

Should there be an underlying learning theory behind the design of interactive Web sites?

If so, what might it look like? Is there room for multiple theories?

What do we mean by "Web Designs for Interactive Learning" and how might learning theory help us achieve that?

How can Web sites support learners in different ways as they engage in the knowledge-building activity that is suggested by constructivism?

WEB DESIGNS FOR INTERACTIVE LEARNING CONFERENCE

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constructivism and online interactivity

Presentation: Chris Quintana, Assistant Professor, School of Education,
Center for Highly Interactive Classrooms, Curricula and Computing in Education (hi-ce),
University of Michigan 2

Group Discussion 12



DISCLAIMER

1. This is *a* learning theory, not *the* learning theory. This is simply an example of how learning theory can impact design. But there are other perspectives on learning that we can consider and use.

2. Constructivism is complex. My time is limited. I will have to be a bit glossy today. If you don't know constructivism, I and others can point you toward some references for more information. If you do know constructivism, forgive me.

SURE

OK

Introduction

If we consider the overarching goal of this conference, one aim is to identify and publicize “best practices” for designing educational Web sites that attract large audiences. Given that goal, I hope our discussion this morning can help us consider some different questions about whether there should be some underlying learning theory (or multiple theories) behind the design of educational Web sites, and how such theories might help inform the types of Web sites that we build.

Within this discussion, I think that we can also be a bit more specific about what we mean by “interactivity” or by “interactive learning.” Hopefully, we can connect the ideas from constructivist learning theories with the notion of interactivity that we will be discussing for the duration of this workshop.

Given those goals and directions, this morning I would like to take a look at constructivist learning theories to give you some background about them and how they emerged. Constructivist theories can also help us describe a particular software approach that we might find interesting and the way that designers can embed different kinds of support for learners in software.

About Interactivity

Before we start discussing constructivism, I want to start out by briefly looking at different notions of *interactive*, because that alone can be a troublesome, nebulous term. There are certainly bits and pieces of what we want in existing descriptions of interactivity,

but hopefully we can use constructivism to help us move towards a more specific notion of interactivity for our purposes. That is the plan—we’ll see where things go.

So what do we mean when we talk about *interactive*—whether it be “online interactivity” or “interactive learning”? *Interactive* is one of those terms that is a bit tricky to pin down because it has taken on different shades of meaning over the years in a computing context.

According to the
Oxford American Dictionary ...

interactive

adjective

- (of two people or things) influencing or having an effect on each other: *fully sighted children in interactive play with others with defective vision.*
- (of a computer or other electronic device) allowing a two-way flow of information between it and a user, responding to the user’s input: *interactive video.*

To start, I looked at the *Oxford Dictionary*. If we consider this definition, the second bullet is the one that is more familiar when it comes to computing, but it is the first bullet that I think is interesting for our purposes, and that is the notion of the effects that an “interactive Web site” might have on the learner. What I am after here is not so much some sort of in-

formation transfer from a Web site to a learner, but rather a Web site where a learner can do something in the Web site in a way that will have an impact on that learner.

According to *Wikipedia* ...

Interaction design is the branch of user experience design that illuminates the relationship between people and the machines they use.

While interaction design has a firm foundation in the theory, practice, and methodology of traditional user interface design, its focus is on defining the complex dialogues that occur between people and interactive devices of many types—from computers to mobile communication devices to appliances.

Let's take a look at another definition, from Wikipedia. Their entry for *interactive* wasn't quite ready yet, but I looked at the entry for "interaction design." Here, what caught my eye was the notion of dialogue, which I wanted to take as more than just a learner executing some action on a tool and then looking at the resulting state of the tool. Rather, a richer view of dialogue, where the tool and the learner work together to help the learner engage in activity that we hope is intellectual and thought-provoking.

There are also other ways to approach the term. Sometimes *interactive* is defined very simply as a machine that responds to user input. Sometimes *interactive* implies software that provides a more media-rich experience, such as highly Flash-based content that is called "interactive media."

But I think that if we consider the previous definitions, the important aspects that we are after simply emerge out of the term itself. First of all, the "inter" aspect comes out of that notion of dialogue. That is, software (or a Web site) can support dialogue and interplay—interplay between the learner and the Web site and interplay between the learner and other people.

We can also consider the "active" portion of the term, whose meaning was hinted at by the notion of a learner affecting the Web site. In other words, learners could use software or Web sites to engage in active work instead of simply making passive observations.

If we look at *interactive* in this manner, we see two different ideas of what Web sites might support for learners: the idea of active learning and some measure of social interaction. I don't think that this is a surprise to many of us here.

It is precisely these two notions that are hallmarks of constructivist theories. Let us now transition to constructivism to see the basis for these two ideas and to consider other related issues of cognitive support that we might embed in the Web sites that we develop.

