The Virtue of Paper:
Drawing as a means to innovation in instructional design.
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Abstract

This chapter presents an argument in favor of using paper to conceive, plan, and describe instructional design projects. Such a simple medium has great capability and, as is well known, a tenacious ubiquity; our offices, practices, and lives are filled with paper. We will see how the attributes of paper help us in both social and cognitive ways, particularly as a medium for drawing.

Prologue

It was a peculiarly beautiful book. Its smooth creamy paper, a little yellowed by age, was of a kind that had not been manufactured for at least forty years past. He could guess, however, that the book was much older than that. He had seen it lying in the window of a frowsy little junk-shop in a slummy quarter of the town (just what quarter he did not now remember) and had been stricken immediately by an overwhelming desire to possess it…. Winston fitted a nib into the penholder and sucked it to get the grease off. The pen was an archaic instrument, seldom used even for signatures, and he had procured one, furtively and with some difficulty, simply because of a feeling that the beautiful creamy paper deserved to be written on with a real nib instead of being scratched with an ink-pencil. Actually he was not used to writing by hand…. He dipped the pen into the ink and then faltered for just a second. A tremor had gone through his bowels. To mark the paper was the decisive act (Orwell, 1948, p. 23).

In this passage, Winston is about to engage the simplest, most immediate medium—pen and paper. His creative process will be unencumbered by layers of technology involving complex skill sets, which, even when mastered, place their own restrictions on their user and become to some extent autonomous. Central to this act is his own intellect, and he recognizes the danger and importance, the intent of the mark, and its ability to connect with others.

Introduction

However we use a notation system, a visible language must build on our human experiences. We choose the media and which technologies we work with, and we make those choices based on our social and cognitive practices. Winston Smith's use of paper embodies human attributes that are politically rebellious: the capacities for private notation and independent thought.

Our current challenges are not so much in the technological systems we use, but in how people conceive, develop, and disseminate ideas through media. The choice is not how to use a new technology or software to visually notate our process of instructional design, but rather how to use visual notation to innovate and improve instructional design and education.
Communication, creative thought, and interaction in complex processes must be addressed by meeting the needs of the human element of design.

**Knowledge work and visual notation**

The focus of our effort is instructional design, the creation of materials for and the structuring of instruction itself. For our purposes here, instructional design is the knowing use of technology for the assistance of learning, and more recently, specifically the use of computer- and internet-based technologies in the service of learning.

Instructional design can be described as “knowledge work” as described by Peter Drucker (1999) and others, and this description may help us understand the use of paper in the field by comparison with other professions. Knowledge work is a classification of work that involves the generation, development, and implementation of ideas. It can be described as work where the true means of production is the knowledge of the worker. Other fields engaged in knowledge work include the law, surgery, and architecture. Knowledge work is generally complex, quite often socially grounded, and involves complicated technical issues. Knowledge work often requires significant education or training, and the work is generally done in organizations and/or teams. Designing, including instructional design, is knowledge work.

Many of the activities of knowledge work are verbal and visual. They involve sharing, recording, notating, and creating ideas—most supported by some technology, the most ubiquitous being paper. There remains, as we shall see later, a continued use of paper in this electronic age. Knowledge work, particularly design, is tied to the use of paper because paper allows visual notations more easily than other media. It is faster, simpler, more immediate, and less separated (or mediated) from our thoughts.

Later in this chapter, architecture will provide a good comparison to instructional design for its use of notation systems: it has similarly complex technical issues (of building and construction); it is socially based, often practiced within a firm and with clients; and it addresses theoretical and philosophical issues in application. While architecture may result in visual form more than most instructional design, it still provides a strong analogy for an examination of design methods and tools as applied to instructional design.

The general field of design can be said to have evolved from craft when need arose to separate the work of creation from the work of production. Within design, visual notation is needed to create, direct, and communicate. "It is, above all else, the separation of designing from making and the increased importance of the drawing which characterizes the modern design process" (Lawson, 2000, p. 241). Drawing, what first developed as a means to direct others in the making of the end product, has also evolved other purposes, notably to support the imagination. The word design, of course, derives from a Latin word meaning "to mark" or draw.

