# 49

# User-Centered Design and Development

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**CONTENTS**

## ABSTRACT

This chapter surveys methods, techniques, practices, and challenging issues in user-centered design and development (UCDD). The traditional instructional systems design (ISD) approach has been criticized for its bureaucratic and linear nature and its slow process. Two alternatives to that approach are discussed here: rapid prototyping and participatory design. These have been put forth as alternative models that address the many limitations of the conventional ISD model.

## KEYWORDS

*Participatory design:* A user-centered design approach in which users are actively involved in the design process of a system or product that addresses their specific needs.

*Rapid prototyping:* A user-centered design approach in which users participate in a rapid, iterative series of tryout and revision cycles during the design of a system or a product until an acceptable version is created.

*Usability:* The ease with which humans can use a system or a product to accomplish their goals efficiently, effectively, and with satisfaction.

*User-centered design:* A design philosophy and approach that places users at the center of the design process from the stages of planning and designing the system requirements to implementing and testing the product.

## INTRODUCTION

One of the most frequent and important challenges faced by instructional technologists is how to design and develop a product or program that both supports users' learning and performance in an effective and efficient manner and also generates user satisfaction. Recently, new approaches to the processes used in instructional design have been proposed and explored. Many researchers have pointed out that the traditional instructional systems design (ISD) approach is reductionist in nature and that it tends to solve a problem by fragmentation, one stage at a time (Finegan, 1994; Jonassen, 1990; You, 1993). In Gordon and Zemke (2000) and Zemke and Rossett (2002), several researchers and practitioners attacked the traditional ISD approach for its bureaucratic and linear nature, as well as its slow and clumsy processes.

The adoption of user-centered design and development (UCDD) into ISD is vital for designing systems that better serve users' needs (Willis and Wright, 2000). If ISD does have to go through a paradigmatic transition, along with changes in the educational and socioeconomic environment, then the new paradigm of ISD must reflect these environmental changes. This would mean that the ISD process should become more user centered, more cost and time effective, and more performance focused.

The concept of UCDD is to place users at the center of the design process from the stages of planning and designing the system requirements to implementing and testing the product. UCDD appears in many different forms within design approaches. In this chapter, we have chosen a philosophical approach to object and systems design, participatory design (PD), and a particular process, rapid prototyping (RP), to elucidate the overall perspective of user-centered design. First, we review the big picture for UCDD, then we examine the participatory design approach—beginning with its historical background and then focusing on the different participation levels within this approach. This is followed by a description of rapid prototyping and a discussion of its challenges. Before concluding, the UCDD approach is reviewed in light of instructional design paradigms.

## THE BIG PICTURE FOR UCDD

### Key Elements of UCDD

What is UCDD? As Bannon (1991, p. 38) stated, "What the term user-centered system design means or how it can be achieved is far from clear." To begin sorting the issue out, we observe that there are two types of approaches to design and development: product-oriented and process-oriented. The product-oriented approach focuses mainly on the creation of a product. The utilization of the product can be a fixed and well understood idea; this means that design requirements can be determined in advance. The process-oriented approach requires designers to view their entire process of development in the context of human learning, work, and communication (i.e., use). The usage of the product in development takes place in an evolving world of changing needs. This involves certain advantages but also imposes various constraints. Because change is the norm in the process, prior specifications for an end-product are not predetermined completely. In UCDD, plans are just the beginning of the process, but the main mission is not conforming to the plan; rather, it is responding to changes throughout the life cycle of the project.

Our focus here is on process-oriented approaches, specifically those that fall under the sociotechnical umbrella. The sociotechnical perspective considers not only technical aspects of a system (tools, techniques, procedures) but also social aspects (people, network of roles, relationships, and tasks) (Goodrum et al., 1993; Mumford, 1983). To be able to implement the sociotechnical approach in system design, information must be extracted from the social context.

