Huitt & Hummel, 2003) and "they are individualistic, self-centered, and expect others to have their perspective" (Cooper, 2005, p. 288). Intermediate, preteen readers (age 9-12) are in the concrete operational stage where "intelligence is demonstrated through logical and systematic manipulation of symbols related to concrete objects" (Huitt & Hummel, 2003). Trial-and-error with physical not abstract objects is how children of this age understand the world and in the digital environment a "… list of alphabet citations may mean much less to children

at this level than an electronic display of familiar book covers" (Cooper, 2005, p. 288). Adolescent teen readers (age 13-17) are in the formal operational stage where intelligence matures to a "…logical use of symbols related to abstract concepts" (Huitt & Hummel, 2003). Information seekers of this age represent emerging adults who reflect similar adult information seeking behaviors.

Information processing research has found that children vary in their cognitive ability to store and retrieve information based on their age driven by two central information processing deficiencies—production and meditational (Cai & Zhao, 2010). Production deficiencies reflect a child's inability to utilize appropriate storage and retrieval strategies without external prompts; meditational deficiencies refer to a children's inability to implement effectively storage and retrieval strategies even if prompted (Cai & Zhao, 2010). Children younger than seven years old are considered to suffer from meditational deficiencies and are referred to as "limited processors" while children between seven and eleven years of age are considered "cued processors" that suffer from production deficiencies and are unable to process information effectively without explicit cues. Older children (around 12 and older) usually no longer have these cognitive deficiencies and are called "strategic processors." (Cai & Zhao, 2010)

Children over six begin to develop more advanced technological and cognitive skills—they start to understand digital avatars represent characters they can take care of and become friends with. Their overall tolerance threshold is higher; they tend to still follow rules explicitly, and in general are more skilled with the computer, mouse, and userids and passwords (Buckleitner, 2008).

Adolescent information seeking (14-18)

Research studies have found that children's information-seeking behavior is largely defined by browsing rather than specific keyword searches (Large, Beheshti, Clement, Tabatabae, & Yin Tarn, 2009). A typical high school aged information seeker (14-18 years old) has a short attention span, is easily bored, prefers scanning material quickly instead of reading (Fidel et al, 1999), and similar to adults, prefers larger font sizes (DiMichele, 2007; Nielsen, 2005). One research study found that "…students rarely progressed in a linear search, but instead would repeatedly return to a "landmark" page, a finding supported by Wallace, Kupperman, Krajcik, and Soloway (2000)" (Large, Beheshti, & Rahman, 2002, p. 80). Because older children have higher order cognitive abilities, their information seeking behavior are similar to adults—"They can, under the right conditions, apply a wide repertoire of decision-making strategies, quickly eliminate alternatives, and focus their attention on information central to achieving their goal" (Rose, Rose, & Blodgett, 2009, p. 6).

Youth information seekers will tend to gravitate to sites that are easy-to-use, have clean designs with "cool" graphics, and contain interactive features such as online quizzes, voting, and games; of particular interest are web 2.0 technologies that allow for social expression and interactivity with others through on-line forums, message boards, and Wikis (DiMichele, 2007; Nielsen, 2005). Youth information seekers enjoy vivid photographs that engage their attention and interest (DiMichele, 2007) and prefer scanning a site's graphics for visual cues that allows them to determine at a glance, a site's perceived relevance and quality of information (Fidel et al., 1999). Typical "distractions," such as moving images or scrolling information, are usually disdainfully ignored. When there is a need to obtain directions or instructions, the student's preference is to receive them as illustrations instead of text (Milligan & Murdock, 1996) and, when text is necessary, they favor concise information in large font.

When exploring websites, youth tend to be repelled by sites with visual designs perceived as "kid" focused including childish content, images, or color schemes (Nielsen, 2005). They may also become quickly frustrated with problems resulting from Internet related issues that impede searches such as sluggish web responses, slow downloading sites, and sites which are under construction, as well as human errors such as spelling mistakes and incorrect URLs (Fidel et al., 1999). Not surprisingly, the "back" button is used frequently as a fundamental search feature and is often considered a safeguard when the student gets lost (Fidel et al., 1999).