Design as a profession and as a practice is methodological, purposeful, and goal oriented. It examines the entire problem, seeking a broader understanding, rather than small improvements addressing known problems, as does craft. Both craft and design seek applied solutions; the craftsperson creates the result, while the designer directs others in doing so
generally through visual means. Advances through craft will be incremental, i.e. minor continued improvements in efficiency or detail; advances in design work may be significant changes or substantial improvements. Currently, much instructional design is craft based, seeking detailed changes in the end product, and often building from existing models of instruction. For greater innovation and invention to occur, however, changes in the design process are necessary.

Paper

Throughout history, visual notation systems for information recording, conveyance, and investigation have been tied to various media, most frequently paper. Since its broad production and use, paper has helped fuel the development and communication of the world's knowledge.

Over the past twenty years, electronic communications methods and media have rapidly developed—newspapers, books, and whole libraries are now accessible online, and many people work using computers, particularly in knowledge and information fields. However, while management, communication, and production in instructional design is done principally on computers.

Paper remains as important in our knowledge stream today as ever before.

The goal of the paperless office

The computer and information revolution have significantly changed our work habits and our understanding of information. The concept of “atoms vs. bits” (Negroponte, 1999), of analog vs. digital, and advanced vs. appropriate technology all pressed us forward to embrace computer technology. Not using the latest technology in the workplace is considered laggard or Luddite. As knowledge workers, we are centered in the use of computers, and paper is passé. The conversion, quasi-religious, is not complete:

Yes, I've been to the crossroads and I've met the devil, and he's sleek and confident, ever so much more "with it" than the nearest archangel. He is casual and irreverent, wears jeans and running shoes and maybe even an earring, and the pointing prong of his tail is artfully concealed. He is the sorcerer of binary order, jacking in and out of terminals, booting up, flaming, commanding vast systems and networks with an ease that steals my breath away. … Do we know what we're doing? Do people understand that there might be consequences, possibly dire, to our embrace of these technologies, and that the myth of the Faustian bargain has not become irrelevant just because we studied it in school? (Birkerts, 1994, p. 211)

The "paperless office" remains as a broadly held belief; however, in real life, the use of paper remains important in the workplace.

Computer technology was supposed to replace paper. But that hasn’t happened. Every country in the Western world uses more paper today, on a per-capita basis, than it did ten years ago. The consumption of uncoated free-sheet paper, for
instance—the most common kind of office paper—rose almost fifteen percent in the United States between 1995 and 2000 (Gladwell, 2002).

If we examine our own work experience through reflection and the work habits of others through research, we can see the continuing use of paper for knowledge work and the reasons for its persistence. For example, while we use email constantly, the promise of paperless communication has not been achieved. In truth, as organizations install email systems, paper use increases on average by 40% (Sellen & Harper, 1997). With email, we use more paper. Why?

**We know how paper is used in our own experiences**

Our own work experience can provide a base for understanding the role of paper in the knowledge workplace. We understand first hand the use, ubiquity, and commonality of paper. The management of "paper" is considered a hallmark of modern professional travail; the clutter of our homes comes significantly from paper; organizations seek to decrease the use of paper and encourage its recycling. We print documents to read and edit, guilty about our use of the world's resources, and about our failure to fully achieve digital literacy.

In general, knowledge workers make a series of choices that take advantage of how to use media. More often than not, we make rational and understandable choices to use paper. For example, we print out email to have a handy record of a communication. We write numbers, names or ideas on available pieces of paper. The grocery list is put on the back of envelope, phone number on a sticky note, and contact information is embellished on the back of a business card. We print out documents to read and annotate; our well-read books are marked up and personalized, the notations becoming part of the cognitive record of reading.

Some of these choices are due to the simple physical attributes of paper that are easily recognized. Paper is (among other characteristics) generally inexpensive, lightweight, light in color, translucent, durable in most situations, easy to use, easy to mark, and readily available. These physical attributes help determine for what it can be used, i.e. its capabilities or affordances.

Affordances, per Gibson, are those capabilities, properties, and attributes of a tool or medium that "...make possible different functions for the person perceiving or using that object" (Gibson, 1979, p. 24). We often make choices about media use by weighing various affordances, choosing media with a perceived relative advantage for our own use.

For example, we chose to write the grocery list by hand on a used envelope instead of on the laptop because it is lighter and more transportable, more easily carried to the grocery store. While it is possible to carry the laptop to the store, we quickly understand that it would be easier to use a lighter weight scrap of paper to help remember grocery items. We mentally and often unconsciously weigh these attributes when we pick up a piece of paper.