User-centered design and development can be considered a subcircle of the sociotechnical approach. UCDD and the sociotechnological perspective are guiding philosophies, not specific methods or processes for design. The idea is to approach design with knowledge of and the will to utilize social and cognitive analyses of human activities. These become the basis of the given project and direct its development; hence, the UCDD approach to design emphasizes user requirements and strives to keep those in mind. Designers are required to initiate early and continuous contact with prospective users to elicit what they need and how they will learn and perform. The approach also stresses that user-oriented technology in development must be tested for usability. These tests are done iteratively as opposed to using phased-stage or lock-step testing. These key elements of UCDD can be summarized as user participation (mutual learning), contextual inquiry, and iterative design. Each element is discussed below.

### *User Participation*

Users of technology are simply those who make use of the tools that designers create; however, this term should be further refined for our present purpose. Maguire (2001) and McCracken and Wolfe (2004) differentiated primary users from more broadly defined users. Primary users are those who will directly use and interact with the system to do tasks, and more broadly defined users are stakeholders—that is, anyone who will be influenced by primary users' capabilities to carry out their tasks or who affects the system requirements. The voices of both primary users and stakeholders should be respected in the design decision-making process.

User participation is vital in UCDD design, so users should be actively involved in the entire design process—not simply consulted at the beginning or at the testing stages of a product. Users can contribute important "folk knowledge" derived from their work contexts (Walenstein, 2002, p. 21). In this regard, designers should understand that users typically know more than what they can initially verbalize. If properly questioned, they may provide useful feedback on proposed design ideas (Nisbett and Wilson, 1977). This interactive process also potentially increases the users' acceptance of the product or system under development. Designers must take care to respect the users' various backgrounds and fields of expertise; this is a necessary condition for mutual learning (Muller, 2003).

The methods included under the UCDD perspective vary as to the timing and amount of user participation they include, from Carr-Chellman's (2007) insistence on users being fully franchised as design peers throughout the process to the sometimes minimal role played by test subjects in rote usability testing that occurs too late in the design cycle for changes to be made to a product (Krug, 2005). At the 1994 Participatory Design Conference, Tom Erickson of Apple Computer suggested four dimensions of user participation (Kuhn and Winograd, 1996). These include direct interaction with the designers, long-term involvement in the design process, broad participation in the overall system being designed, and maintaining a significant degree of control over design decisions.

### *Contextual Analysis*

Another key element in UCDD is considering the users' work needs in context. From the sociotechnical perspective, Goodrum et al. (1993) argued that designers must take into account the dynamics of people, environment, work practices, and technology to develop an *enriched learning and information environment*. Along the same lines, Read et al. (2002) suggested various contextual variables that influence users' participation in design activities. These include environment, knowledge, skills, and security. Read et al. (2002, p. 60) reported that:

- The cultural and physical environment in which a participatory design activity takes place will affect the activity.
- Each participant will bring to the design activity his or her own general knowledge, subject knowledge, and technical knowledge.
- The skills that will affect the ability of individuals to contribute to a participatory design activity include cognitive skills, motor skills, and articulatory skills. Different participants will bring different skills to any project, and it is likely that the balance of skills within a group will affect its functionality.
- Comfort factors, emotional stability, and stress also have an effect on how people contribute to a group activity. These factors can be quite individual and are difficult to predict. Feelings of security within a group will also be influenced by environment, knowledge, and skills.

### *Iterative Design*

In UCDD, designers are expected to initiate early contact with potential users and then focus continuously on what these users require of the technology to be designed. Testing must be done iteratively, in response to design questions and advances rather than being carried out on the basis of phases in a predetermined design process. The iterative process is one of reflection-in-action in which development stages are shaped in context to deal intelligently and creatively with "uncertainty, uniqueness, and value conflict" in a constantly changing world (Schön, 1987, p. 6).

