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INTRODUCING USER PROFILES AND PERSONAS INTO INFORMATION SYSTEMS DEVELOPMENT

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Abstract

Traditional information systems (IS) development adopts a systematic approach for conducting analysis, design, and testing, without necessarily using a specific user model that personalizes the system to one or more user groups. This quasi-experimental study of multi-cases explores introducing novice developers to two User-centered Design tools—user profiles and personas—as a part of the systems analysis and design methodology. Profiles and personas are structured ways of typifying a group of users in text and pictorial form (e.g., conceptually modeling the users). The study results indicate developers find both tools are useful in capturing the team’s understanding of user groups and meeting end users’ objectives; though, profiles seem to have a slight edge over personas. In addition, case analysis indicates the use of user profiles and personas may produce design and implementation deliverables that enhance alignment with system objectives and end users.

Keywords: user-centered design, system analysis and development, personalization

Introduction

Traditional Information Systems (IS) development adopts a systematic approach for conducting analysis, design, and testing, without necessarily using a specific user model. A characteristic of the traditional IS design methodology is that it typically limits user participation to a consultative role, where the bulk of the design decisions are made by the IS analyst and/or developer (Purvis & Sambamurthy 1997). One-way information streams, and other forms of low quantity and quality interactions, between the IS designer and user can prevent developers from evolving a personalized understanding of the various user groups. In fact, systems designers can potentially “ground” themselves (a human natural behavior of finding a known reference point in a foreign information space as described by the psychologists), and run the risk of designing an interface for themselves, rather than the user groups. This is unfortunate as personalizing the system to significant user...
groups can positively impact the users’ acceptance and appreciation of the system, and ultimately, the users’ commitment to it (Baronas & Louis 1988; Baroudi et al. 1986; Ives & Olson 1984). Effective personalization or mass customization is not effective unless we know the targeted user groups and can see the proposed system through their eyes.

The specialized field of Human-Computer Interaction (HCI) deals with hardware and software interactions where users and computers interface. Up until the 1980s, most HCI design methodologies treated users’ cognitive processes as predictable and quantifiable. User-Centered Design (UCD) is a modern HCI design philosophy and a multi-stage problem solving process, in which the needs, desires, and limitations of the end users of an interface are inquired and analyzed, and assumptions of the user behavior are transferred into the prototypes and tested. UCD techniques such as user profile and user persona are structured ways of typifying a group of users in text and pictorial formats (i.e., conceptually modeling the end users). Researchers claim profiles and personas can be very beneficial in (1) preventing designers from grounding themselves, (2) conceptualizing users’ mental models, and (3) helping the development team to mentally visualize and communicate how intended users would interact with the proposed design in a meaningful way (Spool 2004; Seffah et al. 2003). Further study is needed to empirically test these claims as well as other benefits user profiles and personas may have in the systems analysis and design process and related outcomes.

Though all developers may benefit from using profiles and personas, these tools may be especially useful to novice developers. Profiles and personas are, in essence, conceptual models of target user groups. Research indicates that novices have a more difficult time developing conceptual models when compared to experienced analysts due to challenges with domain-specific knowledge, problem structuring, cognitive processes, and established validation procedures (e.g., Bolloju & Leung 2006; Schenk 1998; and Shanks, et. al. 2003).

This quasi-experimental study of multi-cases explores introducing novice developers to two UCD tools—user profiles and personas—as a part of the systems design methodology. The paper is organized as follows: we first provide a background including key existing literatures of UCD, conceptual models, user profiles, and user personas. Next, we introduce our hypotheses and research model. We then discuss our research method and results. Finally, we provide conclusions and inspiration for future related research.

**Background**

**Conceptual models**

Models are not new to the systems analysis and design process. Some traditional and widely used forms of modeling, such as Data Flow Diagram, Entity Relationship Diagram, and the various Uniform Modeling Language (UML) diagrams are utilized extensively during the development of information systems. Studies have found these models helpful in enabling developers and system stakeholders to visualize data processing and interaction between the system and outside entities (Valacich et al. 2004; Davis & Yen 1999). These models semantically represent the structure and behavior of the system, but they do not embody the users’ mental model.