Constructivism

Basically, we can say that constructivism encompasses a broad set of perspectives on learning. Constructivism involves a social theory on what learning is, but it doesn't necessarily provide a specific model of cognition like the information processing models that inform much of human-

Inter + Active

- Sometimes "interactive" means machines responding to user input. Sometimes it means a more media-rich experience.
- **Inter:** Tools (i.e., Web sites) are more of a partner. Tools support interplay between learner and tool or learner and other people.
- **Active:** Tools support active rather than passive work by learners.
- Notions of active learning and social interactions are major aspects of constructivist theories.

Constructivism

- A social theory of learning and behavior that draws on a broad set of perspectives on learning
- Not a specific model of cognition like the information processing model
- View that learning involves the learner's self organization of their view or model of the world

Two Views:

Constructivism (Piaget)

Social Constructivism (Vygotsky)

computer interaction and artificial intelligence.

In other words, while constructivism does not specifically describe the structures that comprise cognition, it does give a description of what learning entails—stating that learners constantly self-organize their worldview or their model of the world.

While constructivism does encompass different views on learning, there are two major schools of thought that we can look at: Piaget's cognitive constructivism and Vygotsky's social constructivism. Let us very briefly take a look at these now.

Constructivism—Piaget

The main ideas that gave rise to constructivism were put forth by the Swiss psychologist Jean Piaget as he described his views on developmental psychology in the late 1920s. Piaget's notion of how children develop was in response to the classic "tabula rasa" view that children were essentially blank slates and learning involved filling the blank slate. To some, this idea has more of an "information transmission" flavor, but basically the idea was that learning involved filling the mind with content or data, and the learner's sensory experiences provided the "rules" for processing that content.

Instead, Piaget said that cognitive development involved a series of developmental stages, with each stage having its own set of cognitive structures and capabilities. We don't have time to go through the different cognitive stages, but the main idea to take away here is that Piaget felt that learning was more than a single "content filling" approach. Rather, throughout their different developmental stages,

children would construct their own understanding in different ways. That is where the term *constructivism* arises—the idea is that children construct their own representation of reality in different ways: by exploring, looking, listening, touching, etc.

When you consider Piaget's notions about what children can do at different levels and how they construct their own knowledge, you begin to see that this is where this notion of active learning or "learning by doing" comes from. Learning is more than the accumulation of content—learning involves different kinds of activity to help learners construct links between new content and their prior knowledge.

Constructivism—Piaget

Introduced a new view of children's developmental psychology

- Previous view was the tabula rasa view
- Piaget said that cognitive development proceeds through different stages and cognitive structures.

Learners construct their own knowledge. Children construct their representation of reality by exploring, listening, touching, etc.

Learning is active...
"learning by doing"

Piaget's theory states that we are constantly transforming and reorganizing the cognitive constructs

that represent our world view. This process of dynamic self-organization is called *equilibration*.

Piaget defined three major processes that are involved in equilibration. The first is *assimilation*, which is the process by which we organize new experiences within our current understanding. Second is *accommodation*, which is where we reflect and reorganize our current understanding to integrate new or disparate experiences. Accommodation is usually in response to a third process, which is called *disequilibrium*. Disequilibrium involves those times when we encounter new experiences that contradict our current understanding, thus we cannot assimilate them.

Piaget's Theory

- Humans are constantly developing organisms that transform and reorganize the cognitive constructs that represent their view of the world. This is called *equilibration*.

Three major processes:

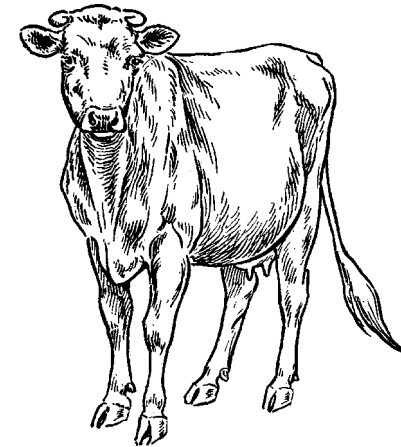
- *Assimilation*: The organization of experience with one's own logical structures or understanding
- *Accommodation*: Reflective, integrative behavior that serves to change one's own self
- *Disequilibrium*: New experiences that contradict our current understanding (and lead to accommodation)

Let's look at a quick example. Pretend that you are a child that already has some understanding about certain animals, and then you see this particular animal.

Piaget's Three Fundamental Processes

Assimilation: Can I fit this thing into an existing framework?

This has four legs and a tail, so it is probably a dog.



Accommodation: I need a new category for this thing.

I've never seen a dog that big, so maybe it is something else.

New experiences produce *disequilibrium*.

Equilibration: Striking a balance between assimilation and accommodation.

Not a linear process, but a constant interplay.

Assimilation involves trying to fit in the new experience into your existing cognitive framework, so you might say that "this new animal has four legs and a tail, so it is probably a dog."