Iterative design is closely related to the concept of *design space*, an idea borrowed from the fields of architecture and graphic design. As Beadouin-Lafon and Mackay (2003, p. 1011) explained design space:

> Designers are responsible for creating a design space specific to a particular design problem. They explore this design space, expanding and contracting it as they add and eliminate ideas. The process is iterative: more cyclic than reductionist. That is, the designer does not begin with a rough idea and successively add more precise details until the final solution is reached. Instead, she begins with a design problem, which imposes a set of constraints, and generates a set of ideas to form the initial design space. She then explores this design space, preferably with the user, and selects a particular design direction to pursue. This closes off part of the design space, but opens up new dimensions that can be explored. The designer generates additional ideas along these dimensions, explores the expanded design space, and then makes new design choices.

When designers expand the design space to generate ideas and contract it to select ideas, various design tools and techniques are used. Besides the most generally used techniques such as questionnaires, interviews (including individual interviews, focus groups, and workshops), and document analyses, other tools and techniques may be used to facilitate the iterative design process. These include task analysis, prototyping (Beadouin-Lafon and Mackay, 2003; Ehn and Kyng, 1991), role-playing activities (Ehn, 1992), site visitation and observation (Ehn, 1992), scenarios (Carroll, 1995, 2000), personas within design scenarios—virtual people who have jobs, hobbies, families, and educational accomplishments (Grudin and Pruitt, 2002)—and virtual reality (Davies, 2004).

### Process Approaches within the UCDD Perspective

Under UCDD we place multiple process approaches. These include *participatory design* (PD) (Bodker et al., 1988), *rapid prototyping* (RP) (Goodrum et al., 1993; Frick et al., 2005), *user-friendly design* (Corry et al., 1997; Dumas and Redish, 1993; Norman, 1988; Sugar and Boling, 1995), *pluralistic walkthrough* (Bias, 1994), *contextual design* (Beyer and Holtzblatt, 1998; Tessmer and Wedman, 1995), *cooperative inquiry* (Druin, 1999), *situated design* (Greenbaum and Kyng, 1991), the *user-designer approach* (Reigeluth, 1996), *ID2 transaction shells* (Merrill et al., 1992), *R2D2 model* (Willis and Wright, 2000), *emancipatory design* (Carr-Chellman and Savoy, 2004), and *user design* (Carr-Chellman, 2007). Although these perspectives are not identical or equivalent, the common thread among them is that in all of them users actively participate to a greater or lesser degree in the design of a system or a product. To illuminate the overall perspective of user-centered design, we have chosen a philosophical approach to object and systems design (participatory design) and a particular process (rapid prototyping) to discuss in further detail.

## CHARACTERIZATION OF PARTICIPATORY DESIGN

### History of Participatory Design

Participatory design is both a set of theories for, and the practice of, using users' preferences to design products or systems. As explained by Greenbaum and Kyng (1991, p. 4) in participatory design, designers are required to take users' work practices and needs seriously; users are regarded as "human actors," not as cut-and-dried "human factors." Their work practices must be viewed within their own situated contexts. Observations of users' social interactions in the workplace are also employed by the designer, thus requiring continuous communication between users and designers.

The roots of systems and product-generating participatory design can be traced back to early Scandinavian systems design efforts in the 1970s (Ehn, 1988, 1993). It began with a political labor movement to bring democracy to work settings. Early projects usually took the form of collaborations between computer science researchers and union workers. Participatory design was pioneered by Kristen Nygaard, whose work involved collaboration with union leaders and members to create a Norwegian national agreement to ensure the rights of unions regarding the design and use of technology in the workplace (Ehn, 1988; Kuhn and Winograd, 1996). This triggered other, similar projects in Scandinavia. In Sweden, the DEMOS project involved an interdisciplinary team of researchers who collaborated with trade unions. With collaboration between

Swedish and Danish researchers and the Nordic Group Graphic Workers' Union, the UTOPIA project was created to design and develop a computerized desktop publishing system for newspaper graphic designers (Ehn, 1992).

The emphasis of this labor movement to empower users gradually changed in response to societal changes. After reviewing ten participatory design projects in the area of software development ranging from the 1970s to the 1980s, Clement and Van den Besselaar (1993) observed that the focus of this labor movement shifted from empowering workers in general to empowering specifically minority and female workers. This change reflected an increase in the population of women in the workplace. When participatory design was eventually applied in the United States, this political focus was deemphasized (Clement and Van den Besselaar, 1993). Now participatory design has widened to other fields such as engineering, architecture, and community design (Al-Kodmany, 1999; Carroll et al., 2000; Cohen, 2003).