Usability\(^1\) of a solution depends 10% on the visual aspect of the product (the “look”), 30% on the “feel,” how a user interacts with the product, and an enormous 60% on meeting and exceeding the user’s mental model (Roberts et al. 1998). The user’s mental model is comprised of their expectations, prior experience, and anticipated behavior. The look and feel are important, however, if the development team do not get the 60% right, there is little-to-no chance of getting the other 40% even close to right. Therefore, understanding who the intended users are—not just their demographics, but also how they think, feel, and behave—is critical to the success of the systems development and, ultimately, to the return-of-investment. In discussing the building of a successful user interface, Righi (1993) made the distinction between a “mental model” and a “conceptual model.” A mental model is an individualized conception of how the world works and the way it is structured. In contrast, a conceptual model is a synergized representation: developers tap into users’ mental models (i.e., systems analysis) to create a user conceptual model; then, developers use the user conceptual model to create an application or provide a solution; finally, the conceptual model is surfaced to users via the interface (i.e., system design).

\(^1\) The International Standards Organization (ISO) defines usability as “the effectiveness, efficiency, and satisfaction with which specified users can achieve specified goals in particular environment” (ISO DIS 9241-11).
User-centered design, user profile, and user persona

UCD is well recognized as an effective strategy to designing ease of use into the total customer experience with products and systems (Vredenburg et al. 2002). UCD is especially useful in improving system usefulness, information quality, and interface quality (Johnson et al. 2005; Gagnier 2006). Basic tenets of the UCD process include: (1) placing the user at the center of the design, (2) focusing early on users and their tasks, (3) measuring usability empirically, and (4) designing iteratively, whereby a product is designed, evaluated, and modified with real users repeatedly in quick iterations. Figure 1 compares and contrasts different levels of user involvement through the user interface design process for a traditional information system analysis and development process, a Joint Application Development (JAD) session, and the UCD process. UCD requires the development team to understand who the users are, their goals, motivations, characteristics, application environment, constraints, and so forth. These user characteristics will dictate the content, structure, and organization of the proposed conceptual models, and will suggest appropriate metaphors and other dimensions for interface prototype design.

Figure 1. Different Levels and Stages of User Involvement in User Interface Design Process

User profiles and personas are conceptual models of users that can serve to promote the shared understanding that underpins UCD. User profiles, dynamic repositories, are used to categorize, characterize, and prioritize a system’s target user groups, sub user groups, and uses (applications) of the system. User profiles can be represented as a table of descriptors, e.g., “male, average age 45-50, intermediate-level computer user, etc.” A typical user profile contains system-relevant characteristics for each user group, such as:

- Users’ prior knowledge and experience (e.g., web site search proficiency, years with company/domain knowledge)
- Physical characteristics (e.g., mobile or stationery computer user; color blindness)
- Cognitive characteristics (e.g., education level, preferences for system interaction, learning style)
- Social and physical environment (e.g., working in isolation, noise level, distraction level, communication patterns)
- Job, task, and requirements (e.g., reporting structure, key tasks for system) (Schwendeman 2006)

User profiles help the crafters of the systems focus on the users by serving as:

- The basis for identifying user tasks and capabilities, and therefore, they impact requirements and conceptual models
- The basis for selecting users to participate in user input and feedback activities, which directly shape the solutions’ design and development
- Input to user interface design
- Input to organizational change management and training plans
- Input to the user personas, which typify the profile of various user groups
A persona is a fictional and supertypical characterization of a user created to represent a user group. It is a profile that comes to life, e.g., "Marty is a school teacher who uses his home computer to shop. His two kids fight over internet use..." The development team creates this user as a symbiosis of the real users they have observed and interviewed for each significant sub user group. Personas often include a name, photo, likes and dislikes, habits, background and expectations, and other information needed to provide dimension. Most importantly, personas explicitly highlight key goals for the user. The primary advantage of the multi-dimensional persona is to help the development team identify with the user, communicate effectively with the users, and constantly remind them to design for the user’s needs. In a study of how to design effective tools to aid software developers, Seffah, Naghsin, and Kline (2003) assert personas to be a helpful technique in closing the gap between a software engineering tool’s functionalities and the intended users’ tasks and experiences with the following primary benefits:

1. helping bring focus on not only the user interface design but also the whole software lifecycle, including the identification of functional requirements and marketing
2. promoting development team synergy and communication by providing a shared framework to discuss the end users and application environment
3. facilitating creative and explicit design decision-making processes
4. generating scenarios for future testing and evaluation of the design

User profile and user persona use a combination of natural language and graphical depictions, which provides the necessary synergies for reaching a shared understanding of a problem (Neilson & Lee 1994). Pruitt & Grudin (2003) not only agreed that persona is a medium for communication, but also argued that it invokes a powerful and well-practiced human capability – to predict another person’s behavior by understanding their mental state (i.e., Theory of Mind), and consequently bring it to the design process. In Figure 2, we illustrate how conceptual user models, profiles and personas, could be integrated into a UML toolset for systems analysis. Traditional systems analysis and design models (such as the UML toolset) reflect system behavior, structure, and function, and typically follow requirements elicitation. Adjustments to requirements and previously drafted models tend to only come from conscientious development teams that make an extra effort to feed back modeling insights into requirements and previously drafted models. User profiles and personas are more than end products of the requirements elicitation effort; they can and should directly impact requirements, functional models, and prototyping. Hence, they with requirements become the hub of the analysis and design process. Figure 2 also illustrates that as a core process in analysis activity iterations, user profiles and personas can be used as a feedback mechanism for the development information gathering protocols and indirectly to develop structural and behavioral models.

**Personalization**

Conceptualizing the user requires a certain degree of personalization to the users’ mental model. Requirement gathering has been particularly problematic in traditional systems analysis and design methodologies as it does not seem to reach the level of personal connection to capture essence of user groups. Past studies indicate that a lack of understanding of or communications with end user groups are among the major problems of the requirements gathering process. According to Khazanchi and Yadav (1995), inaccurate requirements elicitation of the conceptual construct of the users for a particular system attributed to over 50% of the errors in systems design and development. A study by Marakas and Elm (1998) indicates major casual factor for “bad” systems include poor analysis or analyst techniques, poor elicitation of requirements, poor conversion of requirements to designs, and miscommunication between the users and the analysts during requirements elicitation. Davis (1982) listed several factors that may hinder acquiring a complete set of requirements: information processing constraints of humans, complexity of requirements, and complexity of interaction between users and analysts. User profiles and personas may facilitate personalization in requirements and interface designs by facilitating communication between the developers and the end users by creating a “mutually understood context.”

The shortcomings of conventional IS development approach become particularly problematic when the information systems under development span across multiple functional areas in organizations and serve multiple user groups (Wynekoop & Russo 1993). If a system goal is to allow personalization or to do mass customization to serve various user groups, the creation of profiles and personas for each subgroup may be used to determine requirements for what, when, and how to personalize a system. Kramer et al. (2000) appraised the value of UCD in ensuring delivery of personalization that matches end-user value, instead of personalizing for the sake of deploying the technically sophisticated new features.
Shared understanding and the communication process