Although youth are willing to scroll to access information, it is not preferred. If scrolling side-to-side is required, it most likely will not occur (DiMichele, 2007) and information below the "fold" on a computer monitor that can only be found by scrolling down the screen, will largely remain unseen as they move onto other sites. Information is primarily found by moving quickly from one website to another (Fidel et al., 1999).

Pre-adolescent information seeking (10-13)

The typical middle school information seeker (10-13 years of age) shares some similarities with a high school counterpart, preferring visual cues to text and not liking to scroll. The primary information goal, however, resides more with interest and exploration than identification and access to a specific information goal. The middle school student needs bright and engaging colors that attract attention and keeps him or her interested (Large, Beheshti, & Rahman, 2002). Sites that are most appealing are found to be visually pleasing and usually include the use of animation, sound effects (Neilson, 2005), and bright colors throughout the background and the foreground of the site. Middle school students also like creative and significant icons, easily remembered URLs, and well thought-out portal names (Large et al., 2002). They also prefer browsing to searching; only reverting to another approach when information cannot be easily found (Large, Beheshti, Nesset, & Bowler, 2006).

This age group shows a general dislike for scrolling and has a preference for subject categories that can be browsed for more rapid information retrieval. As with high school web users, they do not readily employ help features such as spell-check and become easily frustrated by a lack of immediate success in retrieving desired information. This frustration may be caused by misspellings, resulting in unsuccessful searches (Large et al., 2006) as well as a lack of skill and an underdeveloped knowledge of the use of search engines (Bilal, 2002).

Interestingly, preference for animation depends on the website and information-seeking goals. While middle school students, especially those under 12 years of age, really enjoy animation (Nielson, 2005) and graphics, they can become irritated when it distracts from the information seeking process (Cooke, 1999; Sullivan, Norris, Peet, & Soloway, 2000). When they enter high school, there is a heightened disdain for animation that distracts from general scanning of information.

Age-appropriate web design for children and adolescents

Contrary to common belief, although high school students may be well-versed in the use of iPods and iPhones and may have grown up utilizing computer technology, surfing the Internet, and texting, they are not “techno-wizards” who intuitively and expertly understand how to navigate the Internet for information seeking purposes (DiMichele, 2007; Nielsen, 2005). A study conducted by the British Library found that while the, “‘Google generation’ could access materials, their ability to process those texts was somewhat limited. Online search strategies of this age group are characterized as “skimming and squirreling behavior” (Considine, Horton, & Moorman, 2009, p. 475). The report concluded that today’s youth did not have a strong understanding of their own information needs, had difficulty utilizing effective information seeking strategies, and spent little time processing whether the information they found was either accurate, relevant, or from a trusted source (Considine, Horton, & Moorman, 2009).

There is a growing body of knowledge about designing youth oriented websites (Cooper, 2005; Druin et al., 1999; Harding, Szakacs, & Parry, 2009; Large et al., 2004, 2005, 2007; Taxen et al., 2001). Some design methodologies include Druin et al.’s (1999) cooperative inquiry, Read et al.’s (2002) participatory design, and Large et al.’s (2006) bonded design (see Harding et al., 2009). Cooper (2005) suggests that a youth website should emphasize user control, be open-ended (encouraging exploration), active (as opposed to passive), involve multiple senses, offer quick feedback, balance novelty with familiarity, allow for and be responsive to child input, allow for progressive levels of expertise facilitating competence while offering new challenges, and support social interaction (Appel & O'Cara, 2001; Cooper, 2005; Clements & Samara, 2003; Davidson & Wright, 1994; Haugland, 2000; NAEYC, 1996; Van Scoter, Ellis, & Railsback, 2001).