## Different Levels of User Participation

As discussed earlier, there are varying degrees of user participation within participatory design. Although the definition of what constitutes participation varies in different projects, Kensing offered basic requirements for participation: "The employee must have access to relevant information; they must have the possibility for taking an independent position on the problems, and they must in some way participating in the process of decision making" (cited in Clement and Van den Besselaar, 1993, p. 31). According to Willis and Wright (2000, p. 7), there are "weak participatory design" and "strong participatory design" processes. In weak participatory design, design decision making is mainly undertaken by the designers themselves, even though user inputs are solicited using various tools and techniques. In strong participatory design, the users' full participation is utilized throughout the entire design process. Combining these interpretations with Erickson's user participation dimensions (Kuhn and Winograd, 1996), Table 49.1 summarizes the different levels of user participation.

With different combinations of these dimensions, user participation levels may range from minimal to full inclusion (Read et al., 2002) and to emancipatory design or *user design*—empowering stakeholders in the design (Carr-Chellman, 2007; Carr-Chellman and Savoy, 2004). At the minimal level, users may participate in the design process for a limited time or with a limited scope of influence. At the full inclusion level and the emancipatory level, users are empowered to participate in the design process by cooperating with researchers and developers or carrying out the design themselves with primarily facilitation provided by trained designers.

**TABLE 49.1**
**Levels of User Participation**

| | Weak Participation | Strong Participation |
|---|---|---|
| Interaction | Indirect | Direct |
| Length | Short | Long |
| Scope | Small | Large |
| Control | Very limited | Very broad |

## Application of Participatory Design

In Clement and van den Besselaar's 1993 article, many successful cases of participatory design projects are surveyed. These are cases of projects in system design for work settings (e.g., computer center, human-centered office, local government) conducted since the 1970s, including architecture, urban planning, and community design (Al-Kodmany, 1999; Cohen, 2003), as well as recordkeeping in healthcare training (Carr-Chellman et al., 1998). It should be noted that participatory design projects in education are relatively under-researched (Carroll et al., 2000). In this section, we briefly illustrate one research and design project that has successfully integrated participatory design for computer system designs in the education field; however, we encourage the interested reader to refer also to the case examples above. We begin with a participatory design project of 5 years' duration which involved the design and development of a network-based collaborative learning system for middle-school physical science and high-school physics. The purpose of this example is to (1) illustrate how participatory design was carried out in a specific instance, including what methods were used and when, and (2) consider the effectiveness of, efficiency of, and participants' satisfaction with the participatory design methodology used as well as to consider the challenges encountered during the project.

### *Case Studies*

Carroll et al. (2000) presented an example of how participatory design was applied in the design of a virtual school to support collaborative learning in middle-school and high-school physical science. The case provides powerful insights into the transition of participants' roles over the course of the project. This 5-year project, called LiNC (Learning in Networked

Communities), began as a small-scale project involving teachers from one middle school and one high school physics class and was supported by a U.S. National Science Foundation grant.

The main players in the LiNC project were four middle and high school physics teachers and eight university research team members (four human–computer interaction specialists and four computer scientists). The project was a partnership between Virginia Tech University and the public schools of Montgomery County in Virginia to support collaborative science learning. During the project, physics classes were offered every other year to very small classes (three to five students). The purpose of the project was to bring systemic change to public education through a new computer networking infrastructure.

The project team observed developmental changes in participant teachers' roles as the project progressed, beginning with "practitioner–informant" and transforming along the way to "analyst," then "designer," and finally "coach." From the beginning, the university project team was mindful of employing participatory design in conceptualizing the project, foreseeing that the teachers' active participation must be continued even after the project ended to bring the sustainable systemic change to public education that the project originally set forth as its main purpose.