On the other hand, if you realize that this doesn't look like any dog you've ever seen, then you have disequilibrium—the new experience doesn't quite fit into your existing cognitive framework. In this case, you need to accommodate or reorganize your existing cognitive framework by developing a new category to make sense of the new experience.

Social Constructivism—Vygotsky

- Discussed the importance of social interactions in learning via opportunities for dialogue and assistance
- Dialogue helps us learn by manipulating symbols (language and dialogue) to move from spontaneous (“everyday”) concepts to scientific (formal) concepts
- Assistance can further help us to learn when we are in our *zone of proximal development (ZPD)*

Again, the upshot of all of this is the notion that learning involves the active construction of knowledge by the learner. We can consider the idea of disequilibrium as the “teachable moment”—those moments of dissonance that can lead to learning.

Think about how those ideas about how people develop and learn can impact the technologies that we design as we move to another aspect of constructivism—the idea of *social constructivism*.

Social Constructivism—Vygotsky

Another aspect of constructivism that we can consider is the idea of social constructivism. This was put forth by the Russian developmental psychologist Lev Vygotsky, who wanted to emphasize the social aspects of learning.

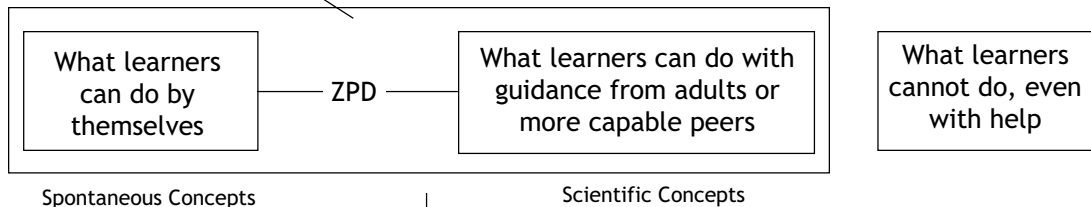
Social constructivism notes the importance of two major types of social interactions in learning—engaging in dialogue with others and gaining assistance from others.

understanding to the more scientific, formal concepts they are learning. This motivates the need for social interaction and dialogue between learners and their peers, teachers, and experts in the domain they are learning.

Second is the notion of assistance that can also come from social interactions. Vygotsky considered those times when learners exhibit a “readiness to learn,” which is when learners can be aided by assistance from dialogues with a more knowledgeable person. This idea of readiness to learn is embodied by the concept of the *zone of proximal development*, or ZPD. The ZPD is the conceptual zone between what learners can do by themselves and what they can do with guidance from others.

If learners are in their ZPD, then assistance from others at that point can foster learning. If learners are not in their ZPD, then no amount of assistance can help—they are not ready to learn.

Again, there is much more to all of this, but the key point to take away involves the importance of social interactions with others and the “interplay” and partnerships between learners and other people (and their tools also, if you want to think about that) to help them learn.



The interplay or partnerships between learners and others (and also their tools)

First of all, Vygotsky noted that dialogue is important because using language and engaging in dialogue with others gives us an opportunity to engage in knowledge construction and knowledge organization. This can help learners move from the spontaneous, “everyday” concepts that may comprise their naive

Constructivist Tenets

Given these ideas, think about how technology (and specifically, the kinds of Web sites we are thinking about here) might support these ideas.

We have seen that learners should be active—they need to be given opportunities to actively construct their knowledge of some discipline to gain a deeper

understanding of that discipline by engaging in intellectual, problem-solving activity.

Learners can construct their knowledge by being actively immersed in a situation that provides social interactions, tools, content, and other information allowing them to explore, invent, create, and so forth in an increasingly autonomous manner.

Such situated learning can occur within some learning community, which can set the stage for learners to begin understanding the culture of the discipline they are learning—say the culture of scientists, or the culture of historians—as they learn the norms, terms, tools, and language of the discipline.

And being part of a community gives learners the opportunity to engage in discourse with others to help them move from everyday concepts to more

Constructivist Tenets

- **Active construction:** Deep understanding is more likely to develop when learners actively construct their understanding of a discipline
- **Situated cognition:** Active immersion within the context of the discipline provides situations where learners can learn via increasingly autonomous activity
- **Community:** Learners begin to become part of the disciplinary culture by extensive and repeated exposure to the community of practice in the discipline
- **Discourse:** Immersion in the culture can help learners learn the “ways of knowing” in the discipline—what are the disciplinary practices, language, tools, etc.

formal concepts of the discipline.

All of this helps us think about what kinds of situations and activity we would like learners to engage in. However, we need to spotlight one more concept that comes out of social interactions for learners. We have talked about how we want learners to engage in certain kinds of problem-solving, exploratory activity. To do so, let us now touch on *scaffolding*, or the notion of assistance that experts, teachers, and peers can provide learners.

Scaffolding as Assistance

While the notion of scaffolding was hinted at by Vygotsky in his description of assistance and the ZPD, the term *scaffolding* was coined by Wood, Bruner, and Ross and further elaborated by Collins, Brown, and Newman in their description of “cognitive apprenticeship.”