Imagine the process of writing the list on one's laptop to illustrate an alternative choice: go to the laptop, start the laptop, start the word processing program, write the list, visit the refrigerator to check current supplies, start the printer, print the list, close the program and
laptop. One could choose to carry the laptop to the grocery store in lieu of printing the list, but that would raise additional difficulties.

We often know it is much easier to use paper without going through a conscious decision making process. We use paper because it has the capabilities we need for the tasks we are performing. It does what we need it to do simply.

**Affordances of paper for knowledge work/design**

Within the scope of simpler tasks, we understand what works well, knowing needed skills and effort. We use what is easy and cheap, paper, the affordances of which stand well apart from our digital tools. There also are more complex or sophisticated affordances of paper that are tied to knowledge work, particularly is how we use paper as individuals and within groups to understand and think.

- **Navigation:** The tangibility, the physicality, of paper helps one navigate and understand a document. Through spatial understanding, through representation of (textual) location, and through a physical gauging of location, we understand the structure of a document. One can understand, visually and haptically, progress in reading a large document or the ease with which one could read a thin children's book. We can find summarizing arguments in many books at the end, and the initial challenge of the author at the beginning. We know the main body of the book contains supporting information in greater detail.

- **Cross referencing:** Spatial flexibility allows the easy comparison of multiple documents, cross referencing between multiple pieces of paper. Multiple documents can be arrayed on a surface and easily cross-referenced, even between paper and electronic sources.

- **Annotation:** Paper based documents can easily be annotated using textual or symbolic notation, using pen or pencil. These marks vary from structural reorganizations to textual comments to visual representations, often all within the same document and using the same marking system.

- **Manipulation:** Paper allows for the multi-dimensional display and reorganization of documents. For example, paragraph five can be physically put at the end of the report, or an image can be located for connection to the text. The manipulation of paper materials is grounded and first hand. For example, we can examine the difference between paper collage and digital collage. There are real limits to a paper collage. One must budget unique resources, and creation is tied to real constraints of paper, cutting, shaping, and gluing. This is contrasted to the weightless world of the digital creation, which is unlimited and, in the end, without gravity. The paper collage is, however, immediate, personal, and unique.

- **Placeholding:** Paper documents serve as cognitive aids to memory; they remain as left until addressed. They are a constant reminder of tasks undone.

- **Portability:** Paper is portable and can be carried to various locations untethered to one's workplace, e.g. away from one's computer. It can be read in the park, handed to an airline ticket agent, or presented to a flight attendant when "all electronic devices must be turned off". Is it not place bound, tied, at the least to an Ethernet wire or a battery pack.
These capabilities of paper do not mean that other digital systems are not useful; these observations mean that the use of paper is often part of the complete process of idea and document development: A document may be initialized and finalized on the computer, but in the process, it may be converted back and forth to paper many times.

Yet, if the computer is the canvas on which documents are created, the top of the desk is the palette on which bits of paper are spread in preparation for the job of writing. Without these bits of paper ready to hand, it is as if the writing, and more especially the thinking [italics in original], could not take place in earnest (Sellen & Harper, 2002, p.1).

These affordances can be contrasted to computer-based electronic systems; all of the tasks could be accomplished using a computer. But all would require substantial investment in technology, skills, and cognitive effort. The tasks would be divorced from direct human intervention and not grounded in the real world. Computers and most software packages separate users—through interfacing such as keyboards, mice, screens, and requirements to learn and often extensively develop skills—from the act of creation.

While paper has substantial value for text-based communication and notation, it is also well suited to use to convey visual images or notation. Paper, broadly defined, is a surface for making marks that require little experience; a separate program or marking tool is not required. Most people have sufficient skill in non-textual visual representation, i.e. drawing, to accomplish rudimentary representations and to decode visual images (Goldschmidt, 1999). This is often more efficient than text alone. The hand, unlike computer programs, has never had a significant division between writing and drawing, between textual notation and visual notation. While skills may vary, the medium is not forcing the use of word or image on the page; a mark is a mark, whether text or image, or visual notation.

**Empirical evidence of paper supported knowledge work**

Sellen and Harper (2002) found that knowledge workers employed paper in ways that were complex and sophisticated, and which also illustrated some of the nature of knowledge work. Their research involved observing work in air traffic control, financial management, and policing. Authoring, reviewing, collaborating, and interacting socially were all supported through the use of paper, even when electronic media for communication were available and well understood.