Although this project resulted in an enviable level of acceptance and use for the designed product, it is worth noting that Carroll et al. (2000) questioned whether it had to take 5 years to work effectively with teachers. In their view, some stages of the project could have been more efficient—for example, by assigning a lead teacher or by helping teachers attain prerequisite skills in design. They cautioned, however, that compressing the timeline for such a project would "compromise the coordination of participatory and ethnographically driven approaches to requirements development" (Carroll et al., 2000, p. 248) and noted that it takes time to build the trust and mutual understanding required to carry out effective design work. Indeed, participatory design is a philosophical perspective rather than a circumscribed set of methods. Within such a perspective, the inherent value of user participation and the presumed benefits resulting from that participation are held to be of greater ultimate importance than the efficiency of the method.

Perhaps with a different kind of preparation themselves, the trained designers on such a project could become more effective at facilitating the participation of users and designers in such a project, but this observation also requires us to step back from the case and consider what is necessary for such a shift in the training of designers. If the inherent worth of user participation in design is great enough, then overhauling the training provided to designers of educational systems might be seen as feasible.

One last aspect of this case to consider is that the users/participants appear to have been only the teachers who would incorporate the system into their classrooms. The students, who would presumably also be users of the system, were not included as participating designers, although they may have been included secondarily as part of the very small classes conducted during the development of the system. Although a case like this one describes a potentially effective, albeit costly, process approach for bringing about change in classroom teaching, it is important to discuss seriously the circumstances in which it is possible and desirable to apply this philosophy and the methods it requires.

A further example of participatory design is the work being done by Reigeluth and Duffy (2007) in the Decatur Township school district. The participants include school teachers, administrators, students, their parents, and community members, as well as the design leaders. Although this is an effort in systemic change, it is also a good example of participatory design in which the stakeholders play major roles throughout the process, the goal of which is the realization of their vision regarding what they want their school system to become. This process will occur over several years, as did the LiNC project described earlier.

## CHARACTERIZATION OF RAPID PROTOTYPING

### Background of Rapid Prototyping

Rapid prototyping, a methodology used in software design (and also in fabrication techniques in manufacturing via CAD/CAM) holds potential for addressing many of the limitations of the conventional ISD model. Since rapid prototyping was introduced as a design methodology in the ISD field (Tripp and Bichelmeyer, 1990), conflicting descriptions of how rapid prototyping applies to instructional development have appeared. This situation has resulted in an inconsistent view of this methodology in the literature.

Tessmer (1994) and Northrup (1995), in the field of instructional technology, argued that rapid prototyping should be considered as an alternative method of formative evaluation in the design and development phases. This is consistent with the role of prototyping described in many studies in human–computer interaction (HCI) and software design. Many people in the field of instructional technology, however, perceive rapid prototyping as a new paradigm of instructional design methodology (Dorsey et al., 1997; Jones and Richey, 2000; Rathbun et al., 1997; Tripp and Bichelmeyer, 1990). In this chapter, our position is the latter perspective, which views rapid prototyping as an alternative to the conventional ISD process. Note that, when rapid prototyping is practiced as an alternative to traditional ISD processes, it can also be characterized as a comparatively weak form of participatory design (Kuhn and Winograd, 1996; Willis and Wright, 2000). This does *not* imply that the rapid prototyping process is weak, but rather that the level of user participation in RP may be less than in other forms of PD.

Customizations of rapid prototyping methods to fit the instructional design field have been based on two perspectives on design. One is Simon's (1996) theoretical view that "artificial science" differs from natural science. Basically, the instructional design and software design arenas share the same design theory, which holds that design is a problem-solving process that uses optimization procedures. The other perspective is that of Schön (1987), who viewed the design process as an iterative process of *reflection in action*. Design plans are not to be predetermined so as to lead to a predefined goal, but should instead be a process that deals creatively with "uncertainty, uniqueness, and value conflict" (Schön, 1987, p. 6).