Scaffolding can be described as assistance that is provided to a learner by a more knowledgeable peer or adult until the learner no longer needs the assistance, at which point the assistance can “fade” away.

Scaffolding can certainly come from different sources, such as a human teacher, supporting materials, curricular materials, or from the tools themselves that learners use. There are different types of support that the more knowledgeable party can provide learners, such as:

- Modeling a new task so learners can see how to do it;
- Providing hints or other types of coaching to learners;

Scaffolding as Assistance

Scaffolding can be provided by a teacher or can be implemented in a range of software features:

- Modeling a new task,
- Coaching and providing hints and advice,
- Prompting learners to reflect and articulate ideas,
- Making links between everyday and formal concepts.

Scaffolding should provide enough structure to make a new activity doable, but not so much that it makes that activity too easy for learners.

Scaffolding Features in Software: Symphony

Symphony was a scaffolded work environment aimed at supporting learners doing air quality investigations

- **Context:** Scientific investigations have a wide range of activities to select from
- **Learner Need:** Learners need activity-option information to help them see what activities are available at different junctures
- **Conceptual Scaffolding Guideline and Strategy:** Provide structure for complex tasks and functionality by using ordered and unordered task decompositions to describe complex tasks

- Prompting learners to reflect on the material they are learning or to articulate different ideas as they are learning new material;
- Making links between everyday and formal concepts by employing different kinds of representations.

The trick with applying scaffolding, as any good teacher will tell you, is to provide “just enough” support for learners. As Brian Reiser notes, scaffolding—whether it is provided by humans or by tools—needs to provide enough structure to help learners engage in new activity that may be difficult for them, but not so much structure that it makes the underlying activity too easy for learners, which would not be useful for learning.

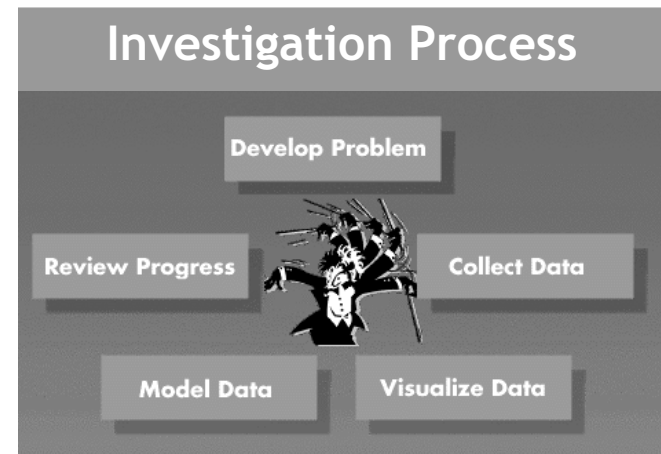
Scaffolding Features in Software

Symphony

Let’s take a look at an example. Consider a software environment that is aimed at supporting learners to engage in scientific inquiry to investigate air quality questions in their community. The inquiry process is an open-ended one that consists of many different activities in which learners have to develop their question; gather, analyze, and model data; and synthesize their work.

Since novice learners might not necessarily understand what kind of work is involved in a science investigation, scaffolding features in software can structure the inquiry process by providing a process map. For example, the process map pictured here from the Symphony software environment serves as unordered task decomposition to help learners see what their options are as they engage in their inquiry

work. As learners begin to understand the inquiry process and the tools that are involved with the different activities, the software can gradually fade the “task-oriented” view and simply provide learners with the individual tools needed to perform these activities.



Scaffolding Feature Implementation: Symphony process wheel shows the space of science inquiry activities that learners can choose from throughout their investigation.

Knowledge Integration Environment (KIE)

Or consider another example, a software environment that supports learners with gathering and integrating different pieces of knowledge and evidence to again help them answer a science question that they may have posed.

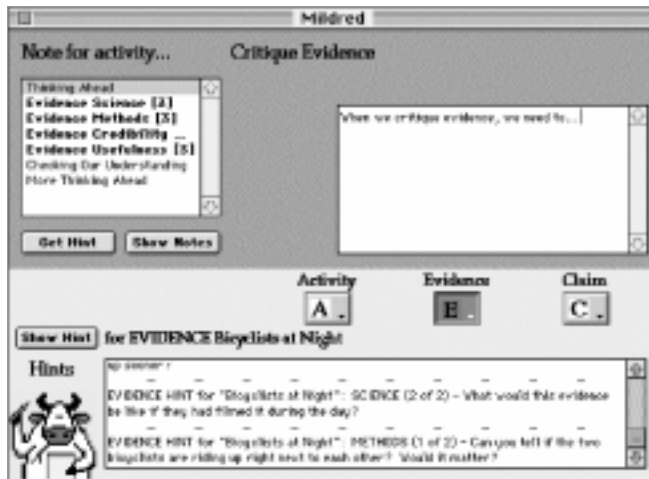
One major constructivist idea is that reflection and articulation are important activities to help learners accommodate and assimilate new information into their understanding. However, many learners will not understand the importance of reflection and articula-

tion, and will thus tend to bypass such tasks. Therefore, scaffolding features can provide explicit reminders and guidance to give learners opportuni-