Authoring, an important component of knowledge work, is well supported by paper. As noted, digital technologies may be used for the finished product, but the actual composition of ideas is done through a combination of paper and digital technologies. We write, compose, draw, create on paper. We may implement those ideas through other media—digital software, oil paint, buildings, and sculpture—but we make our initial authoring choices generally on paper. Even authors who extensively used word processing software move back and forth between print and electronic versions of their work.
Knowledge workers also tend to review the work of others on paper, both for approval and for their own understanding. We understand information through the formation of our own knowledge, and part of the formation of our knowledge often occurs by marking written text.

Similarly, knowledge workers often plan their work using paper, where a lack of imposed structure affords ease and flexibility in jotting down notations, making diagrams, marking emphasis, or connecting ideas. Word processing, by comparison, focuses one type of information and is structured for written documents on a page. The diagram sketched by hand into the paper document is easy; that same diagram in an electronic document requires many additional steps and substantially more skill in software use.

Collaborative activities are also often more easily undertaken through the use of paper. Paper allows the sharing of a common document and making of multiple and diverse marks on it. Knowledge workers can pass around a draft, or even copies of a draft, for annotation and review. Paper often provides the media to record ideas, plans and discussion for working groups. Examples of collaborative paper or paper-based activity in the workplace include the large paper easel pads used to record and archive ideas in team brainstorming sessions, or sticky notes used to plan staffing or procedures.

Finally, paper is often used as a reason for added, informal interpersonal meetings, greasing the wheels for further creativity. Written documents, such as a report or a memo, are often delivered in person. This provides an opportunity to review the materials with the intended audience and to increase creative social interaction in the workplace. Such documents could often be sent by other means, such as email, but the personal meeting is valued more highly than electronic expediency.

One of the most developed paper-based collaborative systems is the A3 Report used by Toyota. "These single page data-dense reports are used as part of a process to gather information, share information, make comments, track progress and graphically represent the improvement process" (Liker and Meier, 2006, p. 201). The A3 Report method involves using one side of an A3 sized piece of paper. "It allows only the most critical information to be shared with others for careful evaluation of the thought process used, as a means of requesting support or advice, and for arriving at a consensus."

Initially, A3 Reports were developed as a standardization choice allowing worldwide communication through a single, simple format: "...this was the largest size paper that could fit in a fax machine: 11 x 17 inches" (Liker & Meier, 2006, p. 203). While the documents could be done in electronic form, the use of paper allows for easy distribution, broadly distributed use, and allows input from all. They are dynamic and collaborative documents, not frozen and uni-directional PowerPoint presentations (Sobek & Jimmerson, 2004).

A3 reports are a hallmark of the "lean" management movement. These single pages of A3 sized paper are used for planning, communicating, generating new ideas, and resolving problems. Use of the single sheet for planning reports forces conciseness, summarization, and organization of thought. The reports, consistent with Toyota management principles, are highly structured, yet created to encourage ongoing input, including editing and marking, by others.
The value of the A3 report is that it ensures communication, either formalized or incidental. Reports are duplicated and presented to others for input. The development of the A3 document is often done in teams or collaboratively; reports can be printed or posted for review, and are easily folded for inclusion in a notebook. Informal annotation of the A3 reports by others, including on the factory or shop floor is encouraged as part of the ongoing process.

**Drawing as a means to design**

Much of our understanding and use of paper is for text; most of our communications efforts are centered around words and writing. However, beyond the linear use of one symbol system, writing, is an entire array of ways to communicate more effectively and expressively. Drawing, a visual notation system, is central…and common to all design fields. Historically, humans have relied on drawing to communicate.

"Drawing is a kind of Universal Language, understood by all Nations. A Man may often express his Ideas, even to his own Countrymen, more clearly with a Lead Pencil, or Bit of Chalk, than with his Tongue. And many can understand a Figure, that do not comprehend a Description in Words, tho' ever so properly chosen. (Benjamin Franklin, 1749)

Central to the use of paper is the ability to generate graphic images or diagrams easily. For the architect or artist, these images are essential to their creation: Drawing, or “making marks,” is an act of decision and exploration. Designers make marks, adjust symbols, manipulate forms, and from that manipulation and iterative design process develop new and better ideas (see for example, Waters & Gibbons, 2004).

How we view visual notation, drawing, is an important key to advancing instructional design. If we use it solely to communicate, we will limit its effective use. Communication with colleagues and clients is an important use of visual notation, to be sure, but more importantly, drawing can serve other functions in our design process. It is where we can generate ideas, it's principle role in many other design fields.

