User Interface as a Literacy - Impact on Design

Andy Johnson
Problem Solutions, in support of the
Advanced Distributed Learning Initiative
Alexandria, VA
andy.johnson.ctr@adlnet.gov

ABSTRACT

Experts focusing on New Literacy Studies, such as James Gee, have been focusing on learning in non-traditional environments. These environments consist of simulations, virtual worlds, and augmented reality, among others. While these environments enable learning, the means by which we interact with them have a literacy of their own, User-Interface (UI) Literacy. Humans have been interfacing with technology for centuries, and typically design for this interface by "what is intuitive."

This topic looks at how interfaces of all types – virtual worlds, software, websites, and even everyday devices can benefit from looking at UI design as a form of literacy. Grounded in the work of literacy experts, aspects of UI design were examined in literacy terms such as language, genre, Discourse, and cultural model, and re-classified into a specification for UI implementation practices. The specification maps user operations to various interface functions based on the user's identity. These mappings can then be scored and used in equations to find optimal UI sequences for each process or for each user-community. Social networking is an ever-increasing part of our lives, making our identities more public and more projected than ever before. Communities of practice and user feedback are more accessible to product and service providers. This data should be used to make good design decisions for our technology.

This new perspective on UI design analyzes not only what is intuitive, but how designers, engineers, and programmers can look at cultural models to make UI decisions. Some of these decisions can be user-specific customizations, re-skinning/re-branding of interfaces to match specific user needs, marketing strategies, and delivering competency-based instructions. Whether designing a flight simulator, a website, or a toaster, this specification will provide a means to expand the scope of the data available for designing a UI while also grounding it in pedagogy.

ABOUT THE AUTHOR

Andy Johnson has been working with Distributed Learning for over 10 years. He has been involved with the SCORM® (Sharable Content Object Reference Model) since 2000, much of the time directly supporting its development as a part of the Advanced Distributed Learning (ADL) Initiative. He has also architected content structures supporting SCORM for various government projects, most notably the first JKDDC (Joint Knowledge Development and Distribution Capability) courses and a series of Pharmacy Technician Training courses designed for the Services by the VA. He currently has the role of Senior Systems Engineer as a part of the ADL Program.

Andy has also worked closely with the University of Wisconsin – Madison since his graduation and later through movement of their graduate program. He received his Bachelor's degree in Computer Science in 2001. He is almost finished with a Master's degree in a program entitled Education, Communication, and Technology. He has studied under experts in Learning Technology, most specifically the integration of games into learning under James Gee and Kurt Squire, who is his advisor. As a lifelong consumer and aficionado of both games and education technology, Andy believes that a worthwhile integration of the two is possible.

User Interface as a Literacy - Impact on Design

Andy Johnson
Problem Solutions, in support of the
Advanced Distributed Learning Initiative
Alexandria, VA
andy.johnson.ctr@adlnet.gov

INTRODUCTION

Do you own or use a PC or a Mac®? A Droid® or an iPhone®? Which is better? Even though each of the two performs largely the same jobs, the way a human uses the devices is quite different. That is because the companies that created these products made decisions regarding the user interface(UI), that is, the means by which we interact with technology.

Are "Mac people" and "PC people" different? What about "iPhone people" and "Droid people"? Are these social constructs even valid? Would you switch devices if one were 50% cheaper and twice as fast? The answer to that question probably lies in the comfort level you hold with learning the new device. There is an expectation that once you are inside one of the brands of devices, that movement between them is quite easy. Additionally, the communities of practice and marketing surrounding each brand distinguish themselves from the other, which feeds the perception that using each device is a different experience.

