

# Generating Mobile Application Onboarding Insights Through Minimalist Instruction

**Brendan Strahm**  
Purdue University  
West Lafayette, IN, USA  
bstrahm@gmail.com

**Colin M. Gray**  
Purdue University  
West Lafayette, IN, USA  
gray42@purdue.edu

**Mihaela Vorvoreanu**  
Purdue University  
West Lafayette, IN, USA  
mihaela@purdue.edu

## ABSTRACT

Mobile application designers use onboarding task flows to help first time users learn and engage with key application functionality. Although some guidelines for designing onboarding flows have been offered by practitioners, a systematic, research-informed approach is needed. In this paper, we present the creation of a method for designing mobile application onboarding experiences. We used the minimalist instruction framework to engage twelve university students in an iterative set of design and evaluation activities. Participants interacted with a physical prototype of an educational badging mobile application through a semi-structured exploration and reflection activity, bookended by structured mini-interviews. We found that this method facilitated engagement with participants' meaning-making processes, resulting in useful design insights and the creation of an onboarding task flow. Research opportunities for integrating instructional design and learning approaches in HCI in the context of onboarding are considered.

## Author Keywords

Onboarding; minimalist instruction; user experience; design methods; mobile.

## ACM Classification Keywords

H.5.2. Information interfaces and presentation: User Interfaces. - Evaluation/Methodology.

## INTRODUCTION

A user's first interaction with an application frames their future interactions, enculturating the user into a complex array of interface and system components [1,4,25]. If new users are unable to understand these components and how they might be used to address personally relevant goals, the application is likely to be uninstalled or ignored [19]. While learnability and usability of application interfaces has been at the core of HCI scholarship for decades [e.g., 2,4], the

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [Permissions@acm.org](mailto:Permissions@acm.org).

DIS '18, June 9–13, 2018, Hong Kong

© 2018 Copyright is held by the owner/author(s). Publication rights licensed to ACM.

ACM ISBN 978-1-4503-5198-0/18/06...\$15.00

<https://doi.org/10.1145/3196709.3196727>

rapid adoption and evolution of mobile applications may present new challenges. In this paper, we focus on the *onboarding* process as a key aspect of the user experience that allows users to discover application functionality in a timely manner and identify how this functionality might allow them to achieve their personal goals. Many applications use onboarding task flows such as instructional text, just-in-time hints, or interactive tutorials to help new users learn the application's key benefits and guide new users toward meaningful engagement with those benefits, yet there is scarce methodological or theoretical guidance to inform onboarding design decisions.

Past scholarship on the learnability of applications and interfaces has focused primarily on large or relatively stable application environments (c.f., "training wheels" instruction [1,6]), but this guidance is more difficult to apply to rapidly evolving mobile applications where users often have a multiplicity of choices. There is a need for a systematic, research-informed method for generating design insights that inform the creation of effective onboarding task flows. Some guidelines for designing onboarding have been created by industry practitioners [e.g., 10,11,12,15,19], but these guidelines are often framed separately from generative user research and neglect engagement with instructional design theory and the ways that users learn to use and engage in new technological environments.

In this paper, we propose a design method that fills this gap by using Carroll's minimalist instruction framework [4,5] to generate onboarding design insights by leveraging users' meaning-making processes. The method consists of an iterative set of design and evaluation activities, wherein participants are engaged in structured mini-interviews surrounding a mediated interaction with a physical prototype. To create and validate this method, we engaged 12 participants in the design of onboarding task flows for an existing educational badging mobile application, identifying relevant and generative design insights that resonate with the theory of minimalist instruction.

The contributions of this paper are two-fold: 1) We propose a systematic, research-informed design method for generating insights for mobile onboarding, which provides guidance to practitioners that design mobile experiences; and 2) We connect learning and instructional theory to the design of onboarding experiences using minimalist instruction as a

theoretical framework, informing a learning-focused view of technology adoption and use. These contributions benefit the HCI community by cross-pollinating research on learning from the instructional design domain and reframing onboarding task flows as an opportunity to engage in minimalist instruction. This method addresses a gap identified and only partially filled by practitioners, providing opportunities for future research on onboarding and learning as part of the user experience.

#### **RELATED WORK**

To frame our research approach, we describe the work of practitioners who have identified nascent generalized approaches for user onboarding and summarize the findings of researchers who have identified situated approaches for user onboarding. We then situate our method development in relation to minimalist instructional approaches that have previously found resonance in the HCI community.

#### **Practitioner Approaches to Onboarding**

Onboarding has been a topic of great interest in the UX practitioner community, but we have been unable to identify research guidance on how designers should create user onboarding experiences through support from a research or prototyping method. Therefore, we will begin with what is known from the practitioner literature, and then move outward to document learnability and onboarding implementation more broadly in the HCI literature in the next section.

According to UX practitioner Samuel Hulick, user onboarding is “...the process of increasing the likelihood that new users become successful when adopting [a mobile application]” [10]. Onboarding task flows are comprised of instructional interface elements located at critical points throughout the application, collectively functioning as a built-in application tutorial for new users. Onboarding can be relevant as users learn to use new applications in general, additional applications within a known and specific genre (e.g., task management, puzzle games), or new versions of known applications. Examples of onboarding design patterns include: instructional text, tours, progress bars, just-in-time hints, tips placed in feeds of user-generated content, and interactive tutorials [11,15].

The majority of practitioner sources propose highly general onboarding design recommendations, including connecting specific onboarding patterns to specific types of applications based on induction from existing mobile applications. This approach positions onboarding as a drop-in solution for specific problems with a focus on design refinement rather than designing based on generative research and learning insights. However, the work of Higgins [11,12] and Hulick [10], both UX practitioners, provide a more substantive set of guidelines and process moves to engage with the challenges of onboarding.

Higgins [12] differentiates herself from other practitioners by explicitly invoking learning in her onboarding design

strategy, using instructional design concepts as a foundation of her approach. She advocates for three principles of onboarding: 1) instruction should be presented contextually through guided interaction to provide a space for learning through exploration; 2) users should be presented with a limited subset of the application’s functionality before being required to create an account in order to build trust and feelings of reciprocity; and 3) onboarding should focus on personalization and facilitating user tasks in order to emphasize the priority of user needs. Higgins [11] has also proposed a participatory design exercise called *Coaching Cadence* to prototype the steps in a guided walkthrough onboarding section. This method is noteworthy as it represents the only generative research method of its type proposed by a practitioner. The exercise is a dialogue where the researcher plays the part of the application onboarding and the participant describes the actions they would like to take. While this method is an effective way to engage potential users in the broad design of an initial onboarding flow, user interaction is removed from actual use of a prototype, and is geared toward identifying pacing issues rather than learnability issues.