Communication within project teams and with stakeholders is a hallmark of the systems development process. Shared understanding facilitates the communication process. Shared understanding refers to the communication among multiple individuals on the same topic in a manner such that all individuals leave the communication session with the same understanding of the topic under discussion. Freeman (2000) emphasized the importance of a shared understanding between the users and systems analysts who may come from distinct backgrounds, experiences, perceptions, and styles. Previous studies have argued that conceptualizations of users’ mental models could be used effectively and successfully to create a shared understanding between multiple individuals over a single topic or domain and thus a better system (e.g., Freeman 2000; Hoover & Rabideau 1995; Roth & Roychoudury 1993, 1992). As aggregated conceptual models, user profiles and personas should facilitate shared understanding in project communications. Few, if any, studies on user profiles and personas have investigated their significance in promoting the shared understanding

Research Purpose and Hypotheses

Previous literature seems to only anecdotally demonstrate the value of user profiles and personas in aiding developers to conceptualizing, visualizing, and communicating users’ mental models (e.g., Spool 2004; Seffah et al. 2003; Pruitt & Grudin 2003). They do not test whether user profiles and personas may foster shared understanding in communication with project teams and with end users. Furthermore, we know of no study that has introduced the two UCD techniques into a mix of tradition systems analysis and design tools such as the UML models.
This study addresses the aforementioned gaps by providing empirical analysis of the effectiveness of learning and adoption of user profiles and personas in a traditional system analysis and development process and systematically evaluating outcomes (final project deliverables). In light of this purpose, we propose to test the following hypotheses:

**H1** With training and application of user profile and user persona, novice developers will report value to the systems analysis and design process in the form of:

a) Appreciation for UCD
b) Value of user profile and persona
c) Better individual conceptual model of end users than existed prior to producing profiles and personas
d) Better collective conceptual model of end users than existed prior to producing profiles and personas
e) Profiles and personas benefiting production of analysis deliverables
f) Profiles and personas benefiting production of design deliverables
i) Profiles and personas benefiting production of implementation plans
j) Profiles and personas fostering communication with end users
k) Profiles and personas fostering communication with the team members about end users

**H2** With training and application of user profile and user persona, novice developers will demonstrate value through systems analysis and design outcomes in the form of:

a) Better understanding of the system request and ability to transfer that understanding to the deliverables than comparable projects that do not use profiles and personas
b) Better understanding of the end users and the functions they perform than comparable projects that do not use profiles and personas
c) Better ability to transfer their understanding of end users to system design deliverables than comparable projects that do not use profiles and personas
d) Better ability to transfer their understanding of end users to system implementation deliverables than comparable projects that do not use profiles and personas
e) Better overall representation of user centered design in deliverables than comparable projects that do not use profiles and personas
f) Better overall evaluation scores than comparable projects that do not use profiles and personas

Our research model is presented in Figure 3.

**Method**

To test our research model and hypotheses, we conducted a field experiment in which systems analysis and design teams were studied. The experiment was conducted in a field setting that enabled the study to be more extensive and garner greater external validity than would be the case with a laboratory experiment. Field experiments have the merits of “testing theory” and “obtaining answers to practical questions” (Kerlinger & Lee 2000). In this experiment, novices worked on “real” analysis and design projects serving professional clients. A nonequivalent group design was used where the experimental groups that used profiles and personas were matched against similar groups not using profiles and personas (hereafter referred to as control groups). The comparison group facilitated rigorous testing of hypothesis 2.

Subjects consisted of 29 students comprising six systems analysis and design project teams in two sections of a senior level systems analysis and design course participated in the study. Team membership was randomly assigned; each team included four to five members. Of the students who participated in the study, 31% were females. Participants ranged in age from 20-22 years old. No participant had heard of UCD or user profiles or personas prior to the course.

All teams participated in a semester-long project in which they created various systems project planning, analysis, design, and implementation deliverables for a system proposed by a real-life client, which they serviced. All students had the same instructor, basic syllabus for the course, and project instructions with the exception that profile and persona material was appended for four of the teams. The control groups were not introduced to user profiles and personas (variables of interest). Isolation from profile and persona material was possible as the students were in a different course section from the experimental groups.
The four experimental teams (all in the same class section) were provided with educational materials on user profiles and personas and received a 75-minute training seminar focusing on (1) UCD principles, methods, and metrics, (2) user profile and user persona techniques, and (3) implementation cases. The content of the seminar, three group discussion exercises, and supplementary reading assignments were designed and selected by a certificated, human factors professional, with extensive experience in UCD research and practices.