What if those who switched brands received a guide with their purchase? Not a handbook, but an actual friend who could teach you how to use your new device. The interaction with the guide would look something like the following:

New Android™ User: *I am having trouble setting up an email account on my Android phone. It is different than I would do it on my iPhone.*

Guide: *Can you tell me how you would perform this task on an iPhone?*

New Android User: *Well you go to "Settings," then "Mail, Contacts, Calendars," and "Add Account." You then pick the type and enter the name, address, and password.*

Guide: *Do you know how to set up the mail servers once you are there?*

New Android User: *Yes.*

Guide: *Ok, well in Droid, you will use the "Applications" button, then the "Email" icon, hit "Next" and then "Add Account." Put in your email address and password. That will get you to the email setup.*

New Android User: *Ok, anything else I should know?*

Guide: *Yes, do not change any of the port settings. Also, you will be able to name your email account, but not until the end. I am aware that iPhone has this setting at the same time you enter in your account information and Droid does that differently.*

The guide in the above scenario sees that the new Android user has mentally mapped a specific function "setting up email" to a series of tasks. A handbook or internet site would simply give users the entire process, but a guide can determine which competencies a user has in the same way a teacher would give individualized instruction to a student. The guide could provide only the necessary information individual users need, rather than dumping the entirety of information on the users and leaving it to them to sort out.

USER INTERFACES

What do members of each community of practice expect from their technology? Within each community, how much diversity is there? What is "normal"? This isn't to say someone can't be both a "Mac person" and a "PC Person" or both a "Droid person" and "iPhone person." Just as a truck driver can obtain multiple licenses to drive different classes of vehicles, so too can someone pick up competencies in multiple devices and even belong to multiple communities of practice. In each case, however, it is most likely that the user or driver has a preference on which device or vehicle he or she would like to use or what he or she would expect if encountering a new one.

This paper explores a variety of aspects about user interfaces and their common bonds with literacy, which, in turn, ties UIs directly to culture. It will look

at how analyzing a user interface as a literacy and then grounding it in a specification can enable the aforementioned guide, among many other benefits.

Humans develop technology to make our lives easier, and user interfaces are how we control that technology. In searching for a suitable definition of user interface, most refer directly to the interaction between a human and a computer. This makes sense as computers are the most commonly customizable and familiar form of technology seen today. However, the definition that is more ubiquitous fittingly comes from a group involved with the deepest of understanding of the openness of computer programming and their user interfaces – The Linux Information Project. According to them, "a user interface is a linkage between a human and a device or system that allows the human to interact with (e.g., exchange information with) that device or system." (2007)

When it comes to interacting with systems or devices, we humans have a list of options – pushing, pulling, turning, swiping, clicking, speaking, gesturing. The list is about as endless as our abilities. Even our bodily processes, moods, and inaction can be a linkage to a device that can then incorporate these subconscious cues into input for the task it is supposed to perform.

To establish links with literacy, some basic components of user interfaces (UI) should be broken out:

- ***Action*** – a specific means by which we interact with the device (i.e., any of the interactions described above).
- ***Manipulatable (Part)*** – a specific part of the device that can interpret an action.
- ***Operand*** – an action performed on a manipulatable.
- ***Operation*** – one or more operands that when performed together directly result in a function.
- ***Function*** – an output or task originating from the device as a result of an operation being performed.

Figure 1: User Interface Components

This taxonomy follows logically from our everyday use of a device. As shown in Figure 1, the function of a cell phone call to another cell phone user is done by performing the operation of pressing (action) a numerical button on the phone (manipulatable) multiple times (each button press being an operand).

LITERACY AND ITS MANY FORMS

Most of us, if asked to define literacy in three words or less would choose the phrase "learning to read." Literacy today, especially in an advanced technological age, encompasses far more than those three simple words. Luke and Freebody (2007) identify four key practices that effective literacy draws upon:

1. The ability to break the "code" of written text by recognizing and using structural conventions and patterns.
2. The ability to understand, participate in, and compose meaningful written, visual, and spoken "text".
3. The ability to use texts functionally by traversing and negotiating the social relations and cultural functions surrounding them.
4. The ability to "critically analyze and transform texts that are not ideologically neutral or natural."