Scaffolding Features in Software: Knowledge Integration Environment

Knowledge Integration Environment (KIE) was a software environment to help students make sense of and integrate different pieces of information used in their investigation

- **Context:** Reflection in science inquiry involves metacognitive activities like planning
- **Learner Need:** Learners need support for articulating more conceptual and detailed plans
- **Conceptual Scaffolding Guideline and Strategy:** Facilitate ongoing reflection and articulation during an investigation by providing reminders and guidance to facilitate planning



Scaffolding Feature Implementation: The "Mildred" guide in KIE uses Thinking Ahead prompts that explicitly ask students what they will do to accomplish a particular task.

ties to reflect on and articulate different opinions, information, or plans and results during their work.

For example, Mildred the cow in the Knowledge Integration Environment software uses explicit "Thinking Ahead" prompts, along with other kinds of prompts, to show learners what they should think about and record as they critique scientific evidence and plan their next steps.

Implications for Online Interactivity

What Does All of this Mean for Online Interactivity?

Learning involves active work, invention, and self-organization.	Learners need tools to help them pose their own questions, generate hypotheses, explore and test possible answers to their questions within a realistic problem-solving situation.
Learning involves organizing, generalizing, and making meaning.	Learners need tools that support them with articulation and reflection during their activity.
Learning can be facilitated by "errors" (disequilibrium can be the "teachable moment")	Learners need tools that help them to explore different possibilities within meaningful contexts, whether those possibilities are "right" or "wrong"
Learning should involve dialogue with peers, teachers, and experts.	Learners need tools that help them engage in dialogue with other members of their community of practice (i.e., other learners or experts) and to gain assistance from more knowledgeable people or tools

To sum up, if we consider some of the different ideas about learning that stem from constructivist ideas, such as those listed in the left-hand column above, we can see that they can steer us toward certain

Web Sites as Cognitive Tools

- Web sites that act as “intellectual partners” with learners to support, guide, and extend the thinking processes of learners who use them
- Web sites that learners can use to explore their world so they can create their own interpretation of their world instead of having a teacher solely interpret the world for them
- Web sites that allow learners to explore, build, communicate, and reflect

general types of features and functionalities for Web sites that we might think about designing for learners.

We can think about Web sites to help learners explore new ideas, engage in open-ended problem-solving activity, work in specific disciplinary contexts, and help them recover from breakdowns or other difficulties they may face during their work.

We can also think about Web sites that help learners communicate with other people during their problem-solving and exploratory activity, and Web sites that communicate with them to provide them with assistance during their explorations.

In short, constructivism sets a direction toward developing what others have called “cognitive tools.” Part of what we might think about over the next few days is what it might mean to develop online Web-based cognitive tools.

Cognitive tools and learning environments have been described as “intellectual partners” that can give learners the opportunities to explore, build, communicate, and reflect, while also providing the necessary guidance that learners need to engage in these activities and extend their thinking process. Rather than putting learners in situations where a teacher does the interpretation and defining for learners, cognitive tools should help learners engage in the exploratory activity that helps them construct their view of the world with help from the tool or others in the environment (such as teachers or supporting materials).

Given our quick tour through constructivism, let me close with one more look at *interactivity*, this time

looking at the description of interactivity that was posted at the WDIL workshop Web site.

According to the WDIL Web Site ...

...(the) development of Web sites that **require an end user to make certain decisions about information** that is presented before more information is made available. Such interactivity can run the gamut from “**guided**” interactivity—in which users select from predetermined, or “canned” choices—to “**independent**” interactivity, in which users can use information to reach conclusions about their own questions using raw data. The entire range of interactivity is important in education, and appropriate levels of interactivity are dependent, at least in part, on learning goals and objectives. Examples include:

- **Gathering and contributing evidence**
- **Selecting options**
- **Forming conclusions**
- **Testing skills**
- **Enabling two-way or multi-way communication between real people**
- **Helping users construct their own chain of inference or meaning**
- **Allowing users to experience the consequences of their choices**
- **Giving users something to do rather than something to see**

We can certainly see a lot of the ideas that we have been talking about this morning—the notions of guided and independent work by learners to actively explore their own questions, construct their own meaning, and communicate with others.

I will close with this thought: I have been focusing on the idea that we can develop Web sites that support learners in engaging in exploratory activity. However, we could also think about how we use informational or content-heavy Web sites as one piece of an overall system in which, perhaps, teachers or curricula pose the exploratory activity for learners.

Similarly, no matter how we might employ technology in a constructivist approach, we also can't forget about teacher support in formal settings and supporting materials in both formal and informal settings. We cannot look at technology alone to support learners.