Why is drawing effective in the development of ideas? Visual form is instantly recognizable, and at the same time encourages interpretation. The generation of visual forms allows the abstraction of ideas and the summarization of complex concepts. One can scribble a drawing, change it, and reinforce one's thoughts. It is “media-as-environment,” a place for the development of ideas (Meyrowitz, 1999, p. 45).

**Reasons for drawing**

In the design fields, drawing or visual notation is central to the design process and is used for a variety of purposes, ranging from the presentations to the public and reviewers, to the cognitive efforts of individual practitioners.

A drawing is like a theatrical scrim, a gauzelike screen whose properties change dependent on lighting conditions. Like a scrim, a drawing is both opaque and translucent, a filter between the drawer and viewer, drawer and object, between
ideas conceived and their two-dimensional manifestation. A scrim and a drawing both prevent as well as allow view, asserting their presence with varying authority and in different ways. When the back light turns on, the scrim disappears. In a similar way, drawings dissolve and open a world of rich possibilities (Fraser & Hemni, 2000, p.18).

Both Lawson (2004) and Fraser and Hemni (2000) describe multiple functions for drawing in the architectural design process; drawing is used to plan, to communicate, to convince, and most importantly, to ideate (See Figures 1-4). Each of these modes of drawing can be applied to use in the field of instructional design. They types of drawings include:

• **Public Communication**: Most design work in architecture is very public; public reviews are common. Many drawings in the design fields are used to present work and communicate intent to outside parties. In architecture, plans are reviewed by government agencies, clients, and communities. These drawings can be described as presenting a positive and finished image to the public (Lawson, 2004). Drawings may be used to support marketing of buildings, securing public approvals, or in convincing a client of the project's value.

Within instructional design, there currently is less use for representation of design work, as often the preference is to have non-working digital models for presentation of early stages. In architecture though, the economics of physical construction compared to the cost of producing a digital prototype encourages visual and often animated representations.

One other comparison for the field of instructional design would be movie production. The development of movies is based on an extensive series of drawn visual representations, storyboards, and iterative representations as the cost of final production is quite high. Most animated movies such as Disney/Pixar's *The Incredibles* (Walker, 2005) are extensively developed on paper in hand drawn form prior to the computer based rendering of the final product.

• **Work communication**: Drawings are extensively used to communicate within the field of architecture. These may take the form of diagrams, representations of data, or representations of ideas. The value of this type of drawing or visual notation is beginning to be well understood in the field of instructional design (cf. Botturi, 2006). Design teams in all areas need to communicate structure, sequence, and organization of their work; visual representation and notation can provide a better understanding than by text alone.

• **Vendor communication**: Drawings are commonly used to communicate directly with those providing services or products; within architecture, some drawings have the legal force of contract and are literally called "Contract Documents." As more of the actual production work in instruction design is done by outside vendors, communication will become a higher priority. Much of this communication will be verbal, but visual notation and communication will also be increasingly valuable.

• **Development testing**: Many ideas cannot be fully understood unless represented visually and those ideas are often explored through drawings. Understanding complex and intricate technologies can be assisted through the use of drawing. For example, the efficient layout of clothing patterns on milled fabric is important for cost effective production; developing
hypothetical layouts of furniture in visual form by interior designers helps understand room use; and urban designers use visual models to understand the ramifications of zoning laws. If verbal annotation is helpful, diagrams, visual representations, or mapping is more so.

In the virtual world of technology-rich instructional design, the real world limits of room layout, fabric width, and neighborhood density aren't immediate concerns. However, early development of screen designs could benefit from rapid visualization through hand-based drawings, and hand drawn maps are a good starting method for web site design.

• **Research drawing:** Architects and others also use drawing as a means to understand observed phenomena. The “grand tour” of Europe, undertaken as part of formal studies in architecture, is often documented with drawings in a sketchbook. Not mere drawing practice, this custom helps the architecture students cognitively engage and internalize what they see.

Most travelers today carry a camera and forsake the personal time and engagement of drawing what they see, yet for most the cognitive residue of taking a photograph is minimal while the understanding gained by drawing one's observation is long lasting. In Japan, hikers still climb Mount Fuji to paint the sunrise. Again, the reflective experience is of considerably greater value.