While Luke and Freebody's "Four Resources Model" hint that "text" goes well beyond words on a page, Anstey and Bull (2006), completely scope this out as what they call semiotic systems (also called semiotics, or semiotic codes (New London Group, 2007)). These categories or modalities of text are:

1. Linguistic – both oral and written, including use of vocabulary and grammar

2. Visual – still and moving images, including the perspective
3. Auditory – sound and music, including the use of silence
4. Gestural – facial expression and body language
5. Spatial – the layout of components within space, including proximity, orientation, and position

Looking at how UIs are created, it is easy to see how these semiotic systems, or modalities of text, are deployed within them. Linguistic UIs are extremely common, whether it be words in areas of a form or website, or the ability to give and understand oral commands such as the SYNC® system seen in automobiles or Siri,® the Apple® assistant. Keyboards and number pads would also fall in this modality. Visual "text," especially icons, dominates many devices today such as any media player, television, or appliance. Color and shapes often times key into the function of a particular control, such as the "Stop", "Play" and "Record" functions on VCRs and DVD players. Auditory pieces of UIs can be seen mostly as feedback devices corresponding to the user doing the correct or incorrect thing, the Windows™ beep/alert probably being the most familiar example. While Luke, Freebody, and other literacy experts typically reference this gestural "text" in the form of human-to-human body language, it is certainly capitalized in touch screen devices that use hand movements as input as well as motion detection devices, such as Nintendo Wii ™ or Xbox Kinect ™. Finally, UI design is predicated on spatial orientation. As devices get smaller, the layout, positioning, and ability to condense meaning into more compact spaces becomes more and more important.

UI designers depend on their audiences being literate in all of these forms of text. Going back to the "Four Resources Model", the user must be able to decode which parts of the device or system are manipulatable and which actions are allowed on those parts. They must comprehend all of the functions of the device and perform operations that logically fit with their expectations and be able to communicate to the device through a series of operands. The user needs to work within the confines of that UI to understand parts that may not be intuitive to them and still be able to interact with the device. Lastly, the most literate users can critique a user interface citing where it serves or does not serve the correct functions based on audience. See Figure 4 to see how the "Four Resources Model" can be applied to a Tablet PC UI literacy.

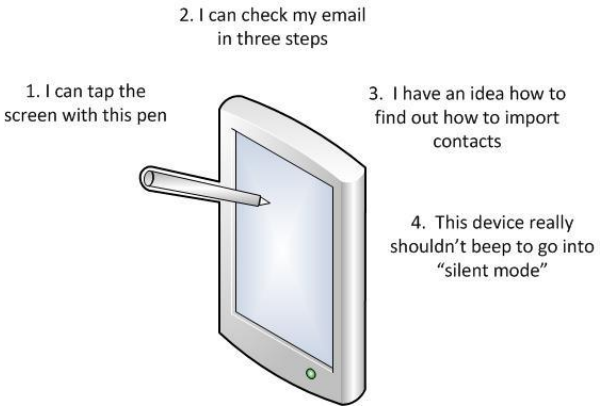

Figure 2: "Four Resources Model" Applied to a Tablet UI

USER INTERFACES AS SOCIAL LITERACY

Literacy experts, such as James Paul Gee (2003), have broken down literacy practices and determined social contextualization. Written language has only been around for 10,000 years, and must be "learned" (p32). This is in contrast to oral language which was present at the dawn of man. Social languages, derived from oral languages, have socially situated identities and activities (p32), are products of history and culture (p35), and vary by culture and circumstance (p35). According to Gee, individuals have different grammatical tools available to them, which they then use in different situations (p33). A genre is a pattern of these language tools, often embedded within structures (p34). From a UI perspective, genres make up operations that serve as inputs to the device, such as turning a knob to change the volume. Genres are made up of a series of activities that involve the identification of and manipulation of language-based controls. These controls are certainly embodiments of social language, as the icons, words, colors, positions, sounds, and motions used with them are all tools within a particular culture. Thus, when we see a knob, we know that we can turn the knob.

Gee goes on to define what he coins as "Big D Discourse," which is learning new social languages and genres at the level of being able to produce them. This expands on "discourse" which is simply defined as language in use (p35). "Even when people learn a new social language or genre only so that they can consume it (interpret it), but not produce it, they are learning to recognize a new Discourse" (p35). Discourses always involve languages, but also involve more than just languages. A Discourse incorporates ways of talking, listening, reading, writing, valuing, etc. Examples of Discourses would be "She writes in cursive when she writes to our Grandmother" and "He speaks loosely when he is out with friends." Gee (p40) claims that each of us has our own "primary Discourse," that we use to define and promote our sense of self. We use

this Discourse to determine who is "like us" and who is "not like us." Figure 3 shows an integration of these social literacy constructs with the UI components from Figure 1.