Final Thoughts

- We can think about constructivist Web sites, but we can also think about informational Web sites that are used within a broader system that implements a constructivist approach.
- Tools alone are not enough. We need to also think about supporting materials and teacher support in more formal settings.
- We also need other perspectives and theories to inform other aspects of our work that constructivism may not address.

quintana@umich.edu

<http://www.hice.org>



Chris Quintana making meaning out of a small group session at the WDIL conference.

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Group Discussion

Constructivism and Loss of Control

- Constructivism is an improvement on “force-feedism” but it is a halfway step in some sense. There is a question that is probably a question for most of the people in this room who are associated with or designing sites for museums and schools: How much do you really want the user and the learner to be in control? The ultimate extension of constructivism, and the ultimate way for the individual to connect with the information, is for them to actually steer the connection.

If you push the constructivist agenda on Web sites, a key issue for everybody designing them is, how much control do you want to relinquish? • Jim Bower, Chairman of the Board & CEO, Numedeon, Inc. (Founders of Whyville.net)

What about this issue of giving up control? People raise the issue, everybody nods, and then we all kind of go off on our merry ways. I think

Jim Bower has hit on something here. The more we design things that we think people should use in a particular way, the less likely we are going to be encouraging people to mess with them or change them (or destroy them).

- Kathleen McLean, Consultant, Independent Exhibitions

I actually designed a virtual library for the Los Angeles Library system in 1987 in hypercard. We got it into the downtown library and three months later, the librarians told us to take it out. The reason was that the line to use the computer was obstructing the people going to the card catalog. Of course, this was a fiction. The thing that really concerned them was that kids had figured out how to use this virtual library to play games, and the librarians felt that playing games was absolutely inappropriate in a library.

The games were “find a book” games. I went and tried to convince them that if you can connect to gaming, if you can connect to play, you are con-

necting with something that is very deep with primates. You *want* to do that. Of course, it’s self-centered play, and they didn’t like that at all. It was really a control issue.

If you push the constructivist agenda on Web sites, a key issue for everybody designing them is, how much control do you want to relinquish? • Jim Bower, Chairman of the Board & CEO, Numedeon, Inc. (Founders of Whyville.net)

Scaffolding and the Role of the Designer/Developer Degrees of Mediation/Scaffolding

- We often create Web sites for art museums and collections-based online exhibitions. One thing we are always challenged with is that idea of mediation. It seems like the culture of the Web is very much about “disintermediation” and giving people access and control to do things the way they want to do it. The curators don’t often really want to give up that mediation role.

So this idea of creating mediation where it’s not an on or off thing, but instead an idea of scaffolding or training wheels—this is one of the things I’m interested in, where it isn’t a matter of being on one side of the gallery wall or on the other side of the gallery wall, where you have access to the database itself. Training wheels are something that are on a continuum, so it’s not on or off, but varying degrees of how much scaffolding you need. That would be a dream, to make something like that, where the visitor can get something on demand.

- Brad Johnson, Co-founder and Creative Director, Second Story Interactive

International Scaffolds: Common Ground

- I'm being pushed to do this, working in an international program. I've been seeing that what you do as a designer regarding the scaffolding that they need for the text is culturally based in a lot of instances. It's the frame of reference, or the common ground. Brenda Laurel referred to this in her computer interface writing a long time ago in her book, *Computers as Theater*. For example, we're now all familiar with the idea that the trash icon on a computer screen also means "eject," but others who don't share that common ground might not realize that.

Now that the Web is essentially international, do we really know what that common ground is? How do we blend together our understanding of cultural frames of reference and common ground with scaffolding so that it works for an international audience? For a lot of us, our audience isn't North American-based or U.S.-based any longer.

I think we sometimes forget about this. It gets to the question of how much thinking is required and just how much we can do in terms of the path that you're going to scaffold to get the user to a learning objective at the end. • Susan Gallagher, Educational Designer, UCAR/GLOBE

Designer/Developer Roles and Controls

Creating Experience

- Regarding the control issue, I think a lot of what scares both developers and clients about the issue of control is that somehow, if you let the user do or

make something more meaningful, then you're not in charge any more.

Any good, inquiry-based, constructivist-based teacher is still in charge. They are moderating and directing the experience, but in a different way, using a different set of skills and tools. It's not that we're just opening the flood gates and saying, "Do whatever you want." We are creating a very carefully choreographed environment, but it's not perfectly scripted and it's not cut and dried. That's what is challenging to think about, the different kind of role we might play doing experience design instead of more formal educational design. We are still in control creating the experience, but it's a very different role that we play. • Steven Allison-Bunnell, Senior Producer & Writer, Educational Web Adventures

Creating Opportunities

- I think in exhibits, the idea of exhibit developers creating the visitor experience may have become a very pompous statement. Visitors create visitor experiences. What we do is create opportunities. Now we choose those opportunities so there are choices involved here, but it's a different attitude or idea of where the authority really lies. The ultimate authority in an exhibit, in my view, is the visitor because they choose what to do or not to do and whether to engage or not to engage. It is really sort of an open-ended piece—they can read or not read, they can look or not look, they can interact or not interact. • Paul Martin, Director of Exhibits, Science Museum of Minnesota

Does "Control" Equal "Goal"?