Four experimental teams were required to produce a user profile and a user persona for their key user group, and both experimental and control teams produced project deliverables during the course of the semester including:

- System Request
- Stakeholder Analysis
- System Requirements
- Use Case Diagram
- Associated Use Cases
- Activity Diagram
- List of Screens
- Windows Navigation Diagram
- Screen Prototypes
- Design Concept/Assessment
- Heuristic Walk Through Assessment (Stakeholder Feedback)
- Stakeholder Change Cost/Benefit Analysis
- Change Management Plan – Information and Political Strategy
- Training Plan

The nature of the course allowed students to select among multiple project options. Two of the four experimental teams worked on a project involving the development of a document archival system for an outside agency (Project A). The other
two experimental teams were engaged with a project involving a prospective student portfolio for the university admissions and recruitment office (Project B). One control group was engaged in a project involving the development of a system that provided a historical record of social work cases closed for an outside agency (Project C); the other control group worked on a system for the student services department to develop an on-line alumni mentor match program (Project D).

To test hypothesis 1 related to reported value, novice developers in the experimental groups completed a survey that explored their perceptions and use of user profiles and personas during the course of the project (contact authors for survey). Questions on the survey were inspired by previous research assessing utilization of new techniques (Amoako-Gyampah & White 1993; McKeen et al. 1994; McAvoy & Sammon 2005) and included both open and closed-ended items. All close-ended items used a Likert type scale with seven anchor points ranging from strongly disagree to strongly agree. In addition to general UCD questions, questions stems for user profiles were repeated for user personas.

To test hypothesis 2 related to outcome quality, four UCD certified professionals, who employ UCD techniques in their daily work, evaluated the above project deliverables. The raters were given a binder of key deliverables from the teams’ analysis, design (including screen prototypes printouts), and implementation phases, with dividers separating each teams’ work. The projects were arranged in random order in the binders. The raters provided ratings of each team in line with the concerns stated in H2 (see Table 3 and contact authors for evaluation form). All ratings used a scale with five anchor points ranging from very poorly to very well regarding how the project manifested the various rating criteria. Analysis of the results compared the ratings of control group deliverables with experimental groups.

### Results and Discussion

With training and application of user profile and user persona, novice developers reported an overwhelming appreciation for UCD approach. They recognized the values of both techniques in developing conceptual models of ended users, and fostering communication between the design team and the end users as well as inside the design team. According to the panel of experts, through training and application of user profile and persona, novice developers in the experimental groups demonstrated better ability to transfer their understanding of end users to system design deliverables. Overall, the introduction of user profiles and personas proved to be a productive and beneficial experience as assessed by the summary of hypotheses testing presented in Table 1.

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Supported/ Not Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 With training and application of user profile and user persona, novice developers will report value to the systems analysis and design process in the form of:</td>
<td>Supported</td>
</tr>
<tr>
<td>a) Appreciation for UCD</td>
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</tr>
<tr>
<td>e) Profiles and personas benefits producing analysis deliverables</td>
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</tr>
<tr>
<td>k) Profiles and personas foster communication with the team members about end users</td>
<td>Supported</td>
</tr>
</tbody>
</table>
Hypotheses Supported/ Not Supported

H2 With training and application of user profile and user persona, novice developers will demonstrate value through systems analysis and design outcomes in the form of:

a) Better understanding of the system request and ability to transfer that understanding to the deliverables than comparable projects that don’t use profiles and personas.
   Not Supported

b) Better understanding of the end users and the functions they perform than comparable projects that don’t use profiles and personas.
   Not Supported

c) Better ability to transfer their understanding of end users to system design deliverables than comparable projects that don’t use profiles and personas.
   Supported

d) Better ability to transfer their understanding of end users to system implementation deliverables than comparable projects that don’t use profiles and personas.
   Not Supported

e) Better overall representation of user centered design in deliverables than comparable projects that don’t use profiles and personas.
   Supported

f) Better overall evaluation scores than comparable projects that don’t use profiles and personas.
   Supported

