Learning-in-use of interactive artifacts

A longitudinal study analyzing the learning experience

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Abstract: In this paper, we present a study into the learning experience as users learn to use interactive artifacts. This learning experience both evolves *over the entire time* that a user uses an artifact and is *personally meaningful* for its users. It is defined by the intentional relations that users have with artifacts as well as how users negotiate their use. In this paper, we summarize this study and early findings into these factors to understand the "learning-in-use" of an interactive artifact. This paper contributes to our understanding of how we learn to use interactive artifacts and how users' relationships with artifacts evolve over time.

Key words: learning, experience, use, evolve, intentionality, phenomenology.

1. Introduction

Research on learning to use interactive artifacts has traditionally focused on the knowledge that users accumulate about an interactive artifact, and how users use that knowledge to complete tasks. This perspective has had an impact on design and usability testing in interaction design [1, 2]. For instance, Carroll et al. [3] have shown how a computer system provides help affects how effectively a user can learn a computer system. While research agendas of this type are important for a holistic understanding of the domain of learning to use interactive artifacts, other equally important elements receive much less attention. For instance, how does a user choose what or when to learn? In this paper, we describe a study of the role that human experience plays in influencing and structuring both the process of learning and the meanings derived from such learning. Moreover, we explore how artifacts become *personally meaningful* through use. Our approach to this topic uses the concept of *learning-in-use*, which articulates learning from a perspective of the experience of learning. This approach promotes research of learning to use interactive artifacts from a perspective focused on meaning making that addresses users' underlying intentional relation when learning interactive artifacts. This work is an extension of Ryan and Siegel [4] focused on learning to use video games.

Petersen et al. [5] provide an example of how a similar notion of "learning in use" occurred for a particular family. The example begins with a family going to an electronics store to buy a new Bang & Olufsen brand television with which they had *prior experience*. The husband already knew many of the television's features such as the cinematic experience, but he was interested in learning new features described to him in the store. His wife did not have much technical experience with the television, but she was *motivated* to learn. In the study,

both users learned aspects of the system at different rates using various *resources* to accomplish tasks as they arose in their daily use. Their *immediate goals* varied based on the *context in which they used* the television and depended on their *expectations* of the television and on opportunities to use the system. At the end of the six-month study, users had developed a *habituated style of use* with the television, while many features that motivated them to buy the television remained unlearned.

The framework described above used by Petersen et al. and Bødker and Petersen [5, 6] is called learning in use that analyzes the learning situation from an activity theoretic perspective. We will distinguish our approach as *learning-in-use* through the phenomenological perspective we take that focuses on the learning experience through the ideas of intentionality and negotiation in use. First, intentionality describes the directedness of a user's experience with an artifact; this intentionality encapsulates the meaning that users make about their experience as they learn [7]. Simultaneously, interactive artifacts have their own technological intentionality imbued by their designers that constrain use by providing a domain in which use is meaningful [8]. For instance, in using Facebook, users must adapt to Facebook, appropriate Facebook to make it meaningful for their needs, or somehow influence the design of Facebook because of the interrelation of intentions between the user and the artifact. Second, *learning-in-use* is defined by the negotiation between users and artifacts through which users develop a coherent understanding of interrelations of artifacts; learn about the uses that artifacts embody; learn how to seamlessly interchange between artifacts or "dig deeper" when an artifacts' response is not sufficient for a user's goals; and finding a match between user, artifact, and situation [9]. Users negotiate their use according to goals; artifacts facilitate negotiation through a discovery process of what is possible through this artifact, which even may not be intended in the original design.

Learning-in-use, since it depends on the learning experience, relies on the personal meaning of the learning experience for each use and relies on changes in use over the user's lifetime. First, users develop their own *personally meaningful* way of using artifacts, and consequently, learning interactive artifacts is strongly influenced by prior experience and current goals. When considering learning, while quantitative researchers might be concerned with means among populations, *learning-in-use* is concerned with differences within a population by analyzing user adaptation to an artifact. Second, user's relationship with an artifact changes *over time* influencing both what and how the user learns. The way users relate to their artifacts intentionally, the way they learn, and how they perceive an artifact will all change over the lifetime of use of that artifact. We have arrived at the following research questions to guide our study:

1. *How do we learn to use interactive artifacts?*
2. *In particular, how does our understanding of use evolve through different* ***prior experiences, contexts of use****,* ***resources****,* ***motivations****, or* ***use of functionalities****?*
3. *How is this understanding stable over time and in what ways does it change?*

2. Study Protocol

We conducted a longitudinal study by recruiting twelve participants with a broad range of experience for five months divided into two phases. Participants received one artifact at the beginning of each phase

from among Photoshop, World of Warcraft (WoW), and an iPod Touch assigned based on their self-described level of motivation and prior experience with each artifact such that they fit into one of the groups described in Table 1. These artifacts were selected because they provide a fairly broad sample of interactive artifacts including productivity, creative, and entertainment artifacts. In each phase, participants learned the artifacts on their own and scheduled three interviews with the researcher—at the beginning, one month into the study, and after two and a half months. In each interview, we asked questions about the learning experience, we had users demonstrate their use of the artifact, we had users complete a standardized task, and we asked a set of debriefing questions. There were no observations outside of the interviews; however, we asked participants to complete diary entries as they use the artifact on their own. Although Petersen et al. [5] have described problems with this technique, we used this technique because it provided opportunities for participants to learn at their own pace, while also providing some measure of their experiences.

Table 1. A breakdown of the two phases between three different groups and the interactive artifact they used. Group distinctions of a or b refer to differences based on what artifact members would start using. There were two participants in each group (e.g., two in 1a, two in 1b, two in 2a, and so forth).