The purpose of rapid prototyping is to demonstrate possibilities quickly by building an inexpensive series of mock-ups so designers are able to obtain early feedback from which they may respond to user requirements This is particularly true in the following three types of situations: (1) cases that involve complex factors, which can make predictions difficult; (2) cases already examined by conventional methods without satisfactory results; and (3) new situations, which do not offer a lot of experience to draw from (Tripp and Bichelmeyer, 1990). Thus, rapid prototyping is appropriate for developing electronic performance support systems (Gery, 1995; Gustafson and Branch, 1997; Gustafson and Reeves, 1990; Law et al., 1995; Witt and Wager, 1994), conference video designs (Appelman et al., 1995), software designs (Dumas and Redish, 1993; Sugar and Boling, 1995), and computer-based instruction (Tripp and Bichelmeyer, 1990). It is also useful in Web design (Boling and Frick, 1997; Corry et al., 1997; Frick et al., 2005) and for collaborative learning (Goodrum et al., 1993; Tessmer, 1994).

As proponents of rapid prototyping have noted, however, it is not a panacea and can lead to an undisciplined design-by-repair approach that ignores initial analysis and planning. Although Sugar and Boling (1995) described conceptual prototyping for nonexistent technologies, rapid prototypes cannot easily be used to develop prototypes for many common instructional applications, such as lectures, workshops, and televised instruction sessions, because the prototyping effort may be prohibitive with regard to both time and cost (Tessmer, 1994; Tripp and Bichelmeyer, 1990). Tripp and Bichelmeyer (1990) pointed out further cautions in the use of rapid prototyping, including the need for tools that support building prototypes efficiently, choice of optimal methods for both design and evaluation of prototypes, and—most importantly—knowledgeable and experienced designers.

Frick et al. (2005) added important front and back ends to the rapid prototyping process. Their inquiry-based, iterative design process was developed and improved through formative research methods and includes needs assessment of the stakeholders, rapid prototyping on paper with usability testing, further rapid prototyping on computers with more usability evaluation, and creating and maintaining the product designed (Reigeluth and Frick, 1999, p. 21). Although their focus was on Web design, their work demonstrates that more than rapid prototyping itself is needed for designing products that work well with intended users.

## Definition of Rapid Prototyping

As Boling and Bichelmeyer (1998) have noted, rapid prototyping has been used in many different approaches to design and development. Examples include rapid prototyping (Tripp and Bichelmeyer, 1990), the participatory design process (Goodrum et al., 1993), rapid collaborative prototyping (Dorsey et al., 1997), user-centered design (Corry et al., 1997; Dumas and Redish, 1993; Sugar and Boling, 1995), context-sensitive design (Tessmer and Wedman, 1995), and ID2 transaction shells (Li and Merrill, 1990). All of these include a rapid series of iterative tests and revision cycles, coupled with the direct participation of users to result in a product that is shaped until an acceptable version is created (see Table 49.2).

Even though these various approaches share the use of rapid prototyping methodologies, the definition of what a prototype is differs somewhat from one approach to another. Tripp and Bichelmeyer (1990) asserted that a prototype should include a required database, the major program modules, screen displays, and input and output for interfacing systems. This definition emphasizes the availability of computer software that offers *modularity*, which allows for flexibility in adding, removing, or modifying a segment of the instruction without introducing severe interactions in the other segments. Modularity also provides *plasticity*, which refers to the ability to change aspects of a unit of instruction with only minimal time and cost (Tripp and Bichelmeyer, 1990, p. 38).