Websites for children should be “colorful, relevant, and easy-to-use” (Dubroy, 2010, p. 213). While animation and interactivity are important care must be given to ensuring its use is not “gratuitous” and that “bells and whistles are useless if the content is irrelevant (Blowers & Bryan, 2004). Design should be simple and easy to navigate; in a study of 55 children, Nielsen (2002) actually found that children tended to have an easier time navigating websites for adults rather than children because children’s sites oftentimes are “convoluted” (Dubroy, 2010).

The use of metaphors and help features are important website elements that can help reduce cognitive load for children; metaphors help scaffold new information being presented to preexisting mental structures and images

(Large & Beheshti, 2005). Help features have been found to be extremely important to children (Bilal, 2005; Nielsen, 2005).

Figure 1 summarizes and compares some of the major differences between younger groups and adult information seekers.

Nielsen's web design table across users

	Animation and sound effects	Mine sweeping for links	Advertising	Scrolling	Reading
Kids	☺	☺	☺	☹	☹
Teens	😐	☹	😐	😐	☹
Adults	☹	☹	☹	☺	😐

Key:

☺ Enjoyable, interesting, and appealing, or users can easily adjust to it.

😐 Users might appreciate it to some extent, but overuse can be problematic.

☹ Users dislike it, don't do it, or find it difficult to operate.

Source: Nielsen, 2005

Figure 1. Nielsen's **k**ids, **t**eens, and **a**dult **p**references

As differences between youth and adult information seeking needs are made clearer through research, there is a need for a design model to help guide designers and developers of youth oriented online resources. Druin's (2002) youth design model, although it does not specifically address teenagers, suggests that, see Figure 2, representative users should be part of the design team from the very beginning, serving multiple roles through the design and development cycle as it evolves (Druin, 2002).

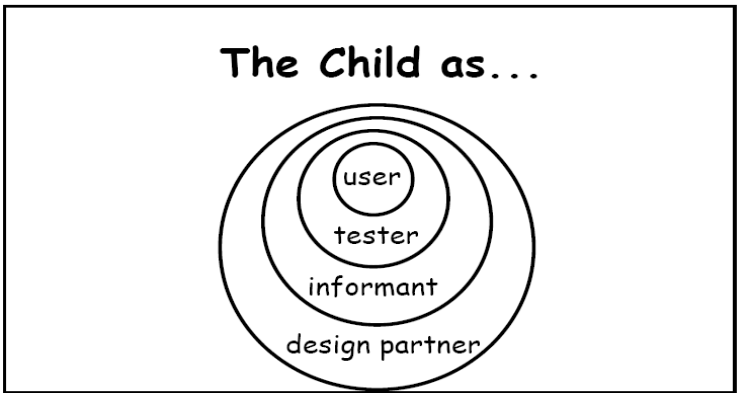

Figure 2. Including children in the web design process in multiple ways (Druin, 2002)

While Druin's model provides a general framework for how to ensure youth are included throughout the design cycle, more specific guidelines and a roadmap for how to properly include youth in the design and development process is needed.

Purpose and rationale

The purpose of our study was to answer three primary research questions:

RQ1: How do you design a website for diverse populations spanning middle school to high school users?

RQ2: Do middle school and high school students have different information needs?

RQ3: What are the "best practices" for websites designed for middle and high school youth?

The significance of the study rests on a recommended web design model informed by both existing literature and feedback from a wide distribution of high school and middle school students, spanning four different states over a four-year period. Although there are clear suggestions that differences exist between middle school, high school, and adult information seekers, previous research has not provided clear guidelines for how to consider these differences in designing and developing age-appropriate websites properly aligned to directly meet the unique needs of these users.

Method

The study used a mixed-method design involving a case study supplemented by focus groups and hard copy surveys.

Sampling

All participants were samples of convenience in close proximity to participating STARS Alliance universities in Georgia, Tennessee, North Carolina, and Florida. The study's sample was comprised of 53 high school and middle school participants who took part in six different focus groups: three with middle school students (n=7, n=21, n=3) and three with high school students (n=6, n=12, n=4). Participants in the third set of focus groups were organized into advisory groups that reevaluated their websites two additional times. Demographically, participants were 70% female and 30% male and 66% white (n=35), 25% African American or Black (n=13), 8% Multi-racial (n=4), and 2% Asian (n=1).