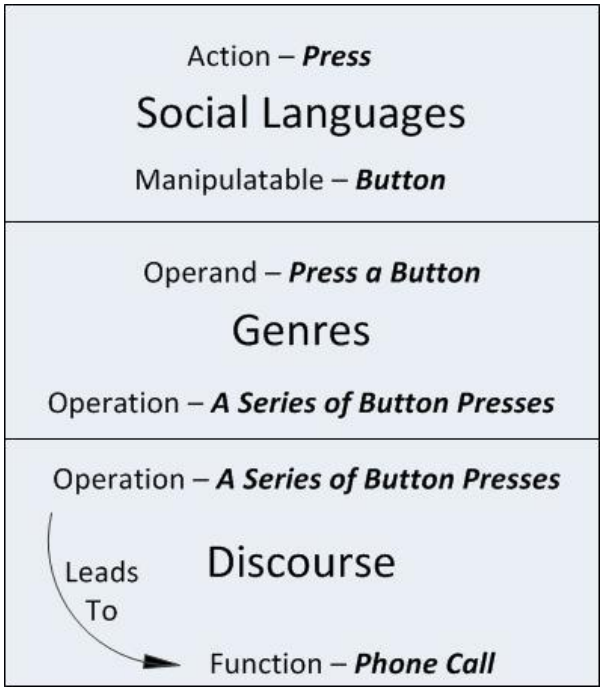

Figure 3: UI Components Embedded within Social Literacy

Discourses, on their own, are not that interesting. It is only when we start comparing them with each other and with expectations that we can really understand how applicable they are. Think about ordering a drink at a motorcycle bar while speaking Shakespearean. There is an obvious conflict there between the culture and the chosen Discourse. Gee (2007) would say that this conflict is because the Shakespearean Discourse is outside of, or in conflict with, the cultural model of the motorcycle bar. "Cultural models are images, story lines, principles, or metaphors that capture what a particular group finds "normal" or "typical.""(Gee, 2007) UIs have cultural models as well. Each UI cultural model is made up of Discourses that make sense to that culture and rejects ones that do not. Imagine an implementation where a UI expected a verbal confirmation of a password. This doesn't fit our cultural model of privacy. It also doesn't fit well in a model where atypical character combinations are used. While verbal commands are great for selecting a song or hands-free dialing, as an operation, it doesn't fit the function of password authorization.

Usage of cultural models is largely a social and subconscious process. Take an example of classic Nintendo™. What does the "A" button do? Chances are, you said "Jump." Without any video game content described, and only the context of "Nintendo," you've revealed your expectation. Many such social literacy practices have become embedded within UIs. It is only when the reality fails to meet our expectations that we notice it. To put it in UI terms, when the function performed by the device doesn't make sense given the operation we provided.

The reason such platforms as simulations, virtual world gaming, and augmented reality are so popular in New Literacy Studies is the ability to create experiences that can take one across Discourses. Gee (2004) says that our mind "works best when it can build and run simulations of experience" (p7). Regardless of the various layers of semiotics(modalities of text), any form of text is all supplemental to the underlying story (Dyson, 2003). These constructs all have embedded narrative, but let the learner get right at the center of it by allowing them to take on multiple identities, each of which can also have its own cultural models shaped by experiences. A gamer can think "about a game as a system and a designed space and not just playing within the game moment by moment" (Gee, 2004). The means by which a user interacts with this system is the User Interface, and just as every experience has a different story, it also has a different means for that "reader" to interact with the story. The more UI experiences we have, the more UI literate we become.

GROUNDING THROUGH SPECIFICATION

By establishing the notion of a UI Literacy, the theoretical parts of Literacy such as Discourses and cultural models can be embedded within a structure that is very concrete. A UI is, by nature, a set of human inputs and corresponding device outputs. Whether physically placed on a device, rendered on a screen or not graphical at all, some form of "space" exists that defines locations for all UI elements. Establishing a common framework is necessary to have intelligent conversations about how a UI can and should be implemented in the context of having literacy elements. A technical specification tying together these ideas together should be implemented to accomplish this goal.