**TABLE 49.2**
**A Comparison of Instructional Systems Design (ISD) Approaches That Include Rapid Prototyping**

| | Tripp and Bichelmeyer (1990) | Jones et al. (1992) | Dorsey et al. (1997) | Tessmer and Wedman (1995) |
|---|---|---|---|---|
| Model name | Rapid prototyping | ID2 | Rapid collaborative prototyping | Context-sensitive ID model |
| Meaning of a prototype | A working model that includes a required database, the major program modules, screen displays, and input and output for interfacing systems | An incomplete but essentially executable version of the final product | Tangible solution ideas that have different amounts of fidelity | A working portion of the final product that is immediately implemented with a group of learners or is reviewed by experts |
| Processes | Assess needs and analyze content.<br>Set objectives.<br>Construct prototype.<br>Utilize prototype.<br>Install and maintain system. | Analyze knowledge.<br>Analyze audience and environment.<br>Analyze strategies.<br>Specify transaction configurations.<br>Develop transaction details.<br>Implement. | Create visions.<br>Explore conceptual prototypes.<br>Experiment with mock-ups.<br>Pilot test working prototypes.<br>Implement product. | Analyze layers.<br>Specify instructional scenarios.<br>Develop alternative prototypes.<br>Negotiate prototype. |
| ISD | New paradigm of ISD process model | Large-component prototype approach | Co-ownership of designers and users | New form of ISD |

Jones et al. (1992) argued that a prototype is an incomplete but essentially executable version of the final product. Tessmer and Wedman (1995) defined a prototype as a working portion of the final product that is immediately implemented with a group of learners or is reviewed by experts. Both definitions emphasize the aspect of a quick, working version of a final product; therefore, a prototype does not have to include everything that the final version will contain. Finally, Dorsey et al. (1997) and Sugar and Boling (1995) viewed a prototype as a tangible idea of possible solutions that have different range of fidelity from low to high. Their definition is very different from the others, in that even a conceptual version of a solution could be a prototype, and it is closest to that used in the software design community (Rudd et al., 1996).

## CHALLENGING ISSUES

Designers face many challenging issues when attempting to implement UCDD, such as effective incorporation of user participation in the design process, control issues over resources, and the practical implementation of the approach utilized. These issues are discussed below.

### Issue 1. Effective Incorporation of User Participation

One of the most difficult challenges of UCDD is the effective incorporation of user participation in the design process. Determination of which voices will be heard and how the users' preferences will be reflected in the design is a values-based decision and is rarely easy. This is especially true in large-sized commercial projects targeted at a range of users from different backgrounds and settings. Along with the issue of who gets to participate comes the issue of how to recruit users who will represent the potential target user groups appropriately when those groups are very large or very diverse. In addition, when user participation is limited only to a certain stage, the users' role will end up being that of information providers rather than codesigners of the project.

Even when the goal of UCDD is to place users at the center of the design process, in many situations the negotiation between the "designed for" approach, in which the designers assume leadership in the design process, and the "designed with" approach, in which the users assume ownership in the process, can become both a philosophical and a practical consideration. How much user participation is too much? Even for designers who consider active user participation throughout the entire process to be the ideal, some researchers have encountered practical difficulties with the process. In a participatory design project intended to build a community learning network using open source tools, Luke et al. (2004) observed that early group brainstorming heightened the users' expectations and demands, and these demands were furthermore unmoderated by any realistic conceptions of the time and costs they would require. When the first prototype was released (past its due date), these same heightened expectations turned into general disappointment. The authors attributed this problem to both the designers and the users, who were "too participatory and too open" (Luke et al., 2004, p. 11). They then warned that user participation in the early stages of a project can be disadvantageous if it is not balanced with realistic constraints. Processes can be developed to ameliorate or eliminate these kinds of problems, but the potential for them to arise remains.

Some researchers, however, have been able to elicit user participation positively, even in long-term, large-scale PD projects. Letondal and Mackay (2004) conducted participatory design activities with research biologists, bio-informaticians, and programmers at the Institut Pasteur in Paris over a period of 7 years. The focus of their project was the development of tools to support end-user programming. They did observe some tensions between different groups of participants; however, overall the participatory design worked in that context. The main reason for this success was attributed by the authors to maintaining a balance between "low-responsibility" and "useful results" (Letondal and Mackay, 2004, p. 39). Again, it appears that designs committed to the UCDD perspective require experience and skill to carry it out effectively.