Another substantive practitioner perspective comes from Hulick [10], who proposed an onboarding strategy focused on the user journey rather than directly on the onboarding task flow. This approach focuses on two meaningful points that ideally occur early in the user’s journey: the “*aha!*” moment and the *quick win*. While these points in the user journey have not been empirically validated, they serve as a helpful frame for the present study and method design.

#### *The Aha! Moment*

Hulick calls the first point in his strategy the “aha!” moment [10], which comprises a moment of realization where new users identify personal benefits to using the application that help organize and cohere their perception of the application. Without onboarding, users might make this realization after investing significant effort, if they are willing to persevere. The purpose of onboarding could then be stated as clearly and efficiently guiding users to their “aha!” moments. Generating these moments is situational, and it is recommended that new users be provided with a rational explanation of the mobile application’s purpose and an emotional reason to be interested in it.

#### *The Quick Win*

The second point in Hulick’s strategy is called the “quick win” [10]. In order to achieve meaningful progress before new users lose interest, Hulick recommends that designers focus on helping the user achieve one core benefit. For example, a quick win in the Twitter onboarding flow is to follow a few people, thereby populating the user’s timeline. Not only does this deliver on a core benefit in a personal way—feeling connected to interesting people—but it is also easily attainable in the first session of use due to the availability of user recommendations. This provides closure and a positive conclusion to the user journey.

## Learnability of Applications

Learnability of interfaces and application systems has long been at the core of HCI theory and practice, impacting the design of systems and their usability as experienced by the anticipated end user [e.g., 2,5,17]. In the design of computing systems in the 1980s, philosophies of application design and usability such as “training wheels” [1,6] ensured that users would be able to effectively explore and use applications in a scaffolded manner, with clear instructional aids and limited functionality to guide potential actions. Other scholars have engaged in various aspects of the learning process users undergo when using a new application, generally building in some way upon learning or instructional theory. Yi and Davis [27] described how users build skills within a software environment, and identified the role of observational learning processes (attention, retention, production, and motivation) in this skill acquisition process. Haramundanis [9] identified key aspects of learnability in information design, focusing on visual consistency and usability as key drivers of creating learnable materials. Finally, Leutner [13] built on the “training wheels” approach, using detailed guidance in conjunction with limiting application functionality to create “double fading” of support, thereby increasing user acquisition of application knowledge.

Onboarding has been addressed in a limited number of HCI publications, but always in relation to specific products, contexts, or learning outcomes rather than being oriented towards a general method for producing effective onboarding experiences. One common area for onboarding study is the open-source software community, where technical and conceptual barriers to collaboration are addressed, with a limited analysis of the interaction design of the system that may promote effective onboarding (e.g., [23]). In parallel, Fraser et al. [7] and Cardoso [3] have addressed onboarding in crowdsourcing communities, focusing on the retention benefits of effective onboarding. Fraser et al. [7] addressed onboarding in the context of a photo manipulation extension, while Cardoso [3] presented in-progress work on a citizen science online platform. Other scholars have addressed onboarding in specific domains such as gaming [26] and education [14]. Petersen et al. [26] used surveys and physiological response to analyze the onboarding experiences of existing free-to-play mobile apps, while Lochrie et al. [14] documented the creation of a companion mobile application to allow children to productively engage with physical computing devices in an educational setting. While these onboarding implementations have generative and theoretical value, no prior scholarship has proposed a content- or context-free method for generating onboarding interactions, and further, no extant scholarship has engaged with instructional design and learning theory to inform onboarding design decisions.

## Minimalist Instruction

Minimalist instruction (MI) is an instructional design framework developed in the 1980s by Carroll [4] as an alternative approach to hierarchical software training

manuals. Its main goals were to give users more to do, less to read, and help users recover quickly from errors; this was made possible through the production of non-linear, goal-driven instructional materials that served as flexible instructional scaffolding. Carroll codified and operationalized this approach, resulting in the principles and heuristics of minimalist instruction shown in Figure 1 [25]. These principles support onboarding goals, and serve as a theoretical framing for the development of our method. While it is possible that these principles are tacitly in use in existing onboarding sequences or practitioner guidance, our focus in this study is on how MI can be used to inform onboarding-focused user research, not to explain or evaluate the presence of MI principles in existing products.

---

### Principle 1: Choose an action-oriented approach

- 1.1: Provide an immediate opportunity to act.
- 1.2: Encourage and support exploration and innovation.
- 1.3: Respect the integrity of the user’s activity.

### Principle 2: Anchor the tool in the task domain

- 2.1: Select or design instructional activities that are real tasks.
- 2.2: The components of the instruction should reflect the task structure.

### Principle 3: Support Error Recognition and Recovery

- 3.1: Prevent mistakes whenever possible.
- 3.2: Provide error-information when actions are error-prone or when correction is difficult.
- 3.3: Provide error-information that supports detection, diagnosis and recovery.
- 3.4: Provide on-the-spot error-information.

### Principle 4: Support reading to do, study, and locate

- 4.1: Be brief; don’t spell out everything.
- 4.2: Provide closure for chapters.

---

**Figure 1. Minimalist Instruction Principles and Heuristics (adapted from [25]).**

Using an *action-oriented approach* focuses on engaging the learner in activity to build and sustain engagement, with an implicit argument that effective learning must be situated in action meaningful to the learner. Carroll [4] identified that new users feel an urge to make tangible progress toward their goals, and this principle engages users in that active learning early, balancing their need for information with their need to experiment and produce, giving learners a sense of confidence and control. In a direct parallel to the “quick win” of onboarding design [10], Van der Meij and Carroll [25] connect this principle to creating a series of short-term goals to reflect rapidly changing learner goals.