The Sharable Content Object Reference Model (SCORM®) (Advanced Distributed Learning, 2012) Specification is an example of a technical specification. The SCORM was created as a common way for systems to track a learner's progress within web-based courseware. It provides a common vocabulary and framework to describe implementation details. This

paper begins a possible taxonomy for such a specification for UIs. This taxonomy consists of:

- A layout area – usually would have a graphical layer, which specifies the positioning, size, text, image, audio, allowed actions, etc., of each manipulatable. If not a graphical layer, the layout area could provide a "data space." In this layout, manipulatables would be made known by supplying an identifier.
- An operations area – this is where each operand would be stored, embedded within one or more operation tags. Pairs of manipulatables and actions would go together to make an operand with associated identifiers, such as scenarios where consecutive or simultaneous button presses make up a single operand. Sets of operands would combine to make operations, also with identifiers. Operations and operands would have a variety of actions corresponding to possible device inputs. The device type would largely dictate which actions make sense. (Clearly, one cannot "press" a sound).
- A functions area – specific functions of the device would be listed here by both name and description. Each function would map to one or more operation. Even transitional functions, such as "bring up Menu 2" would exist in this space.

To think about these areas in literacy terms, the layout area would be where all of the language tools are identified. The operations area would use specific social practices with tools to create genres. Finally, the functions area would map genres to specific tasks the device performs, which creates Discourses. The mapping could then be analyzed against one or more cultural models.

INTERFACE OPTIMIZATION

Grounding the Discourses of a device that uses a UI in a technical specification means the exact mapping of user operation-to-device function is now in a data format that allows sorting and analysis. By defining such paths, and the associated time for performing each operand and operation, a total time of every function can be mapped. This could allow the construction of Interface Optimization Algorithms (IOAs). An IOA is very useful in that it can detail out the fewest number of UI steps for a desired collection of implementations for a device. It could also serve to minimize the time. By applying weights of importance to each function, advanced mathematical techniques such as Linear Programming (Ferguson, 2000) can be used to determine the optimal solution. With these techniques, the appropriate cost of adding or removing a control (for example, an oven with a button that automatically takes the baking temperature to 350 degrees) can be determined.

IOAs in the previous context operate outside of a cultural model, at least if the weights are determined with factors not pertaining to a cultural model. A cultural model is valuable in that it determines which Discourses belong and which Discourses do not belong. That is, the cultural model helps determine the difference of expectation vs. reality that a set of users (or even all users) has. Take for example a microwave that has a specific button for "Popcorn." Such a button may optimize the UI for the cultural model of people that need four minutes and thirty seconds to pop corn. If this microwave were placed in a different cultural model where the popcorn only took two minutes and forty-five seconds to pop, the button would be essentially useless unless it were changed. IOAs can apply weights to certain actors and manipulatables to determine if they are indeed causing a high degree of unexpected behavior (i.e., if the popcorn time was twice what I expected). That is, it can maximize the intuitiveness of the UI and minimize confounding behavior. The designer can then make the necessary tweak to the UI to improve performance. This could be a change in vocabulary, size, color, placement, or even to the mapping of an operation.

DOES CONVERGENCE KILL DIVERSITY?

It isn't expected that such algorithms would precipitate all UIs into complete similarity (although it could) unless it were desired by the collective consumer. In this way, there could certainly be a shaping of all UIs towards a particular cultural model of device users, which could then cause more representation within that cultural model. David Nye (2007) explores the issue of cultural uniformity by analyzing what other experts have found. He cites sociologists that have "argued that industrial technologies were homogenizing people, places and products" (p68). Nye warns through Johan Huizinga, that "the more human inventiveness and exact science become locked into the organization of business, the more the active man, as embodiment of an enterprise and its master, seems to disappear" (p68). Nye's epitome of "the world of little boxes" was Levittown, New York, which as a development effort created 17,400 houses that were essentially the same (p71). He wonders if "uniformity (would) produce standardized, soulless people?"