### Issue 2. Control over Resources: Money, Time, Tools, and Space

Another challenging issue in UCDD is acquiring and maintaining control over enough resources to support a project—money, time, tools, and space. Acquiring and allocating these resources can cause a great deal of tension. Even after full members in the design team have been identified, the question still remains: How can the team elicit full user participation when the users may also have to fulfill their own full-time job duties? In their review of ten different participatory design projects, Clement and Van den Besselaar (1993) observed that, although some projects provided funds for the users to hire temporary staff to take their places while they were working with the design team, users in other projects had to perform their regular job duties while concurrently contributing to the project. Design teams seeking only intermittent and short-term involvement from users may face lower barriers but may still have trouble recruiting users who can afford to take the time necessary to participate in the test of a prototype—or repeating such sessions.

Sugar (2001) pointed out that one of the common misconceptions among researchers in UCDD is that designers should relinquish all of their authority and allow the participating users to make all of the design decisions. He warned that users are not expert designers, and designers should not expect users always to know exactly what they want to use. He pointed out that they may not be right all the time, either, and that even though users' opinions must be respected designers need to present the possibilities and limitations of proposed solutions properly. Although this is true for any design project, Sugar claimed that the governing responsibility of designers is certainly crucial in UCDD. To implement this approach effectively, designers must also delve beyond the surface of these issues and carefully consider each of them by means of in-depth analyses (Sugar, 2001). Carr-Chellman (2007) has offered multiple suggestions for carrying out user design activities in which users function as the primary designers and trained designers as facilitators but also pointed out that the process can be very difficult and is not suitable for every context or situation.

Raskin (2000), who played a major role in the design of the Macintosh computer interface at Apple Computer, emphasized that what users prefer in a design is not necessarily what is most efficient and effective. He cited several empirical studies where users actually performed more poorly with interface designs they preferred than they did with others they did not prefer. This illustrates the tension between what users want compared with what is best for them based on scientifically proven principles, similar to the problem with what people prefer to eat vs. what is good for them in terms of nutritional value and their long-term health.

## DISCUSSION

When designers select a design approach, their choice is influenced by their philosophies (Visscher-Voerman and Gustafson, 2004). In their attempt to understand how designers carry out instructional design projects in reality, Visscher-Voerman and Gustafson (2004) found that all 12 of their examined designers (from 6 different settings in the initial study) integrated a traditional ISD model into their work. The ways in which they incorporated this model, however, were diverse and varied. In their second study, Visscher-Voerman and Gustafson developed four alternative design paradigms (or conceptual frameworks) that are anchored in philosophy: instrumental, communicative, pragmatic, and artistic. Table 49.3 shows the characteristics of each of these paradigms. In general, the UCDD approach seems to be related to communicative and pragmatic paradigms in the sense that UCDD puts an emphasis on users as codevelopers in the design process. This is achieved by means of the nonlinear and iterative analysis/design/evaluation format of cooperation. Rapid

**TABLE 49.3**
**Four Alternative Design Paradigms**

| | Instrumental Paradigm | Communicative Paradigm | Pragmatic Paradigm | Artistic Paradigm |
|---|---|---|---|---|
| Emphasis | Aligned goals, learning situations, process, and outcome of the design | Communication between designers and users to reach consensus | Repeated testing and revision | Creative design |
| Designer's role | Expert (responsible for design) | Facilitator (shares responsibility with users) | Expert (responsible for design) | Artist (fully responsible for design) |
| User's role | Information provider and approval for action | Information provider; codesigner | Information provider; product user | Product user |
| Design process | Typically linear | Nonlinear and iterative | Nonlinear and iterative | Linear or nonlinear |

*Sources:* Adapted from Visscher-Voerman, I. and Gustafson, K.L., *Educ. Technol. Res. Technol.*, 52(2), 86, 2004.

prototyping, when used as the cornerstone of an alternative ISD model, may be closer in philosophy to the pragmatic paradigm. In either case, UCDD, in both strong and weak forms, represents some shift in philosophy for instructional designers who employ it. To the extent that UCDD gathers momentum in the teaching and practice of instructional design, we can expect to see changes in logistics, methods, and power dynamics in design projects within this field.

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