Procedures and instrumentation

Pre/post focus group survey

Each participant attended a focus group and completed a 12-item survey divided into four sections: demographic information (Q1-Q4), thoughts on careers in computing and information technology (Q5-Q8), future careers (Q9), and general website feedback including information that they would like to see presented (Q10-Q12). The first three sections of the instrument were completed before the focus group and the fourth section covering website feedback was completed after the focus group.

Focus group questions

Students were shown a web page specifically designed for either middle school or high school students and a series of 13 focus group questions were asked focusing on general reactions to the home page, color, and graphics (Q1-Q7) and what content they would prefer from a site designed to introduce careers in computing and information technology (Q8-Q11). The final two questions focused on what youth their age considered "cool" or "in style" (Q12) and the most important factors when considering future careers (Q13).

Data collection and analysis

To protect against threats to the study's internal validity all participants completed the same survey. Utilizing SPSS v20 cross tabulations for all six groups were conducted which identified group descriptive statistics such as means, standard deviations, and range. The overall Pearson Chi-square, a non-parametric statistic used because participants were not selected randomly, was statistically significant at the .05 level suggesting that the group web ratings differed enough to be from different populations.

Results

First iteration of middle and high school channels

As part of the design process focus groups were conducted with high school students in three different states. Because the initial high school site was not ready prior to first focus group, they were asked to assess the alpha

version of the middle school test site, which emphasized the use of bright colors and images intended for a middle school-age user.

Figure 3. Middle school test site v.1

Overall satisfaction ratings were low (M=5.8, SD=1.72) on a 10-point scale (1 lowest, 10 highest). The students liked the banner and the pictures but disliked the overall color and coordination of colors and graphics.

The second high school focus group used the first iteration alpha version of a high school website (v.1). The site was rated slightly higher (M=6.2, SD=2.62) then the first test. Students liked the ability to play music on the site and the overall access to information. Conversely, they found the site was generally "boring" and needed more "wow" colors and interactivity.

Figure 4. High school channel mock-up v.1

The middle school site followed a similar iterative design path. The initial middle school focus group (n=7) was a full point higher (M=6.7, SD=.756) than the high school group. They liked the colors and graphics but disliked the density of the information, the organization, and the colors, which they felt "did not go well together." Based on this feedback, the color coordination was refined and new graphics were added, representing a beta version .5.

Figure 5. Revised middle school channel v.5

After refining the site's colors and adding additional images, the site was retested with two additional middle school focus groups. The first group was comprised of 7th grade girls (n=16) and their mean rating unexpectedly was 2.5 points lower (M=4.2, SD=1.24) than the initial focus group ratings. They found that although the information was good, the new color scheme was dull and they complained of the lack of interaction or use of multi-media. Another middle school group was comprised of 8th grade boys (n=5) and the site also received low ratings (M=4.4, SD=1.25). They liked the information and personal testimonials, but also cited the color and overall "dullness" of the site as major concerns.

Second design iteration of middle and high school channels—Youth as design partners

The design team revisited the literature to identify major design flaws behind the beta versions. What became clear is that neither the pervasive usability design process nor Druin's (1999) child design model, which suggested youth must be design partners from the very beginning stages of design and development, were accurately implemented. As a result, three middle school students and four high school students were brought on as design partners to help redesign both youth sites.

The high school student advisors found the design was "too mature looking," "too professional" in appearance, used "dull colors," and too boring. Reviewing best practices identified from the literature, major elements were absent. A checklist comprised of best practices (see Tables 1 and 2 below) was created and design elements were identified in collaboration with the youth design partners. With their input, interactive features such as mouse over rollovers, a blog, and links to several online job assessment quizzes were added.