While creating UIs that different cultures can agree upon, what can save us from this collective fate of becoming "soulless"? Customization. Nye explores the other side of the coin by looking at the diversity afforded to us by our own creativity and individuality. Levittown today is not a row of "little boxes" as it was originally. : Houses have become customized with a variety of colors, landscaping, and accessories that provide individuality (p71). In addition, the fears of becoming uniformed by economical aspects don't tend to hold true as "new information technologies are driving the financial costs of diversity – both product and personal – down toward zero." (p67). The benefits of a UI specification then, could create both a convergence to a generic cultural model, and at the same time, allow diversity towards an applied or specific cultural model, one that supports one's Primary Discourse.

Can such a world exist? It already does. Look no further than McDonald's® and Subway® restaurants. McDonald's is very good at reproducing something from a standard model. Subway is very customizable, relying on a great deal of user input to create the meal. If you had only eaten at one of these types of places and walked into the other, you would probably be quite confused. "Why can't I add tomatoes to a hamburger?" or "Why can't you just make me a turkey sandwich?" This is because there are very different Discourses involved in the ordering process of these two restaurants. In this sense, Discourses become similar to competencies. Competencies then, as Discourses, must be acquired to be able to participate or function effectively within a particular cultural model.

DISCOURSES AS COMPETENCIES

Many of the principles of competencies stem from Vygotsky. A useful summary of his work in relation to experiential and social learning appears in a Bordova and Leong article entitled "Vygotskian Principles on Teaching and Learning Early Literacy" (2003). The two most important points made are the idea of the Zone of Proximal Development (ZPD) and the idea of an evolutionary process that takes cognition from "natural" to "cultural."

The ZPD defines a set of information that consists of what a learner knows and what a learner doesn't know. The area just outside of the border is what the learner can learn easiest. This idea does seem industrial in a way, that perhaps there is a scientific process for learning everything in the universe if there were sufficient time. This is the foundation on which competencies are based – but with the added notion that everything that can be known is broken into "chunks." While the process is set up in a seemingly dehumanized, way, the criteria for determining what is in each zone are much more cultural. A learner's identity has a tremendous role in determining what information is indeed the "low hanging fruit." (Bordova & Leong, 2003)

This is in line with the second Vygotskian principle discussed in this article, the cognitive process evolving from "natural" to "cultural." The most natural process is that of stimulus. It is natural to have an observation and form a reaction (p. 247). The second step along the process spectrum is that of the use of symbols or tools, beginning in a particular context. The symbolism can be conscious or unconscious, and as it becomes more conscious, it can also be deliberate and outside the original context in which it was learned (p. 248). This deliberate externalization of tools is the third step that moves cognition in the direction of being cultural. Finally, the tool becomes internalized, and becomes part of our overall cognitive process (p. 248). Through this process, we end up consuming the very tools we use and integrate them into our core self. Since tools themselves are products of culture, their use independent of culture is impossible. Figure 4 presents this process applied to a UI that most computer users have already internalized, the mouse.

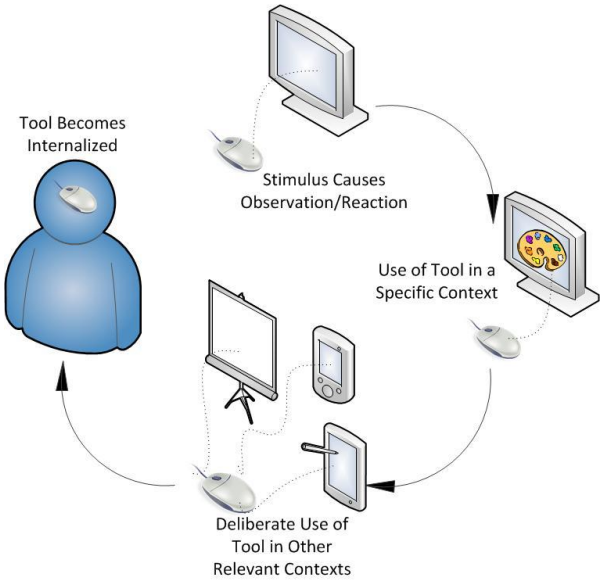

Figure 4: Cognition from "Natural" to "Cultural"

Drawing this back to the ZPD and competencies, we find in society that we are deemed "competent" in using tools for certain functions based on our culture. A hammer can be used as a weapon or in construction, and one can have proficiency with a hammer in each area. We are either familiar or unfamiliar with various

Discourses within one or more cultural models. Finally, applying this to user interfaces - we become familiar, or gain competency with, devices or certain brands of devices as we further recognize the relationship our actions have with the functionality of the device(s).