Group	***1a***	***1b***	***2a***	***2b***	***3a***	***3b***
Phase 1	*WoW*	*Photoshop*	*iPod*	*Photoshop*	*WoW*	*iPod*
Phase 2	*Photoshop*	*WoW*	*Photoshop*	*iPod*	*iPod*	*WoW*

To analyze the collected data, we employed standard practices of identifying patterns and key events in field notes [10]. Each analysis begins with writing narratives describing the learning experience of each participant. Using these narratives, we compare each participant's experience with other participant's experiences, the use of each artifact across all participants, and all participants' use of all artifacts.

3. Initial Findings from Research

At the time of this writing, we had completed one phase of this study and were able to observe participants for one full cycle of their use of these artifacts. Each story that we collected from participants was unique. For instance, one participant using an iPod contemplated hacking it to be able to download apps that he wanted even though ultimately he did not. One WoW participant who reported a low motivation for the game initially made it further than any other participant and said that she thought she might be addicted at the end, while some participants who said they were motivated to play did not get far beyond the beginning, but still looked at their progress as successful. All but one experienced user in Photoshop mentioned learning new features throughout the study, but all seemed to plateau in their use and interest during the study. All artifact participants experienced such plateaus except for WoW participants who mentioned renewed interest once a new patch was installed that made completing quests in the game much easier to accomplish. This finding corroborates the idea that over time shifting situations are instrumental in shaping our learning experiences. Finally, we found three important themes that played out in many if not all users' learning experiences in some ways. These include the social experience of learning, the multistability of meaning, and organizing use into the participant's life. Descriptions and examples of each theme are provided below.

3.1. Social aspect to the learning experience

Several participants in the study described the ways in which social factors completely altered the way they learned and experienced the artifacts. One particular example of this aspect was the participant described above who excelled in WoW. She told her friends who played the game that she started playing, and they soon joined her and guided her through the game. By the time she reached level 60 of the game, and as her friends coincidentally stopped playing with her, she was able to play the game on her own with the knowledge that she accumulated. In this case, it seemed that she used WoW not in place of socializing, but as a new avenue with which to socialize with her friends. Other examples of the social experience influencing learning include the way family life influenced two iPod participants' experience or the way some Photoshop and WoW participants depended on user comments to validate the efficacy of Photoshop tutorials and WoW quest guides respectively.

3.2. The multistability of meaning in learning

The multistability of meaning describes the general instability of intentional references [8] as we interact with interactive artifacts. Multistability is the unstable flip-flopping between two ways of seeing a dilemma or artifact such as an image of the 3-dimensional line drawing of the Necker cube. Multistability emerges from how the meaning of an artifact depends on both the object (noema) and the perspective of the subject (noesis) to structure the meaning of the experience of that artifact [9]. Consequently, users can shift such meaning whenever the object changes or the subject's perspective changes over the course of an artifact's lifetime. Several photoshop participants experienced a form of multistability as they would test out different ways to reproduce some effect from an image they found. They would alternate between two modes of constructing the image. As they worked, they would compare what they had already, where they wanted to take the image, and how they were working. At times throughout the study, especially when working on the task we provided which in part involved creating concentric circles, they would start working on part of the image and then start over using a new course of action simultaneously comparing it to the previous way they just tried. If this new technique proved to be more efficient or more effective for reproducing the image, they would continue; otherwise, they might scrap this approach and return to the original way of working on the image already knowing exactly how to get back to that point. With the multistability of meaning, multiple possibilities are revealed through use, and users must balance competing point of views about their work. It is only through experience that a user can know exactly how to interpret and assign meaning to such a situation, but this multistability always ensures that new interpretations may be useful for future situations described by McCarthy and Wright [11] as unfinalizability.

3.3. Organizing learning to use interactive artifacts into life

One of the most pervasive issues in learning to use the artifacts for participants was finding a way to fit using and learning to use these artifacts into their life schedules. All participants dealt with this issue in some way, and while some felt they were able to balance time to learn to use the artifact with other time constrains they had, others did not. One WoW participant described his difficulty finding time to play because he was not able to play the game when his girlfriend was around since he did not share the game experience with her as well as because other games he played competed with time he could use for playing WoW. All of the iPod participants mentioned how their use of the iPod hit a plateau after about a month of use. Some mentioned how the iPod could not take over the roles filled by either their cell phone or laptop. Participants in the study had to find ways to organize and

negotiate their interaction at a social level, at a level of ongoing activities in their lives, and in relation to all the other devices and functionalities they already use.

4. Conclusions

This paper describes a study that analyzed the ongoing learning that people engage in as they learn to use interactive artifacts through a notion of learning-in-use. The account of learning described here goes beyond understanding the knowledge gained in learning artifacts and the types of errors made, but describes a learning experience that includes how people make their learning meaningful and how that meaning dynamically changes over the lifetime of their artifacts. We asked three research questions above. First, with respect to how people learn, all the study participants had their own unique way of learning, and the learning in which each participant engaged was *personally meaningful* in large part because the situations in which they learned were slightly different. Second, with respect to the factors, new functionalities made the biggest difference for affecting motivations for learning in the study as the new patch in WoW demonstrated, while prior experience not only made a difference in how they approached learning, but also influenced perceived possibilities using an artifact. Social resources including the internet influenced both motivations people had and how learning unfolded though most other resources did not seem to matter. The context of use for the artifacts did not seem to change much after the study began. Also, opportunities to learn—a factor emerging from the study—as described through fitting learning into users' life schedules impacted the learning situation. Finally, while participants experienced periods of stability in their learning-in-use, changing situations of use affected the motivations that they had when learning these artifacts. The problem of learning to use interactive artifacts can still be analyzed much more broadly than through traditional methods. We have proposed *learning-in-use* as one such lens that allows us to focus on the learning experience as it unfolds by those engaged with interactive artifacts.

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