The new high school design received increasingly higher ratings over three design iterations: M = 6.75 (SD = .957), M = 7.1 (SD = .629), and M = 8.0 (SD =.500), respectively, a full 2.0 points higher than the previous focus group ratings. Chi-Square analyses, χ^2 (4, N = 26) = 12.92, p = .059, however, found that the null hypothesis could not be rejected at the .05 threshold, which suggests that the differences in ratings may have occurred by chance and were not statistically significant.

Figure 6. Revised high school design v.75

Students thought the site was "professional," "clean cut," "attractive," and incorporated effective graphics. They did find, however, there was a lack of clarity in terms of the site's purpose and a need for more color. Revisiting the table of best practices, three of the four factors were present in the new design: interactivity and social networking, graphics emphasizing photographs along with a clean "uncluttered" design, and limited text for easy scanning.

Table 1. Comparing redesign to best practices for high school students

Recommendation	Does our site have this?	Comments
Easily bored; liked interactivity such as online quizzes, voting, and games; sharing activities such as forums, message boards, and wikis (Nielsen, 2005)	Yes	We added online quizzes and assessments as well as a blog
Preferred illustrations to text instruction (Milligan & Murdock, 1996)	No	We are still mainly text based
Cool graphics and clean designs (Nielsen, 2005)	Yes	Overall design tested clean and organized and students liked it
Like to scan not read (Nielsen, 2005)	Yes	Overall design is more "scanable"

Figure 7. Middle school redesign v.75

A similar process for the middle school student advisory group was followed.They initially rated the site a 6.0 (SD=.707) and found problems with layout, color, and identified a need for interaction. Analysis of the site compared to middle school best practices found that the design was lacking the primary best practices identified by the literature. Utilizing a best practices checklist and the feedback of the middle school design partners, the colors were refined, animations and sound effects were added, and the site was renamed simply "MSZ" (acronym for Middle School Zone). The next two iterations were rated much higher: $M = 7.5$ ($SD = .707$) and $M = 8.3$ ($SD = .354$), a full 3.7 points higher than the previous focus group and 2.0 points higher than the design group's initial rating. The design group liked the new colors, the access to real stories of computing and information professionals, and the various interactivity and animation. A Chi-Square test, χ^2 (4, $N = 34$) = 39.82, $p = .00$, found that the null hypothesis could be rejected at the .05 threshold, which means these differences in overall ratings were different enough to be statistically significant and suggest they came from different populations.

Reexamining the site design by utilizing the best practices table suggested three of the four factors were now appropriately implemented.

Table 2. Comparing redesign to literature best practices for middle school students

Recommendation	Does Our Site Have This?	Comments
Colors need to be bright and engaging (Large et al., 2006; Schaller et al., 2004)	Yes	"Engaging" and "bright" colors are of course subjective; after testing with our new design partners we improved in this area
Inverse relationship between animation and sound effects and age; younger children (6-12) like them more (Nielsen, 2005)	Yes	We added both animation and sound effects
Positive reactions to icons and mascots	No	We have a number of icons but still do not have a mascot for the site
Name of website is important and ideally should be fun (Large et al., 2006)	Yes	We came up with the MSZ or "Middle School Zone"

While the current ratings from the high school and middle school design partners could still be higher, the new design process including age-appropriate youth design partners appeared to be successful. Table 3 below summarizes the focus groups results by age group illustrating the changes over time.

Table 3. Focus group and survey results by age group

Age Group	Version Evaluated	M	SD	Likes	Dislikes
MIDDLE SCHOOL					
Focus Group 1 (n=7)	v.5	6.7	.756	Colors and graphics	Color coordination; dense information
Focus Group 2 (n=21)	v.75	4.3	1.24	Information and personal testimonials	Dull color; lack of interactivity
Advisory Design Group Meeting 1 (n=3)	v.5	6.0	.707	Good colors, clear titles, kid friendly, good resources, good projects	Aesthetics, links, layout, needs interaction
Advisory Design Group Meeting 2 (n=2)	v.75	7.5	.691	Like "real stories", bright colors, interesting, like options	Needs patterns in the background, still a bit dull, needs color backdrops
Advisory Design Group Meeting 3 (n=2)	v.1.0	8.3	.354	Liked blog, tests and polls; You did a good job with overall appeal of the site and the colors are great!	Colors and text style are a little too cute; I think you should add some more links to the site
HIGH SCHOOL					
Focus group 1 (n=6)	v.5	5.8	1.72	The banner and pictures	Color is too bright and not well coordinated; need more graphics
Focus group 2 (n=12)	v.75	6.2	2.62	Ability to play music and access to information	"Boring;" need more colors and interactivity