CONCLUSION

By both understanding and articulating the different Discourses of UI literacy, we can provide those using the new devices with the information they need to successfully use those devices. We can enable the "guide" that helps "iPhone people" also become "Droid people" and vice versa. On perhaps a more practical level, if they are using a new phone from a **different** manufacturer than they are used to (not a known Discourse), we could point them to New User directions; but if they had previously owned a phone from this manufacturer, point them to Experienced User directions. Another practical creation could be the "top 10" things you need to know based on the competencies you have as your Primary Discourse. The provision of information could also be flipped on its head. Why make the user adjust their Discourses if they are unable or unwilling to do so? Left-handed players playing the popular video game "Guitar Hero" aren't expected to play right-handed. The game allows players to customize the UI to a left-handed play style. Currently, most UIs require a higher degree of understanding to customize them. A UI designed with literacy in mind could customize itself based on a user's cultural model (based on product history and identity) or Primary Discourse (based on competencies).

Martin Heidegger said that human beings come to be defined as beings-in-a-situation. (Margonis, 2010) We are all shaped differently by the different situations we find ourselves in throughout life. We are all culturally dependent and in some way, connected. With the multiple identities afforded by different technologies that support "text" and a story, we can assume the cultural model of a variety of Discourses, even if our Primary Discourse, or core self, doesn't prescribe to them. In training members of the global force, who are confronted by the most complex situations, we cannot underestimate the value of being UI literate. The most powerful technology is useless if we cannot interface with it properly.

REFERENCES

Advanced Distributed Learning (2012). Retrieved June 3, 2012 from http://www.adlnet.gov/capabilities/scorm

Anstey, M. and G. Bull. *Teaching and Learning Multiliteracies: ChangingTimes, Changing Literacies.* Newark, DE: International Reading Association, 2006.

Bordrova, E. & Leong, D. (2006) Vygotskian Principles on Teaching and Learning Early Literacy. *Handbook of early literacy research. Vol. 2* Neuman, S. B. & Dickenson, D.K. New York: The Guilford Press.(2003)

Dyson Anne H. (2003) Writing and Children's Symbolic Repertoires: Development Unhinged . *Handbook of early literacy research. Vol. 2* Neuman, S. B. & Dickenson, D.K. New York: The Guilford Press.(2003)

Ferguson, Thomas S. (2000) "Linear Programming: A Concise Introduction." Retrieved June 3, 2012 from http://www.math.ucla.edu/~tom/LP.pdf

Gee, James Paul (2003) A Sociocultural Perspective on Early Literacy Development. Neuman, S. B. & Dickenson, D.K. (Eds.)(2003). *Handbook of early literacy research.* New York: The Guilford Press.

Gee, James Paul (2004) *Situated Language and Learning: A critique of traditional schooling*. New York and London: Routledge

Gee, James Paul (2007) *What Video Games have to Teach Us About Learning and Literacy.* New York: Palgrave MacMillan

Linux Information Project, The (2007). Retreived May 30, 2012 from http://www.linfo.org/user_interface.html

Luke, A., and P. Freebody. "Further Notes on the Four Resources Model." 1999. Retrieved May 30, 2012 from http://www.readingonline.org/research/lukefreebody.html

Margonis, Frank (2010) *From Student Resistance to Educative Engagement*. Studies in the Postmodern Theory of Education, Vol. 259. New York, Washington, D.C./Baltimore, Bern, Frankfurn arn Main, Berlin, Brussels, Vienna, and Oxford: Peter Lang

New London Group (2007), Retrieved June 3, 2012 from http://www.newliteracies.com.au/what-are-new-literacies?/116/

Nye, David E. (2007) *Technology Matters – Questions to Live With.* Cambridge, Massachusetts and London, England: The MIT Press

Strop, J.M. and .J. Carlson. *Multimedia Text Sets: Changing the Shape of Engagement and Learning.* Winnipeg, MB, Canada: Portage & Main Press, 2010.