- I think there is an internal conflict or tension that arises when someone goes through an interactive learning experience. My husband is a game designer, while I work on the education side, and we have a lot of interesting conversations. Kids are smart, and as learners, they aren't fooled by us saying that this is going to be a fun experience.

There is this perception that, whatever cognitive model they're using, somebody somewhere is trying to get me to learn something specific, versus a game as a learning experience, which I think is the underlying theme of the model that you were telling us about. I just think it's going to be a lot more difficult to give up control, because the control is actually the goal that we have when we're putting this forward. I have no answer, I'm just trying to put a different light on this. • Sonja Hyde-Moyer, Director of Advanced Technologies, Museum of Science, Boston

Barriers to Adopting a Constructivist Approach

Test-Driven Education

- One thing we find with a lot of our educational clients is that they start the conversation by saying they want open-ended learning, and then as we start to develop tools that will allow them to do that, we conclude that what they really want is to spoon-feed information so that the students can pass the test at the end of the curriculum. So even though everybody uses these terms, it's lip service, because when it comes down to it, they need to get their funding for the next year and the students have to pass the test, otherwise the school will be closed. • Brent Lowrie, Games and Animation Director, Rare Method



ture of being a book seller. So a lot of it has to do with the internal structure of the organization.

- Toby Levenson, Senior Research Associate, WestEd

Mistrust of Users/Visitors

- It's also about not trusting your visitors. There's a parallel in the exhibit world when we talk about doing the kind of exhibit where you put something out and then let visitors say what they want to say. The first response is always, "Oh, they're just going to put up curse words and other horrible things." There's this weird notion that somehow we have to filter what the visitor is doing because what they do might not be appropriate, whatever that means. • Kathleen McLean, Consultant, Independent Exhibitions

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Overcoming Barriers

Bringing Curators et al. up to Speed

- I would like to backtrack to this question of curators as expert providers of information before we dismiss their fears about what we are doing with their content and how other people will use it. We have an interesting grant that involves using storytelling and narrative for history education. We recently had a session with both historians and educators in the room. It was very interesting to start off the day with historians who were saying we could put pictures of objects online, but we should put labels or quotes next to them. The educators were saying, "That doesn't work for us." As the day went along and the educators explained their thinking, the historians came around and were more comfortable about putting objects out there. So part of our job is making sure that people

Organizational Paradigms

- Several of the conversations I've had over the past eighteen hours or so have had nothing to do with the content, they had to do with the internal structure of the organization, whether that is a museum that doesn't want to look at itself as providing its main service through the Web because they provide it through physical exhibits, or a book publisher who wants to do something different with the same content and can't break out of the corporate struc-

like curators and historians are brought up to speed. • Nancy Ross, Web Editor/Web Projects Manager, Chicago Historical Society

The Role of Software

Computer Interfaces:

Increasingly Sophisticated Scaffolding

- One aspect that may fall under the category of scaffolding that is somewhat unique to interactive user design is the process of learning how to use the tools themselves. That may be an aspect of learning that is evolving. A lot of help systems are not about how to learn the materials, but about how to use the site. Maybe, as people become more and more familiar with how to use Web devices, our interfaces have to become more sophisticated and provide multiple pathways for the same information.

In designing a Web site, there's the navigational hierarchy but there's also the search engine, and I think that probably different users are coming upon information from different pathways and have the expectation that they'll be able to do that. And as users become more familiar with all of the sophisticated computer interfaces that are possible, that becomes one of the things that the users then expect. • Scott Weinrobe, Web / Educational Technology Manager, Oregon Museum of Science and Industry

Software as Intellectual Partner

- I really like the term Chris used, looking at software as an "intellectual partner." It is different from a deliverer of information or a deliverer of experience. Rather, it is a partner with the person who

wants to do something, who is not learning content but something else. And it is the software as a partner that allows them to do that. There's a lot more we can do if we think about software being a partner and not a delivery vehicle. • Dan Barstow, Director, Center for Science Teaching and Learning, TERC

Are you trying to communicate content or are you trying to communicate process? ... If you're trying to do both simultaneously, I think that's a really high bar. • James Harold, Director, Information Systems and Technology, Space Sciences Institute

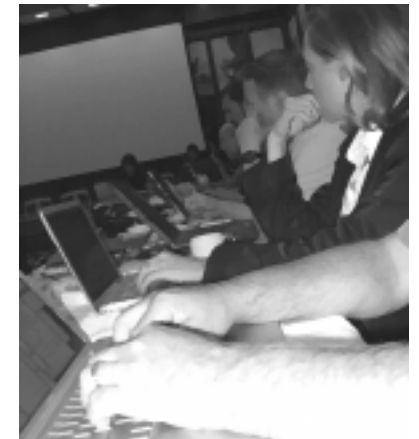
The Learners

Does Interactivity Require Readiness to Learn?