Advisory Design Group Meeting 1 (n=4)	v.5	6.75	.957	Looks professional, organized, informative, and has easy access to information	Poor design, unclear purpose, needs more color, too mature looking
Advisory Design Group Meeting 2 (n=4)	v.75	7.1	.629	Clean cut design, nice background, like links, attractive	Needs mission statement, needs Facebook link, videos
Advisory Design Group Meeting 3 (n=3)	v.1.0	8.0	.500	As a viewer of the site, I would say that all of my needs are met, so good job! I like it, I like the colors	Some of the pictures are unclear

Discussion

Although best practices for designing age-appropriate web spaces have been previously identified through the literature, our findings suggest it is difficult to change the adult-centric paradigms of typically adult designers and developers; these prioritize efficiency and clean designs that minimize extraneous information such as animation, audio, and other interactive features that distract from the information seeking process. When the study first began, the design called for identifying and leveraging best practices from the literature to design highly efficient and effective age-appropriate youth web spaces. Because satisfaction ratings of progressive iterations of both high school and middle schools sites actually decreased amongst representative users, it quickly became clear that a significant gap between what the adult designers deemed "age-appropriate" and what actually was youth appropriate had occurred.

Often the greatest lessons are learned through lack of success; after reflecting on the results of the first and the second versions and the changes that were made based on user feedback, it became clear that although some aspects of the design had improved others had not. For example, while the color coordination of the second iteration of the middle school site was refined based on user feedback, in doing so, some of the original bright colors preferred by this age group were muted. Another finding was that the design team relied too heavily on a combination of our adult-centric design experience and adult oriented web design guidelines and failed to accurately incorporate existing research on how middle school age and high school age information seeking preferences were different.

One of the central problems in developing websites that creates an environment which successfully supports and facilitates user information seeking, is that they are often designed by those who are not well informed of either user or organizational goals or information needs (Lin, 2007). The result is a site that serves as merely an information resource comprised of sources written by many different people with equally disparate goals and objectives. In this case, the designers, although well versed with organizational goals, certainly embodied this typically occurring problem in terms of user needs, especially given an adult-centric information seeking paradigm.

The major design flaw: Not including "representative" users

The major design flaw was failing to include middle school and high school aged users at the beginning of the design process. Referred to as user groups in traditional usability (Jordan, 1998), including members of the typical users of a site in the design process should protect against the very real threat of using the site designers' current paradigms to create web spaces that may ultimately prove to be a highly inappropriate match between site and user goals. Most importantly, this disconnect can be prevented in the initial stages of design and development as opposed to during usability testing when a significant amount of time and resources have already been allocated. Representative users must be design partners as opposed to merely testers of an already potentially flawed design.

Identifying best practices from the literature provided the vocabulary to isolate these design flaws. Working directly with middle school and high school youth in the redesign process allowed the design team to better operationalize such subjective terms as "cool," "interactive," and "professional yet not boring" from a youth-centered perspective. The ability to design a web space using existing user paradigms can be referred to as *concept actualization* or the ability to authentically embrace and implement a concept in site design through the lens of the users who will be utilizing the site. Concept actualization took place through a set of steps, which represented an additional step to the DDE model—Engagement. By combining best practices identified by the literature, and our own experience, we

have developed a new design model—Engage, Design, Develop, and Evaluate (EDDE) for developing youth-appropriate web spaces as outlined in Table 4.