Drawing as a tool to research and understanding is not limited to architects and tourists. Early scientists, including Sigmund Freud, used drawing as a means to understand and develop ideas.

"In the latter part of the 19th century, German researchers considered drawing to be instrumental to scientific discovery, both as a way to capture the microscopic detail of nerve cells, for example, and to illustrate theories of how the brain might work” (Gamwell, in Carey, 2006, unnumbered).

For example, Darwin's drawings were essential to his seminal work in *The Origin of Species*. And the recorded anatomical observations of Leonardo da Vinci are early examples of the use of drawings for research. Mechanical or electronic reproduction of visual images does not require the same cognitive effect as the engaged and personal representation.

• **Sketching as visual thinking:** The most important aspect of drawing is its ability to help create and develop new ideas. This type of drawing, called "study sketching" by Goldschmidt (1999), and "design drawings" by Fraser and Hemni (2000), occurs in many fields. It is finding answers to complex problems through visual representation, and is "…practiced by individuals who attempt to conceive of a new entity, be it a work of art, a building, a technically-oriented invention or novel artifact, or a scientific concept” (Goldschmidt, 1999, unnumbered). Many design fields such as architecture, graphic design, and industrial design have active histories of design sketching. This process is drawing to invent, to generate the new, drawing to create.
This type of drawing is often intensely personal. It is a one-to-one visual conversation with oneself through the medium of drawing, and it is generally not meant for extensive communication. Such sketches can be decoded, understood, and valued by knowledgeable others, but their primary purpose is one of supporting thought.

The imperfect feedback (or "backtalk" per Goldschmidt, 1999) of media is an important component of the design process. Representing an idea through drawing is not always an exact science; through the vagaries of the media, the roughness of the paper or bleed of ink, or even through the inaccuracy of the hand, differences and changes occur. This can be a conversation as challenging as an engaging argument with a peer, and it is where ideas develop. Lawson (2004) calls these drawings “proposition drawings.” “These are drawings where a designer makes a 'move,' or proposes a possible design outcome” (p. 45).
Designing, particularly within architecture, is often iterative, making a series of choices within a larger conceptual goal. This type of drawing becomes game-like, combative, an interactive argument, and, as often described, conversational. It is an interaction with a sheet of paper, akin to “thinking out loud,” helping ideas and decisions emerge from the page, away from the brain, in a two dimensional use of symbols comparable the leap to writing envisioned by Ong: Thought requires some sort of continuity. Writing establishes in the text a ‘line’ of continuity outside the mind”. (Ong, 1982, p. 39). Drawing expands this capability in multiple dimensions.
Figure 4: Preliminary site concept drawing for Cambridge Community College, Minnesota, USA. Courtesy Hokanson/Lunning Associates, Inc., architects.

This method of drawing is closely related to the concept of cognitive tools developed by Jonassen and others to describe the use of computer based tools to investigate various hypotheses and directions. A spreadsheet, for example, can be used as a cognitive tool to define, structure quantitative relationships, and to iteratively advance various numerical scenarios. The use of drawing in design can easily fit within Jonassen's (1996) description of cognitive tools as "…readily available, generic applications; they are affordable; they are used to represent knowledge in content domains; they are applicable across different subject domains; they engage critical thinking in learners; they facilitate transfer of learning; they are simple, powerful formalisms; and they are reasonably easy to learn" (p. 709). How parallel is Goldschmidt's description of the cognitive mechanism of drawing: "…this is a ‘front edge’ process in which partial and rudimentary representations are produced, evaluated, replaced by others if need be, transformed, modified and refined, until their maker is satisfied with the result." (1999).

As we have seen, the visual notation of architecture, drawing, serves a wide variety of needs, which can be compared to the work in instructional design. Drawing, i.e. paper-based, free flowing visual notation, has value on many levels, from public communication to private cognition. In both fields, ideas and concepts need to be explored and described in ways beyond simple text. Similarly to architecture, the drawing of instructional design must be free flowing, inventive, both personal and public, and easily used.
Visual notation must have both a cognitive and practitioner base in drawing, a basis gained by making marks by hand on surfaces, which occurs most easily and commonly on paper.

**Drawing on paper**

Media, of course, are needed to communicate and to support thought. The use of some technology is necessary to extend our thoughts to others. But the type and extent of media technology imposes change on the message and change on the process. Two things stand out: first, the cognitive load and communication skill required to use more complex technologies detracts from the capacity for thought. Using simple media allows greater concentration on the task at hand – design, information, communication, or invention.