- I was really intrigued by the idea of "readiness to learn." My sense is that most formal education is geared towards people who don't have a readiness to learn. If you're really interested in something, you're self-motivated to learn it on your own. I guess my question is one of design. In terms of interactive design, do you want to gear it only towards those people who do have a readiness to learn? And do those who don't have a readiness to learn then go by the wayside? • Cynthia Ramlo, Graphic/Instructional Designer, American Indian Studies Research Institute, Indiana University

An Inborn Readiness to Learn

- To respond to Cynthia's question, the problem with Web design is the people paying you to do it, not



Clarifying Goals

- About ten years ago, we started doing workshops for physicists interested in getting into education, and we started to introduce some of these concepts to them and get them to think about doing inquiry-based activities and the idea of science as a process as opposed to science content and facts. If you want a little fun, take a roomful of Ph.D. physicists, have them do an activity and tell them there's no right answer.

I share that because it helps to have a handle on the goals you are going for. Are you trying to communicate content or are you trying to communicate process?

They're not the same thing. A lot of people do process, and if someone gets a wrong answer you can still succeed in your goal. If you're trying to do content, it's a whole different game. If you're trying to do both simultaneously, I think that's a really high bar. • James Harold, Director, Information Systems and Technology, Space Sciences Institute

the people you want to use it. That is the problem. We run into this all of the time because, as Brad Johnson was saying, clients want all of this stuff, but when you show them how to do it they say not in my collection, not in my school, not in my classroom.

The Web design problem is not getting twelve-year-old kids to figure out how to use the Web. They know—they know better than anybody in this room. The problem is the people in this room and whom they talk to.

For my other point, which I think is really important, I'm going to pull a neurobiology card. If I sectioned any brain in this room, or any human brain, and was asked to identify this person versus that person based on the structure of that brain, you could not do it. There is a notion that creeps into education all of the time, that somehow there are some people who are adept at learning and want to learn. We are all using the same machine.

What we have learned over and over again, doing hands-on science and constructivist learning in schools or through the Web, is that if you give the kids the chance, the tools, the opportunity, it turns out that every human roughly has the same brain with roughly the same capacity. They love to use their hands, they love to use their eyes, they build theories, they explore. If you see somebody who isn't doing that, in the absence of some drug-induced problem, it has to do with something we've done to them, not to their native, natural abilities or desires.

I have a one-year-old, and I want him to act like he acts now when he is in twelfth grade. It's going to be very hard because the educational system is de-

signed to suppress that. • Jim Bower, Chairman of the Board & CEO, Numedeon, Inc. (Founders of Whyville.net)

Designing for Multiple Language Groups

- We are all speaking the same language, but even in North America you have Spanish speakers and French speakers. How do you go about designing for the different groups who are here, just on our continent, as well as for those in the rest of the world? • Sesh Kannan, Principle and Producer, Flaneur Media
- We just finished a Web site for the Virtual Museum of Canada and the Glenville Museum in Calgary for the Blackfoot people. The Web site includes a Flash interactive site and an HTML non-interactive site. The Web site mirrors the in-museum gallery on the Blackfoot people, and both the Flash and the HTML are produced in English, the Blackfoot language, and French. So it's definitely possible, and I don't think there's a language on earth that has longer words than the Blackfoot language translated to English. • Brent Lowrie, Games and Animation Director, Rare Method
- Another way to do that is to not use any written language at all. There are ways to do it without writing, depending on what you're trying to do. • Bryan Kennedy, Internet Developer, Learning Technologies Center, Science Museum of Minnesota
- That's what Ikea packaging is all about. • Anon.



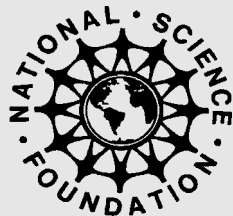
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This document is intended to be a faithful synthesis of the discussions at the Web Designs for Interactive Learning conference that took place at the Cornell Lab of Ornithology in Ithaca, New York on June 15-18, 2005. It is meant to serve as a resource for those who attended and as a resource for others in the field. It does not necessarily reflect the views of the Cornell Lab of Ornithology, the Exploratorium, or individual symposium participants.

In some sections, participant comments have been paraphrased. These are not exact quotes, rather they are an attempt to capture the content and meaning of the ideas presented.



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607.254.BIRD (2473) telephone
www.birds.cornell.edu

159 Sapsucker Woods Road
Ithaca, New York 14850



415.563.7337 telephone
415.561.0307 facsimile
www.exploratorium.edu

3601 Lyon Street
San Francisco, California 94123-1099