Phase 1: ENGAGE…	
1. Design partners	Put together a small group of age-appropriate users as your design partners
2. Age-appropriate user group	Keep group together so you can seek constant and consistent advice on design standards, specifications, and general perceptions and opinions
3. Web designers and developers	Ensure web designers and developers are meeting directly with your youth design partners. Seek concept actualization
Phase 2: DESIGN…	
4. Site specifications (i.e., using Word processing software, Photoshop, etc.)	List main goals of site in priority order
5. Information architecture (i.e., using Word processing software, Photoshop, etc.)	Create information architecture map detailing main channels and sub pages
6. User interface on paper (i.e., using Word processing software, Photoshop, etc.)	Establish general design elements of color, format, layout, etc.
7. Usability test (i.e., using Word processing software, Photoshop, etc.)	Show design to youth design partners; test information architecture through scenario and task completion
8. Refinement	Refine site based on user feedback and usability testing.
9. Usability test	Seek user feedback on refinements made (formal testing not necessary)
Phase 3: DEVELOP…	
10. Alpha version of the site	Using HTML, XHTML, web design software, etc., develop web pages with images, animations, color, information, hyperlinks, selected functionality, etc.
11. Usability test	Show initial version to design partners; test information architecture and all design and functional elements through scenario and task completion.
12. Beta version of the site	Incorporate results of testing into refined version
13. Usability test	Show refined version to design partners; test information architecture and all design and functional elements through scenario and task completion
14. Usability test final beta version	Seek user feedback on refinements made (formal testing not necessary)
15. Version 1.0 and release to public	After making final refinements roll site live (note: certainly another iteration of design and usability testing can occur)
Phase 4: EVALUATE…	
16. By collecting user feedback informally	Informally collect user feedback by utilizing an online survey and/or user feedback/comment box that is available anytime
17. Through formal usability testing	Conduct usability test by engaging age-appropriate users that are not design partners; test information architecture and all design and functional elements through scenario and task completion
18. Results to refine site accordingly leading to start of second Engagement phase.	Utilizing results begins refinement and starts the design and development of a second version of your site. This begins the entire EDDE process again

Table 4. The EDDE youth website design model

Conclusion

Limitations and implications

The study has three primary limitations. First, high school and middle school sample sizes are too low to generalize findings beyond this study. Second, bias with the advisory group ratings exist as each group provided three different

ratings on design iterations based directly on their input. Lastly, as the sites were reviewed as a focus group, social desirability may have been a confounding variable that contributed to the overall consistency of survey results.

This study contributes to the literature in three primary ways. First, it further validates differences between high school and middle school information seekers and provides concrete examples and discrete tables that can be used as checklists for web designers to understand the unique information needs of youth. Secondly, the study serves as an applied case study of the difficulty of implementing appropriate designs that effectively incorporate the unique information needs of disparate age-groups, especially as these differences may be contrary to existing design and development paradigms held by the designers that govern adult information seeking.

Finally, when utilizing the principles of information architecture, usability, and marketing, the unique information-seeking environment of the web represents one of the single most important factors that must be considered. In the case of this study, designers successfully aligned organizational goals with the major information goals of our website in the planning stages but failed to incorporate user preferences, mostly in graphic design and user control elements such as animation and interactivity, which are consistent with the different user expectations based on age-group and keeps information seekers engaged enough to remain on a particular website.

Opportunities for future study will focus on generalizing the study's findings to a larger, more representative sample of high school and middle school users. In addition, the design team will need to create user groups centered specifically on middle school and high school-aged youth who can help through a multi-layered set of evolving roles as user, informant, test, and overall design partner (Druin et al., 1999). By recognizing major initial design flaws, which stemmed largely from not following a consistent, research supported design and development process, the study has reinforced how critical it is to follow a systematic and carefully followed design process that embraces pervasive usability and user input leading to *concept actualization* throughout the entire design and development lifecycle. The affective domain and its impact on youth information seeking needs to also be further examined. This research can serve as a roadmap for others to follow that will help facilitate more highly usable web spaces for youth.

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