*Anchoring the tool in the task domain* reinforces that the tasks presented in minimalist instruction should be real and meaningful, not imaginary, scenarios. Tasks should be immediately understandable by the learner and easy to complete in order to provide an attainable and personally

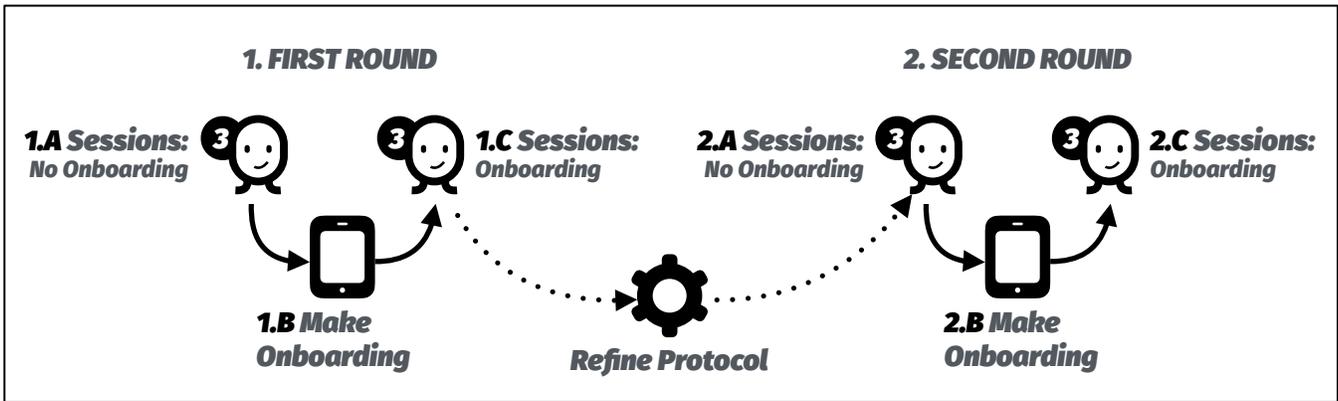


Figure 2. Iterative protocol structure.

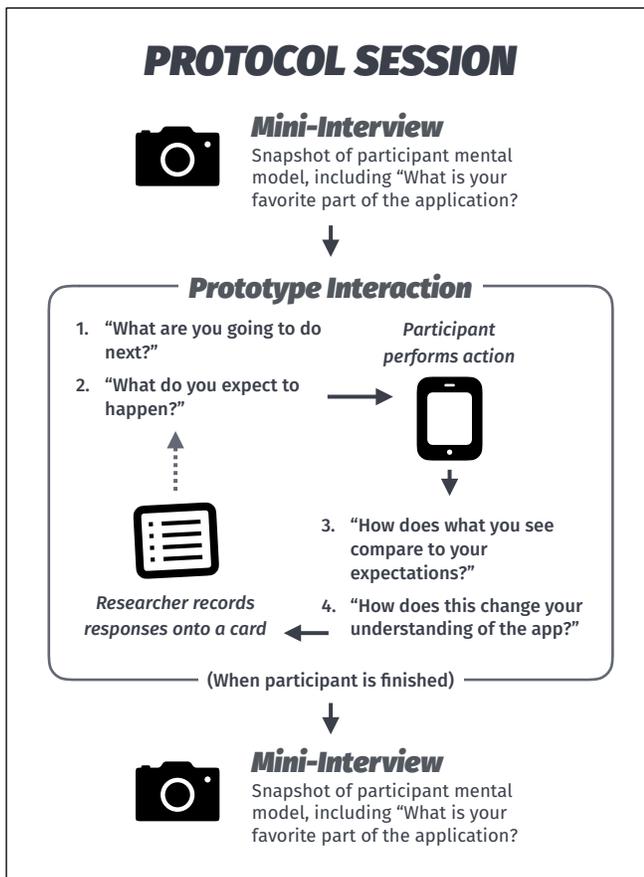


Figure 3. The process for conducting a session.

relevant reward [25]. This task-oriented approach supports experimentation and also provides common tasks using terms and descriptions that are natural for users instead of system-oriented language.

*Supporting error recognition and recovery* holds that the best way to fix a mistake is to prevent it from happening, while acknowledging that demanding an error-free system is unreasonable and unrealistic [4]. Designers should work to prevent common mistakes and provide contextual error information to opaque or critical tasks, while also providing clear recovery paths when errors do occur. Good error

information allows users to qualify these experiences as aberrant and maintain confidence and motivation.

*Supporting reading to do, study, and locate* recognizes that instruction must be direct, concise, and contextual. [25] recommend designing prompts that allow users to infer missing detail, as the bulk of instruction should be mediated by interaction and context. Designers should make instructions as self-contained as possible, grouping related skills together into “chapters” with a distinct start and end.

#### STUDY FOCUS

When creating onboarding experiences, designers must identify which tasks and features to onboard, which design patterns to use to accomplish these goals, and how and where the onboarding fits into the rest of the application. Because onboarding task flows are inherently instructional in nature, we posit they should be grounded in insights from user research in order to substantively support situated user goals during the first session of application use.

The focus of this study is to create and validate a design method to provide further guidance to designers as they specify appropriate onboarding task flows. While the resulting method may be broadly applicable to onboarding experiences for new apps or versions of existing applications, in our validation, we focus primarily on an application type that is new to users. To evaluate our method, we will answer the following research questions:

1. What design insights can UX designers generate in guiding new users through the method?
2. What are the characteristics of “aha!” moments, as experienced by new users in the method?
3. How do design insights and the “aha!” moments inform the design of an onboarding experience?
4. How does the onboarding method facilitate the verbalization of meaning-making by new users?

#### METHOD

To address our study focus, we conducted a design protocol study [8], engaging 12 participants in an iterative set of design and evaluation activities in order to generate onboarding insights and design onboarding task flows for an

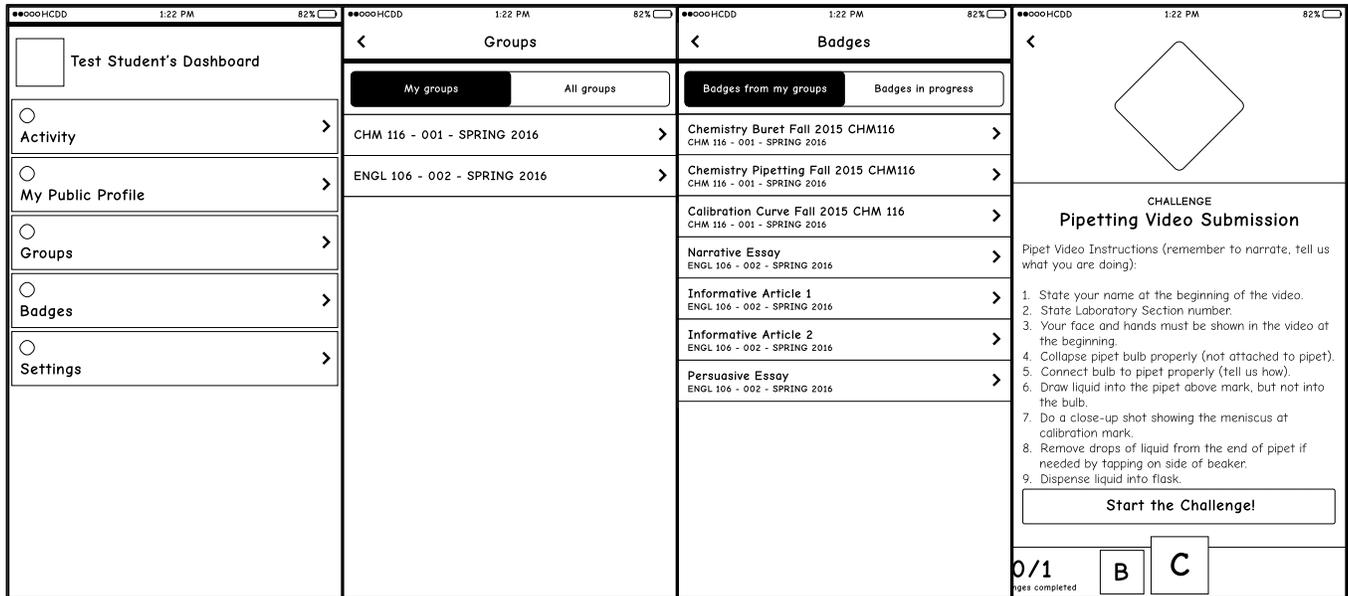


Figure 4. The main menu, groups, badges, and challenge screens from the interactive prototype.

educational badging mobile application. The app uses educator-generated badges to denote levels of competence in a topic. Badges are populated with challenges, such as quizzes, writing assignments, and video reflections, which facilitate instruction and assessment of students in an active learning setting. The lead researcher was a developer on this app, thus lending authenticity to the design task where the results guided future development [20]. Users interacted with a low-fidelity, phone-based, clickable prototype of the main screens of the application. We conducted a pilot study with six participants in order to refine the method procedure and then used the refined protocol with an additional six participants. For clarity, this paper only addresses data gathered using the refined protocol.

The researchers used minimalist instruction as a theoretical framework and generative design resource to inform the generation of onboarding insights and data collection methods. The principles and heuristics of minimalist instruction were used to guide the choice and implementation of onboarding design patterns. Data collection was structured around capturing participants' meaning-making processes, with the assumption that minimalist instruction should encourage continuous interpretation and sensemaking as users explore the space.

The method uses an iterative design (Figure 2) in keeping with minimalist instruction practice [4]. In this study, we conducted data collection and analysis sessions with three participants in order to generate onboarding design insights using a prototype with no onboarding (A). Then we made onboarding for the prototype based on the collected results from the session (B). Finally, we performed data collection and analysis with three new participants using the prototype

with onboarding (C). We compared the insights generated by the two prototypes to evaluate the effect the onboarding had on the participant meaning-making process. The method was designed to support continued iterations in order to continue refining the onboarding design.

### Participants

We recruited 12 participants (M=5; F=7) through email blasts to student lists, flyers, and face-to-face recruiting. All participants were undergraduate students and represented the primary user group for the badging application under study. No participants had prior experience with this application, but they displayed basic knowledge of learning management systems. Based on iterative analysis of data throughout the study period and findings from the pilot study, we found that six participants across two iterative sessions was sufficient to reach data saturation due to the richness of qualitative data we were able to collect, a key criterion for rigor in qualitative research [18]. Because the goal of the evaluation of this design method is validating pragmatic utility, our aim is not to show deep generalizability, but rather demonstrate that deep and actionable insights can be gained with relatively few participants. Additional research is needed to identify the limitations of sample size in relation to design outcomes.

### Data Collection

The method protocol engaged participants in a structured set of activities, allowing consistent forms of data generation and researcher-participant interactions (Figure 3). Data collection was centered on participants' interaction with a clickable wireframe prototype, which drew inspiration from the single-person variant of the CARD method [24]. We also collected demographic information from all participants and conducted a short entry and exit interview.

### Interactive Prototype

Participants were asked to interact with a prebuilt wireframe prototype, delivered as a clickable and frameless application on a smartphone (Figure 4). These interactions were captured through audio and video recording, and all generated artifacts were retained for further study (Table 1).

	Video & Audio	Card Artifacts	Survey
Prototype Interaction	●	●	
Entry & Exit Interviews	●		
Demographic Survey			●

**Table 1. Sources of data collected during the protocol.**

In order to engage with the participant meaning-making process, the prototype interaction was mediated using a semi-structured process to capture progression through the application. The researcher asked participants questions off of cards (Figure 5) and summarized the salient points of their answers onto the card itself, so that each card encapsulated one step in a larger meaning-making process. The first two questions on each card asked about the participant's next action and their expectation of its result, and participants were asked to perform the action after answering these two questions. The last two questions elicited the participant's perception of the result of their action as shown in the prototype and prompted them to reflect on its possible meaning in the larger application.

- |   |
|---|
| <ol style="list-style-type: none"><li>1. What are you going to do next?</li><li>2. What do you expect to happen?</li><li>3. How does what you see compare to your expectations?</li><li>4. How does this change your understanding of the mobile application?</li></ol> |
|---|

**Figure 5. The four questions on each card elicited participant expectations of an action and reflection on its results.**

Participants were asked to explore the mobile application step-by-step through this questioning process until they notified us that they were ready to stop. Without this mediation, participants would have been more likely to proceed through the application without giving expectations and be unable to accurately remember their reactions to events during the interaction. Because these questions were asked during prototype exploration, they created a step-by-step record of the expectation and rationalization in the participant meaning-making process.

### Demographic Survey and Interviews

Participants were asked to complete a demographic survey which detailed their smartphone use. These results were captured and transcribed after the protocol session. This was followed by a short interview that captured an initial summary of participant perceptions of the purpose and

audience of the mobile application under study. The primary researcher read participants a short description of the mobile application, which provided information similar to a cursory look at an app store page, and asked participants a set of predefined questions which documented their perceptions of the application's purpose and intended use. At the conclusion of the participant's interaction with the prototype, we conducted a second short interview to capture how their perceptions of the mobile application had changed through prototype exploration. Questions from the entry interview were repeated; in addition, participants were asked to explain the mobile application as if they were talking to their past self at the start of the session. Both interviews were audio recorded and transcribed for further analysis.

### Analysis and Onboarding Design

Analysis took place iteratively after each group of three participants completed their sessions. Each round of analysis only considered data from the current round of participants. The primary researcher first reviewed the video recordings and transcribed the interaction sections into a spreadsheet for identification and tracking of salient concepts. He then laid out the card task flow and interview responses for each participant, providing an overview of their meaning-making process. The researcher identified participants' perceptions of the main sections of the mobile application and their use, situations where the participants' understanding of the application or underlying system was challenged, and how the participants reconciled new and unexpected information with their understanding of the mobile application.

After completing analysis on the participant level, the primary researcher compared insights across participants to identify common insights, filtering out insights that were not shared by a majority of participants. Then the primary researcher identified a common "aha!" moment and quick win by comparing answers from the post mini-interviews across participants to identify perceived strengths of the experience as a whole, reviewing the prototype exploration for relevant individual experiences that resulted in expressed realization or understanding (indicating "aha!" moments) or expressed satisfaction or closure (indicating quick wins), and synthesizing the posthoc narratives and exploration experiences together into a coherent and consistent narrative of a common "aha!" moment and quick win.

Following these two levels of analysis, the insights were used to inform the design of an onboarding experience. The goal of the onboarding approach was to 1) promptly guide participants through the "aha!" moment to a quick win; and 2) help to minimize disruptions or barriers that may impede users' progress towards these goals. Relevant onboarding design patterns from practitioner sources that fit the identified insights were used.

After the creation of an onboarding experience, onboarding wireframes were added to the initial prototype. A second group of participants then used the same protocol in order to evaluate the efficacy of the onboarding experience.

The results from this group was compared to the previous group to identify how onboarding had addressed onboarding barriers and delivered on the “aha!” moment and quick win.

## RESULTS

In order to provide a real-world example of how onboarding was conceptualized, created, and assessed using this method, in this section we present a selection of results across all stages of the protocol. The results presented here focus on the identification of the aha moment and quick win and the creation of onboarding directly related to those central moments.

The "aha!" moment and quick win we identified were related to badges and challenges. The intended functionality of this system was for users to earn badges representing mastery of a specific subject by completing predefined learning challenges related to that badge.

### RQ1: Design insights from new user interaction

The first step in analysis was to identify aspects of the participant meaning-making process shared among the majority of participants and use them to generate design insights. All three participants explored and referenced badges and the badge concept frequently during their interaction with the prototype and their post mini-interviews, which was later found to be relevant to the “aha!” moment. These frequent interactions led to the generation of five design insights, presented here along with exemplary participant quotes.

1. All three participants thought badges were achievements, functioning as a metric of accomplishment: *“\*somewhat sarcastic\* [Going to a badge page will] show you a star saying “Good job! You did it!” \*exaggerated fist pump\* ... and you got 10 extra credit points and you’re not going to fail Chemistry.”*
2. All three participants thought that badges were earned by completing challenges: *“It seems like when you take challenges, you’d earn the badges, and then the badges would show up on your profile.”*
3. Two participants indicated that badges shouldn’t function as containers for grouping challenges: *“I really like the idea of badges. I really don’t like the idea that they are the completed activities themselves. ... I really like [them as a] reward system.”*
4. All three participants referred to badges and challenges as activities, tests, and quizzes: *“[Maybe the app] is for you to go into the activities ... to practice for your tests and quizzes, to get better in your knowledge if you’re having*

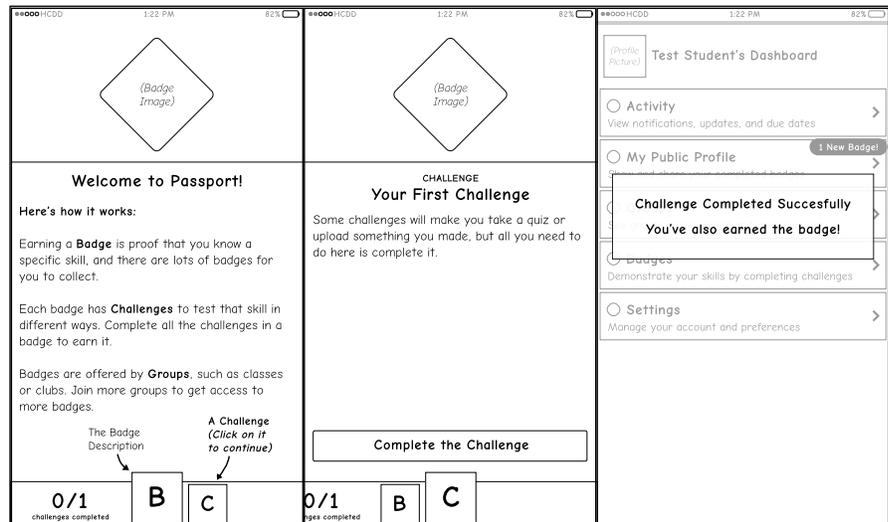


Figure 6. The “welcome” onboarding badge created using the Playthrough tutorial design pattern.

*struggles.”*

5. Two participants thought the Badge/Challenge navigation menu was unintuitive: *“\*after tapping on the chemistry quiz badge screen a few times\* Maybe there was supposed to be some other button to click? ... That’d be my only guess because it seems like a dead end [...]”*

These insights contributed to the onboarding design process in different ways. Insights 1 and 2 encompassed perceptions that participants used as premises for reasoning about how application systems functioned and what screens might contain. While the conclusions participants arrived at were not completely accurate, these design insights indicated what participants were able to learn about badges from the application in its barest form and what aspects of badges would need additional onboarding to be instilled. Insight 3 referenced a value judgment that participants made upon reflection, either indicating that the relationship between badges and challenges should be changed or that it should be introduced to participants earlier and more explicitly. Insight 4 highlighted a difference of vocabulary between participants, which on the surface indicates that the terminology for app systems was unclear, but could also imply that participants had different conceptions of how the badge and challenge system worked. Finally, Insight 5 indicated an area of the application where participants were unable to successfully interact with the interface, indicating that the interface should be changed if possible.

### RQ2: Identifying characteristics of an “aha!” moment

We identified a shared “aha!” moment to use as a focus for onboarding design by reviewing a combination of the post mini-interviews and prototype explorations. One of the questions in the post mini-interview was designed to direct researchers toward “aha!” moments by asking participants about what they thought was their favorite part of the application. All three participants answered that their

favorite part was either challenges, badges, or both, and briefly explained why they thought so. As one participant stated: *“Because the learning challenges are specific to a group or class in general, it can be a potential help... It’s not as if you’re going in there just to do a learning challenge, you’re going in there for a purpose... and if that’s a way to benefit an eventual test grade, then I don’t see why you wouldn’t do it.”* This pointed to an “aha!” moment occurring while participants were interacting with the badge and challenge system. Our next step was to review those sections of the prototype exploration to identify specific “aha!” moments related to badges and challenges.

We identified each participant’s “aha!” moment by reviewing all sections of prototype exploration where badges or challenges were mentioned. Upon first navigating to the main menu, all participants went to sections of the application that involved the badge and challenge system. Participant reflections quickly shifted to talking about badges and challenges as systems instead of interfaces, and they began speculating about the purpose of the systems:

*“Now that I’m looking at it—it might [...] link what your professor wants and what you are supposed to [do]. I see Collaborative Curve Quiz here for [a chemistry course], so maybe the professor can upload quizzes for you to take on your phone. Or maybe it’s just [...] for quizzes and tests and activities [...]. It might be for in-class activities, too, so the professor might be like, ‘Everybody pull up your phone, go to [the app...] do this activity in class’.”*

Participants also began speaking in a more animated manner, connecting the value of the badge and challenge system to their lived experiences: *“...[if I were practicing for freshman math] I would have gotten a badge for it, which would have helped me through my emotional turmoil.”* The combination of the abrupt integrative shift in the perception of badges and challenges and the reflection on the system’s personal utility indicated that these instances were “aha!” moments.

We then reviewed the post mini-interview responses once more in order to reinterpret them in light of these specific participant experiences and synthesize them into one shared “aha!” moment for use in onboarding design. In considering which parts of the application were most meaningful to them, Participant A was most interested in earning badges and Participant C was most interested in completing quizzes, but Participant B bridged the two by connecting completing challenges and earning badges together as parts of a process. Their specific experiences during prototype exploration supported the common thread in their posthoc narratives that working to earn badges has intrinsic value while also benefiting extrinsic goals, like improving course outcomes. Therefore, we identified that the shared “aha!” moment took place when participants internalized the process of completing challenges to earn badges and thereby succeed in their courses.

### **RQ3: Using the design insights and “aha!” moment to**

### **inform the onboarding experience**

Once we identified our shared “aha!” moment, we began designing an onboarding task flow to guide participants to that moment and reify some of its benefits in a quick win. Our design for the quick win was inspired by participant B theorizing that *“If you joined a class you [might get] a welcome badge.”* We used the Playthrough onboarding pattern to create an introductory badge that would facilitate early engagement and encourage interaction with the system (Figure 6). The design leveraged the insights that badges were achievements and were earned by completing challenges by introducing those concepts to new users in their authentic task domain, in keeping with minimalist instruction principles.

The badge description framed the essential information about groups, badges, and challenges for a new user. The challenge screen was intended to guide new users through the process of completing a challenge, reinforcing the badge earning process before users arrive at the main menu. Upon completing the challenge, users were shown an overlay saying that they earned their first badge and were taken to the main menu. This part of the onboarding design integrated all four minimalist instruction principles.

### **RQ4: Impact of onboarding on users’ meaning-making**

The final step in analysis was to generate design insights from shared aspects of the participant meaning-making process during the session using the prototype with onboarding and compare them to the insights from the previous session, which used a prototype without onboarding. Participants once again referenced badges frequently, and we generated three design insights from their interaction with the onboarding badge and five relating to badges in general.

1. All three participants thought the onboarding badge was a tutor: *“This is an introduction screen that tells you the basics behind the purpose of the mobile application. It’s basically... a guide.”*
2. All three participants identified that you earned badges: *“[I learned] that you have these challenges. So it’s basically testing your knowledge on each of these tasks and testing you if you have mastery of them.”*
3. One participant connected the onboarding badge to later badges and challenges. This is significant because it explicitly validated one of our intentions for the onboarding badge: *“[This screen] has the same layout on the bottom as the original challenge, so it’s taken me to another challenge.”*
4. All three participants thought that badges were collectible: *“[Tapping on the badge] will show a list of what you should do to collect the badge.”*
5. All three participants connected badges with challenges: *“It will show a list of what you should do to collect the badge.”*

6. All three participants expected the Badges screen would contain a list of badges: “[Badges would contain] the listing of badges.”
7. All three participants connected the Badges screen with showing homework: “I think it’s like a list of more... \*pauses and raises eyebrows\* homework to complete. ... [Tapping one] will show a list of what you should do to collect the badge.”
8. All three participants thought that challenges test your knowledge and mastery of skills. They talked about quizzes, activities, homework, and assignments as types of challenges: “Okay. It’s a description up top and then a video submission, so I guess you complete the challenge that way. You submit whatever assignment or whatever it is into the mobile application and then I guess you’re finished with the quiz.”

Our assessment was that the onboarding improved the perception of badges and challenges. Unlike with the initial prototype, all participants learned the main features of badges and challenges and connected them together without issue. Participants also demonstrated good knowledge of the Badges section.

## DISCUSSION

We have presented our method and explored its value for identifying insights that may lead to effective scaffolding of the user’s journey through onboarding. In this section, we synthesize and discuss opportunities to connect learning and instructional theory to the design of onboarding experiences, describing implications of this cross-pollination of theoretical constructs for HCI practice.

### Minimalist Instruction as an Onboarding Framework

Our review of onboarding best practices resulted in the identification of a nascent area of UX practice. While practitioner efforts towards the generation of onboarding design patterns have been useful and generative in contrast to the relative vacuum of scholarly guidance, these practitioner-led approaches have frequently lacked the guidance of instructional design and learning theory to engage with onboarding design—problematic in a process that is inherently about learning.

Our experience in developing and validating a method to identify design insights to guide onboarding design indicates that minimalist instruction may be an extremely valuable and relevant tool in building an onboarding framework vocabulary, both for practitioners and for the HCI community. Using minimalist instruction as an analytic and design framework shaped how we approached our research goal by situating onboarding as part of a new user’s meaning-making or interpretive process. Findings from our method underscored the importance of engaging users in interaction with a prototype of the actual application in order for meaning to be co-constructed similarly to how it would be with a finished application. In this sense, we concur with existing co-design and participatory approaches [e.g., 21,22],

which could be extended in future iterations of the onboarding method.

The principles and heuristics of minimalist instruction provide a language that foregrounds learning processes when critiquing and comparing onboarding task flow alternatives. Viewing existing onboarding design patterns through the lens of minimalist instructional principles and heuristics illuminates their relative strengths and weaknesses and provides guidance on how designers might productively address learning gaps or misconceptions. For example, the deferred account creation pattern serves a structural purpose, allowing new users to explore a portion of an application’s content without needing to create an account. Viewing the pattern through the lens of minimalist instruction reveals that the pattern is not focused on the content of the instruction, and thus should be paired with other onboarding design patterns that focus on presenting content. Using minimalist instructional principles and heuristics as a common language for critiquing and comparing onboarding design patterns fills a gap in practitioner onboarding design knowledge, providing useful and pedagogically-sound alternatives to the current standard of inferential and largely incomparable tips and tricks.

Carroll’s principles and heuristics may also inform data analysis resulting from user interactions when reframed as questions to be answered about the onboarding experience. For example, if onboarding is intended to respect the integrity of the user’s activity, what tasks were the users trying to perform and where did those tasks conflict with the intentions of the application systems? As another example, if onboarding is supposed to provide enclosed, self-contained sections, where did users draw on prior or outside knowledge, especially in unintended ways? In this way, the principles and heuristics function as a lens to examine the application as users perceived it. This lowers a possible barrier to practitioner design research and provides opportunities for further investigation by the HCI community into refining, extending, and codifying useful avenues of inquiry for onboarding design research.

The results of this study indicate that even a low-fidelity prototype can elicit many meaningful and useful insights for onboarding design, consistent with prior research and conventional design wisdom regarding low-fidelity prototypes. We were able to readily identify insights about *participant behavior*, such as when participants consistently visited the Activity section first from the main menu; insights about *perception*, such as that participants all initially thought that Groups contained social aspects and tried to persist that belief even in the face of contradictory evidence; and insights into *participant mental models*, such as identifying that participants used their current class experiences as a proxy mental model for groups, badges, and challenges in the app through their use of words like “class,” “assignment,” and “quiz.” These results demonstrate the value of combining minimalist instruction with design

insights generated from user interaction.

### **The “Aha!” Moment as a Threshold Concept**

Identifying an “aha!” moment to convert into a quick win is a central part of the analysis procedure of this method, and appeared to be a key conceptual framing of the practitioner guidance. This term is not found in existing research literature, yet we believe it has great value for understanding the initial stages of the learning process as experienced by new users. One possible conceptual analog in the educational literature is the *threshold concept*. Meyer and Land [16] describe threshold concepts as “a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress.” Threshold concepts have five defining characteristics, including the following: 1) transformative, marking a radical shift in the learner's perspective; 2) irreversible, in that the new knowledge cannot easily be unlearned, if at all; 3) integrative, creating previously unknown connections between concepts; 4) bounded to a specific conceptual area; and 5) troublesome until understood [16]. The “aha!” moment appears to take on many of these characteristics, in that it represents a transformative, irreversible shift in the user's perception of an application, integrating previously arbitrary facts and features into a mental model that is newly situated towards personal and purposeful use. The troublesome aspect resolved by the moment includes a recognition from the educational literature that facts and features of the application are inert or disconnected knowledge until integrated into a coherent mental construct [16]. This is consistent with previous understandings by HCI and cognitive science scholars, which positioned the user's mental model in relation to the system model; however, the educational literature provides additional grounding to describe what defines users' transition from disconnected to “aha!,” in addition to guidance on how to scaffold these learned behaviors (e.g., minimalist instruction).

### **IMPLICATIONS AND FUTURE WORK**

While this study is limited in impact due to the small number of participants and specific prototype used, our results strongly suggest the value of leveraging user experiences and instructional theory in the design of onboarding task flows.

#### **Extending the Onboarding Method**

In future studies, differing contexts of use and user groups may indicate additional areas where minimalist instruction or a revised protocol may support the generation of onboarding insights. This may also productively include applications that serve multiple user types, where issues of how to prioritize among conflicting groups may arise. This would require sufficient specialization of the onboarding for each persona to complete a meaningful quick win. Additionally, while this study did achieve data saturation, we do recommend that groups of 4-5 participants be used in the future, in order to make the delineation between common insights and edge cases clearer. Finally, in this study we conducted the protocol with a low-fidelity clickable wireframe prototype of the app. Performing additional

studies with different types of mobile applications, different types of prototypes, and different levels of fidelity would further validate the method.

### **Integrating Instructional Design in HCI Scholarship and Practice**

This work opens up questions for further investigation of the “aha!” moment. While the work of Carroll and others in the 1980s and 1990s—bridging instructional theory and HCI—appears to have continuing value, further connections among learning and instructional theory and HCI methods and practices would likely be beneficial to future design practice. While this may open many disparate threads of integrative, multi-disciplinary research, we will propose a few opportunities for future work specific to onboarding. The presence of the learning jump, articulated as the passing of a learning threshold, indicates a potentially fruitful area for deeper investigation. This may include the identification of salient learning- and interaction-mediating characteristics, and the opportunities to refine and extend instructional design theory and existing HCI methods to effectively design for these thresholds in onboarding and other types of instruction.

Our analysis and protocol also provides significant contributions to instructional design scholarship by connecting it to onboarding and the practical concerns of interface design in a mobile context. Some researchers, such as Carroll, have explored learning outside of traditional educational areas, but more work is needed in applying instructional design theory outside of the classroom and traditional learning contexts. This study reveals numerous opportunities for instructional design and HCI scholars to align theory and knowledge bases with onboarding-focused practitioners, thereby advancing scholarship in research and practice.

### **CONCLUSION**

In this paper, we have presented a method for designing and validating mobile onboarding task flows, building on minimalist instructional design principles and existing practitioner guidance. We found that focusing on the evolution of participant sensitivity to elements of the application allowed for the collection of useful insights for onboarding content, placement, and form. Using minimalist instruction as a lens for designing onboarding provided a helpful and validated set of user-centered instructional design principles. This study contributes a research-informed design method that can be leveraged in the creation of onboarding experiences by design practitioners, leading to generative insights.

### **REFERENCES**

1. Maria Bannert. 2000. The effects of training wheels and self-learning materials in software training. *Journal of Computer Assisted Learning* 16, 4: 336-346. <http://doi.org/10.1046/j.1365-2729.2000.00146.x>
2. Susanne Bødker and Marianne Graves Petersen. 2000. Design for learning in use. *Scandinavian Journal of*

*Information Systems* 12, 1: Article 5.

3. Marina Cascaes Cardoso. 2017. The Onboarding Effect: Leveraging User Engagement and Retention in Crowdsourcing Platforms. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '17)*. ACM, New York, NY, USA, 263-267. DOI: <https://doi.org/10.1145/3027063.3027128>
4. John M. Carroll. 1990. *The Nurnberg Funnel: Designing minimalist instruction for practical computer skill*. MIT Press, Cambridge, MA.
5. John M. Carroll. 2014. Creating minimalist instruction. *International Journal of Design for Learning* 5, 2: 56–65. <https://doi.org/10.14434/ijdl.v5i2.12887>
6. John M. Carroll and Caroline Carrithers. 1984. Training wheels in a user interface. *Communications of the ACM* 27, 8: 800-806. DOI: <https://doi.org/10.1145/358198.358218>
7. C. Ailie Fraser, Mira Dontcheva, Holger Winnemoeller, and Scott Klemmer. 2016. DiscoverySpace: Crowdsourced Suggestions Onboard Novices in Complex Software. In *Proceedings of the 19th ACM Conference on Computer Supported Cooperative Work and Social Computing Companion (CSCW '16 Companion)*. ACM, New York, NY, USA, 29-32. DOI: <https://doi.org/10.1145/2818052.2874317>
8. John S. Gero and Thomas Mc Neill. 1998. An approach to the analysis of design protocols. *Design studies* 19, 1: 21-61. [https://doi.org/10.1016/S0142-694X\(97\)00015-X](https://doi.org/10.1016/S0142-694X(97)00015-X)
9. Kathy Haramundanis. 2001. Learnability in information design. In *Proceedings of the 19th annual international conference on Computer documentation*, 7-11. DOI: <http://doi.org/10.1145/501516.501519>
10. Samuel Hulick. The elements of user onboarding. Retrieved from <https://www.useronboard.com/training/>
11. Krystal Higgins. 2016. *Evaluating onboarding experiences*. Retrieved September 19, 2016 from <http://www.kryshiggins.com/evaluating-your-new-user-experience/>
12. Krystal Higgins. 2015. *Engaging new users: Guided interaction*. Retrieved November 3, 2015 from <http://www.kryshiggins.com/guided-interaction/>
13. Detlev Leutner. 2000. Double-fading support—a training approach to complex software systems. *Journal of computer assisted learning* 16, 4: 347-357. DOI: <http://doi.org/10.1046/j.1365-2729.2000.00147.x>
14. Mark Lochrie, Glenn Matthys, Adrian Gradinar, Andy Dickinson, Onno Baudouin, and Paul Egglestone. 2016. Co-designing a physical to digital experience for an onboarding and blended learning platform. In *Proceedings of the The 15th International Conference on Interaction Design and Children (IDC '16)*. ACM, New York, NY, USA, 660-665. DOI: <https://doi.org/10.1145/2930674.2936002>
15. Ty Magnin. 2016. *We categorized 327 user onboarding experiences into 9 UI patterns (Find out which you should use)*. Retrieved from <http://www.appcues.com/blog/we-categorized-327-user-onboarding-experiences-into-9-ui-patterns/>
16. Jan H. F. Meyer and Ray Land. 2003. Threshold concepts and troublesome knowledge (2): Epistemological considerations and a conceptual framework for teaching and learning. In *Improving Student Learning Theory and Practice: 10 Years On*, Chris Rust (ed). Oxford Centre for Staff & Learning Development, Oxford, UK, 412-424.
17. Jakob Nielsen and Raluca Budiu. 2013. *Mobile usability*. New Riders Press, San Francisco, CA.
18. Benjamin Saunders, Julius Sim, Tom Kingstone, Shula Baker, Jackie Waterfield, Bernadette Bartlam, Heather Burroughs, and Clare Jinks. 2017. Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity: International Journal of Methodology*. DOI: <http://doi.org/10.1007/s11135-017-0574-8>
19. Justin Singer. 2011. *Onboarding: The first, best chance to make a repeat customer*. Retrieved November 3, 2015 from <http://justin-singer.com/post/2684064738/onboarding-the-first-best-chance-to-make-a>
20. David J. Roedl and Erik Stolterman. 2013. Design research at CHI and its applicability to design practice. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*. ACM, New York, NY, USA, 1951-1954. DOI: <https://doi.org/10.1145/2470654.2466257>
21. Elizabeth B.-N. Sanders and Pieter J. Stappers. 2008. Co-creation and the new landscapes of design. *Co-design* 4, 1: 5-18.
22. Elizabeth B.-N. Sanders and Pieter J. Stappers. 2014. Probes, toolkits and prototypes: Three approaches to making in codesigning. *CoDesign* 10, 1: 5-14.
23. Igor Steinmacher, Tayana Uchoa Conte, Christoph Treude, and Marco Aurélio Gerosa. 2016. Overcoming open source project entry barriers with a portal for newcomers. In *Proceedings of the 38th International Conference on Software Engineering (ICSE '16)*. ACM, New York, NY, USA, 273-284. DOI: <https://doi.org/10.1145/2884781.2884806>
24. Leslie Gayle Tudor, Michael J Muller, Tom Dayton, and Robert W Root. 1993. A participatory design technique for high-level task analysis, critique, and redesign: The CARD method. In *Proceedings of the Human Factors and Ergonomics Society Annual*

*Meeting*, 295–299.

25. Hans van der Meij and John M. Carroll. 1995. Principles and heuristics for designing minimalist instruction. *Technical communication* 42, 2: 243–261.
26. Falko Weigert Petersen, Line Ebdrup Thomsen, Pejman Mirza-Babaei, and Anders Drachen. 2017. Evaluating the Onboarding Phase of Free-toPlay Mobile Games: A Mixed-Method Approach. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '17)*. ACM, New York, NY, USA, 377-388. DOI: <https://doi.org/10.1145/3116595.3125499>
27. Mun Y. Yi and Fred D. Davis. 2003. Developing and validating an observational learning model of computer software training and skill acquisition. *Information Systems Research* 14, 2: 146-169. DOI: <http://doi.org/10.1287/isre.14.2.146.16016>