Details of the perceptions of the experimental groups are presented in Table 2. The means for all constructs related to hypotheses fell above the neutral (4) anchor point and were generally in the mildly agree (5) to strongly agree (7) range. Therefore, it seems participants found the tools to be beneficial to the systems analysis and design process. However, if a team was faced with time constraints and could not develop both a profile and a persona, results indicate that participants may be best served by opting to create profiles, as participants rated user profiles higher for all constructs.

<table>
<thead>
<tr>
<th>Table 2. Process Results</th>
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<tr>
<td><strong>Overall</strong></td>
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<tr>
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</tr>
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</tr>
<tr>
<td>User Profile:</td>
</tr>
<tr>
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<td>Improved communication within the development team</td>
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</table>

In evaluating the effectiveness of project outcomes, as determined by the panel of UCD experts, Analysis of Variance (ANOVA) was used to compare system analysis and development outcomes across the fixed factor of Experimental/Control.
groups and also the random factor of Participants. The unit of analysis was the project team work product. Deliverables by teams using user profiles and personas were rated statistically significantly higher than control teams’ with respect to ability to transfer their understanding of end users to system design deliverables and overall representation of UCD in deliverables (see Table 3).

### Table 3 Outcome Results

| With training and application of user profile and user persona, novice developers will demonstrate through their project deliverables: | Between Experimental and Control Groups |
|---|---|---|---|---|
| | N | Mean | Stan. Dev. | Diff. Stat. Sig.? |
| Better understanding of the system request and ability to transfer that understanding to the deliverables | Exper.: 16 | 4.2500 | .57735 | No (p=.165) |
| | Control: 8 | 3.8750 | .64087 | |
| Better understanding of the end users and the functions they perform | Exper.: 16 | 4.6250 | .50000 | No (p=.129) |
| | Control: 8 | 3.8750 | 1.24642 | |
| Better ability to transfer their understanding of end users to system design deliverables | Exper.: 16 | 4.3438 | .62500 | Yes (p=.027) |
| | Control: 8 | 3.5625 | .77632 | |
| Better ability to transfer their understanding of end users to system implementation deliverables | Exper.: 16 | 4.3125 | .60208 | No (p=.290) |
| | Control: 8 | 3.8750 | .99103 | |
| Better overall representation of user centered design in deliverables | Exper.: 16 | 4.3125 | .60208 | Yes (p=.006) |
| | Control: 8 | 3.3750 | .74402 | |
| Overall Rating | Exper.: 16 | 4.3688 | .1472 | Yes (p=.000) |
| | Control: 8 | 3.7125 | .2322 | |

Though this study provides comprehensive insight regarding the use of profiles and personas, it is not without limitation. Limitations to this study include potential variation among teams regarding variables that we could not control, such as the projects students chose, individual differences among team members (e.g., cognitive styles and information processing abilities), and matching instead of randomizing projects between experimental and control conditions in the quasi-experimental design.

### Conclusion

The study results indicate both profiles and personas are useful in capturing a team’s understanding of user groups, enhancing shared understanding between the end users and the system development team as well as within the development team, and consequently meeting end users’ objectives. Though, profiles seem to have a slight edge over personas. Regarding specific IS development tasks, profiles and personas were found particularly useful in translating system requirements into interface design, development of change management and training strategies, and potentially identification and implementation of users’ various personalization needs. Based on the findings in this study, we plan to conduct a field experiment with experienced systems analysts and developers to extend our research model. In addition, we plan to address some individual differences in reported value of user profiles and personas by obtaining a baseline measure of development team members’ cognitive styles and information behavior.

### References