Simpler media also impose less of their own structure on the interchange and allow a freer form of idea development. Software is an indispensable tool of instructional design, but any software, as a medium, structures the results, “perfecting” ill-formed ideas in its own likeness. (Drucker, 1999). For example, a word processor often completes or re-spells words; presentation programs such as PowerPoint utilize wizards to summarize presentations, limiting expression and communication (Tufte, 2003), and desktop publishing programs make some layouts easier to use than others, encouraging their use.

*If the meaning of Goethe's Faust, of Van Gogh's Landscapes, or Bach's Art of the Fugue could be transmitted in discursive terms, their authors should and would not have bothered to write poems, paint, or compose, but rather have written scientific treatises (Von Bertalanffy, 1965, p.44).*

Media biases communication, whether the media is computer based software or oral speech (Innis, 1951). The clearest, easiest, and least biased use of visual notation (for the foreseeable future) will occur through the use of drawing directly on paper.

**Conclusion**

We have seen, through both our own experiences and through research, that paper continues to be an important component in knowledge work, the work of thinking, invention, design, and innovation. This will be the important work of the coming century, and it also includes instructional design. Paper will continue to be used for a number of reasons, both common and complex. In modern society, it is always present, inexpensive, light weight, flexible, and relatively stable. We note things on scraps of paper or in more developed notebooks, on agendas, on programs, and on napkins and note cards. It also has value in more complex ways; it remains less mediated than computer based communication as fewer processes are needed to use and understand it. Further, paper provides abilities in the areas of editing, annotation, collaboration, and manipulation that remain more difficult on the computer; and it supports close interpersonal contact in meetings, conveyance, and personal delivery, i.e. it encourages face-to-face social interaction.

Our ideas come from our use of media. While the other tasks of visual notation or drawing that are primarily representational are important to the process, the generational aspects of any notation, whether drawing or writing are paramount; drawing is a cognitive tool, unmediated through a computer.
Perhaps the most critical element in the use of drawing or visual notation is the ability to generate ideas, to create within this simple medium. Ideas are created through various processes, through thinking, working, communicating, and experimenting. They are not birthed fully formed. Highly developed programs and media short-circuit the process and pre-structure the results. Ideas need an environment, a medium that allows their formation like a cloud of matter coalesces into a planet; an environment for the growth of ideas.

While Einstein was able to mentally generate images, most mortals require some sort of cognitive assistance and some exploration with an external medium. Few humans can completely envision the results of their ideas, whether that is quantum physics, mathematical examples, or designing a new bathroom. This envisioning must occur with ease, with the tools at hand, with the least mediation. That is why Sellen and Harper (2003, p. 185) have written that “the reality [is] that the workplace of the future [is] full of paper.” And it's marked with the results of our thinking.

As we develop a common symbolic language for instructional design, we may learn from the work of Christopher Alexander, architect, and author of *Pattern Language* (1971). The book extensively explores hundreds of architectural elements in diagrammatic and photographic form. Ideas for houses, cities, rooms, and spaces are examined and diagrammed as a means to understand the richness of architecture. Far from a template for design, it can better used as a descriptive observation of the built environment, an artifact from Alexander's own observations. What was most important was the making, not as a product for codified reuse.

While there are a number of computer based notational systems in use, there remains no common system for instructional design. The development of any notational system must be more than a one-off program; it must be based in the human process of design and development, and its use must be easy, inexpensive, shared, and widespread to be of value. Designers will need to use the system on an informal and unmediated manner. They have to be able to use it without a computer, anytime, anywhere, and at a moment’s notice.

Such a system will evolve bottom up, through usage by drawing, much as the rules of writing have evolved from informal oral speech: "The rules of grammar in natural human languages are used first and can be abstracted from usage and stated explicitly in words only with difficulty and never completely (Ong, 1982, p. 7)."

Visual notation in design must encompass many tasks. It will be used for communicating with other team members, but will also be used to plan out tactics and set goals as an decision recording method, to define components created by others, to present ideas and progress to clients, or to develop ideas for the invention of new forms of instructional design. What is not needed is a canned set of symbols, like logos, icons, templates, or emoticons, but a broad based development of representational or generational skills: skills at conceptualizing, summarizing, editing, communicating, organizing, ordering, and structuring for instructional designers. In simpler terms, instructional designers need to draw to plan, to conceive, and to communicate.
References:


