Empowering Independence Through Design: Investigating Standard Digital Design Patterns For Easy-to-Read Users.

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ABSTRACT

As designers and researchers, it is our duty to ensure information accessibility for all, irrespective of cognitive abilities. Currently, Easy-to-Read (ETR) is commonly used to simplify text for individuals with cognitive impairments. Although design aspects of text comprehensibility have recently gained attention, digital design patterns remain relatively unexplored. Our understanding of how ETR users interact with digital media, and how to design specifically for their needs, is still limited. Our study involved observing 20 German ETR users engaging with a digital PDF and a website designed in a participatory process. We collected data on their access to digital media, personal use and workarounds, and their interaction with digital design patterns. Tasks on the smartphone were completed mostly successfully, while only 50% could navigate a digital PDF. In both cases, visual cues played a significant role. Our findings contribute recommendations for beneficial digital design patterns and future research.

CCS CONCEPTS

• **Human-centered computing** → *Empirical studies in interaction design*; **Empirical studies in accessibility**.

KEYWORDS

Easy-to-Read (ETR), typography, reading, digital design patterns, interaction design, usability, accessibility, inclusion

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1 INTRODUCTION

According to the 2006 United Nations Convention, accessibility is a human right [52], but the range of users' needs and abilities is vast. Easy-to-read (ETR) is therefore a key to an inclusive society that allows every person to access and understand information [1] and was created to empower participation of people with low reading skills due to so-called intellectual disabilities (ID). The principles of ETR were developed using print media and then applied to digital media, although they are entirely different and have unique requirements. In addition, web accessibility research has not yet adequately represented users with cognitive impairments [87], and this is even more true for ETR users.

Although some claim that ETR might support a wide audience like the elderly and foreign language speakers [54], our study focuses on people with ID for two reasons. First, this was the original target audience of ETR, and this group is already heterogeneous regarding age, reading level, experience with digital media, and cognitive and motor skills. Second, there is a scarcity of user research and testing since it is difficult to access this group. People with ID are often under legal guardianship and live or work in institutions for people with disabilities. We concentrate on users with ID who can at least read words. Both our co-researchers and all test participants have a diagnosed ID and individual additional impairments. We use the term 'ETR users' given the community's rejection of the term 'ID' due to its stigmatizing connotations and the inadequacy of their self-chosen term 'learning disabilities' in cognitive science. By using the term 'ETR users', we refer to users who read ETR regularly, regardless of their reasons.

Originally, ETR focused on simplifying language and participatory testing [9, 92]. Social workers translated content using programs like Microsoft Word, without considering professional visual design [62]. Print products and the first guidelines [8, 53] reflected this lay design practice. Instead of aiding comprehension, the typical designs were dysfunctional, negatively affected readability, and contradicted design research results [66]. Design researchers, especially those with an emphasis on typography, are experts in readability and visual design. Their findings are currently being incorporated into the upcoming German ETR guidelines, which will then be ratified as a standard that includes a chapter on visual design [11, 22].

In digital media, ETR is increasingly offered as an accessible alternative. Digital design includes text, design, and interaction elements. These elements are represented in digital design patterns, which are the focus of our study. The term 'design pattern' originates in architecture and describes a solution to a recurring design problem [2]. Design research picked up this prototypical (rather than taxonomic) approach, as it corresponds to the way (graphic) design is practiced. For example, a headline on a page stands out as the primary piece of information because the type is usually larger and bolder than the running paragraph text of the articles. The

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reader intuitively applies a reading strategy of skimming headlines on a page and then choosing an article to read. Thus, design patterns work because they directly correlate to our perceptual system, not simply because they are learned [86]; it is nature, not just nurture. In digital media, code and functionality are embedded in the patterns, e.g. selecting the 'hamburger icon' (usually represented by two or three horizontal lines) opens a menu. Most digital design patterns are established, familiar, understood intuitively, or make use of accepted mental models. New patterns, however, need to be learned and adopted. For example, the swipe gesture was not familiar prior to its usage on mobile devices [45]. While technology standards have been explored, the role of design in ensuring the universal usability of digital design patterns still awaits research and testing [68].

Given the scarcity of published research findings on digital ETR use, it is unclear how ETR users interact with existing 'standard' digital design patterns, despite the vital role that such patterns play in making digital information accessible and comprehensible. Therefore, our paper investigates the following research questions (RQ):

- RQ 1: How do ETR users operate digital devices and what limits the user?
- RQ 2: Does the target audience understand and employ digital design patterns?
- RQ 3: Which digital design patterns might be helpful for ETR users?

In this article, we summarize the views of different disciplines on the topic, outline our interdisciplinary and participatory project structure, present the results, and, through discussion, propose an optimized user interface design for ETR users.

2 RELATED WORK

We will begin by reviewing social science research on ETR users' media use, followed by an exploration of User Experience (UX), accessibility guidelines, universal design, and research in cognitive psychology, linguistics, and design related to ETR. Finally, we will analyze the trend of individualized interfaces.

2.1 Usage of digital technology by ETR users

Access and the ability to interact with digital media, such as web pages or accessible PDFs, are key requirements for modern societal inclusion [26]. Two meta-studies—one conducted in the EU in 2017 and another in the UK in 2016—revealed that only 50% of people with ID have access to the internet, compared to 70% of the general population [60]. When they engage in social media they have positive experiences in terms of friendships, self-esteem, and enjoyment [18]. Identified barriers encompass concerns about safeguarding, literacy, communication difficulties, and accessibility issues including inadequate equipment [18]. A 2020 Norwegian study found that touchscreen technology can provide empowering opportunities for individuals with ID, even if they encounter challenges in reading, writing, or using voice-activated strategies [67]. Furthermore, a 2018 Australian study highlighted how young adults with ID engage in social media based on personal interests. Nevertheless, their participation is hindered by issues such as low literacy, authentication problems, advertising content, and a lack of awareness regarding tools that could address these issues, such as voice search, auto-login, password retrieval protocols, and ad blockers [6]. A 2021 study in Germany suggests an internet access rate of 93% [7]. However, as this survey was conducted online and required internet access to participate, it is questionable how representative these findings are. Access to the internet might be discouraged by caretakers or guardians with little digital skills, who see more dangers than opportunities in internet use, and assume that people with ID cannot, with appropriate concern and choices, classify viruses, Trojans, spyware, and chatbots, or may incur debt when shopping online [12]. Regarding gaining digital skills, there is a lack of training for staff and residents in institutions [13, 51, 91]. Practice showed that ETR users are in principle able to acquire digital skills [49] and gained far more competence and knowledge than was expected. Unfortunately, existing digital competency tests (such as [19] or [3]) are not suitable for ETR users since the questions are too difficult from a language and cognitive point of view. ETR users' digital competency is therefore difficult to measure and largely unknown.

2.2 UX principles and recommendations for accessible design

Besides users' digital competency, digital products must be designed according to user needs. General UX principles define quality components for usability, best practices in user experience design, and web accessibility [36, 38, 40]. The Web Content Accessibility Guidelines (WCAG) guidelines [89] follow general UX principles. Seemann and Lewis [2019] summarize two studies [32, 69] and conclude that "the problems encountered by many people with cognitive disabilities are, broadly, the same usability problems that affect all users, but the impact on people with cognitive disabilities is more severe" [61]. The WCAG are further specified by publications of the Cognitive and Learning Disabilities Accessibility (COGA) Task Force [82]. The authors state that digital inclusion for the COGA group is far behind other groups of disabilities and there is a lack of user research and user testing [61]. Practice-oriented contributions like the 'a11y project' [57] provide valuable resources in which UX designers with neurodivergent backgrounds contribute based on their life experience. Meredith identified "access" and "success" as keys, suggesting that "abundant design" [50], which provides the user with two (or more) ways to achieve the same goal, would facilitate a better, more successful user experience. ETR users are a subgroup of the COGA group and differ from other groups of users in that dyslexia or ADHD is not the predominant reason for low reading skills.

2.3 Universal Design and touchscreen devices for users with ID

Universal Design (UD) looks at designing for the greatest number of possible users: it promotes the idea of designing products and environments to be used by as many people as possible, accounting for as wide a range of abilities as possible, in the greatest number of scenarios as possible. [81]. For users with ID, the main benefits are being able to use the same product as everyone else, which avoids social stigma and extra costs, gives them better opportunities to interact with (non-disabled) family and friends, and to access the same digital content as everyone else [67]. An example of UD on smartphones is the accessibility features: high contrast backgrounds and text magnification have been built in to assist users with visual impairments, but are also used by many people without visual impairment. Studies have shown that touchscreen devices are easier for users with ID [59, 67] since errors can be overcome and the user experience is more comfortable than using a keyboard. One study from 2016 and another from 2018 reported difficulties resizing and using two-finger gestures for zooming. The tests were conducted using ‘artificial’ UI designs created to test tasks on an iPad Mini [59] and a smartphone [88]. In the smartphone study, the instructions looked like a list or menu, leading participants to tap and expect another page. These findings were interpreted by Williams and Shekar [2019] as “priority of appearance” and they concluded that “the more visceral the affordance, the higher the usability appears to be.” [88] However, we attribute these difficulties to misapplied digital design patterns.

2.4 Cognitive psychology and research on ETR in print

UX principles refer to findings from behavioral and cognitive psychology [90]. Chandler and Swellers’ [1991] cognitive load theory [20] distinguishes the Intrinsic Cognitive Load (the effort associated with a specific topic), the Extraneous Cognitive Load (the way information is presented), and the Germane Cognitive Load (the effort required by the learner to understand the material). ETR users might have less previous knowledge and, due to their lower cognitive skills, face a higher Germane Load. Consequently, they would need materials with an adjusted Extraneous Load, hence an ‘easier’ language and design. This is in line with psychological research into ETR suggesting to consider the recipient and the text side [21]. Key recipient issues identified by Christmann [2017] are low retention [44], difficulties with inference, e.g., linking pieces of information in a text and with previously learned information [15, 16], and problems in suppressing irrelevant meanings [29]. On the text side, ETR users are helped by linguistic simplicity, semantic brevity and continuity, cognitive organization, and motivational stimuli [21]. However, these linguistic aspects do not take into account the visual design of the product and its impact on text comprehension. In a joint linguistic and design study on ETR, Bock & Sieghart [2019] added the design factors ‘legibility’, ‘readability’, ‘structure’, and ‘motivational design’ that facilitate text comprehension for readers using ETR [65].

2.5 Reading research in general and into ETR

Design research provides information on how to visually support reading. Typography (the design of a text) plays a role in several phases of reading: perception, assigning meaning, and comprehension. The first phase is the perception and decoding of letters, which is the subject of legibility studies and is addressed in nano and micro typography [4]. Letterforms designed to match the physiology of the retina and visual cortex facilitate reception [75]. A 2022 study involving users without disabilities examined fonts in digital media and confirmed that “different fonts are effective for different people”, noting that some fonts could increase reading speed by 35% [83]. This might also apply to ETR readers who, in a study with print material, read the same typefaces faster than non-ETR readers—compared with their generally lower number of words read per minute [64]. The second phase is to assign meaning to what is seen. Prototypical design using established design patterns gives an indication of what kind of text to expect, even without reading a single word [78]; a novel looks different from a poem, a newspaper, or a contract. Macro typography creates recognizable structures and layouts using linguistic text types and genre-typical design. Contrary to previous assumptions that ETR users do not know genres “because they do not use them in daily life” [14], an interdisciplinary study found that ETR users have knowledge of linguistic text types and design genres and use the visual language to understand the content [10, 63]. The third phase is content comprehension. This is dependent on the reader’s prior knowledge, cognitive abilities, reading medium, and environment [41, 58, 75, 77, 85, 86]. Typographic systems are highly complex, with many interdependent factors. Expertise is required to select optimal fonts and specify micro- and macro-typographic settings in order to create appropriate design patterns and set up valid studies on this topic [5].

2.6 Individualized interface design and tools for ETR users

The benefits of personalization (done by the system) and customization (done by the user) have been discussed for some time [55, 56] and efforts have been made to automatically configure personalized accessibility features. An example is the ‘morphic’ tool, which has been developed with personas and tested with students who have an impairment, but also a much higher level of (digital) literacy than ETR users. While the technical parts have been solved, Vanderheiden [2020] claims that “we have not yet found the approaches needed to reach many of those who could use these features” [80]. The WCAG experts see opportunities in adapting websites to the individual needs of the COGA group and, as a bridge, suggest tools to improve access [61]. Currently, several digital products are developed to adapt content and design for ETR users. Some tools will not change any visual design or interaction design and focus solely on text simplification, such as ‘capito digital’ [17]. ‘Easyreading’ [24], a product to improve the cognitive accessibility of digital documents “by personalization through annotation, adaptation and translation”, [25] currently lacks user tests [34], which are planned in the follow-up project ‘EVE4all’ [24]. From a UX design point of view, the aforementioned WCAG and UX standards might not be met and the operation might involve effort on the user side (and thus customization). Another tool uses state-of-the-art UX design, but fails to consider the low reading skills of the target group: The plugin ‘accessiBe’ [23] works with extensive settings using standard language. The average ETR reader would have to cope with an unmanageable amount of text. Furthermore, the settings neglect the hidden dependencies of typography and perception laws: font choice, type size, and word and line spacing are mutually interdependent, as well as contrast, color of type, and background. The tool allows dysfunctional combinations to the point that completely unreadable interfaces are displayed.

There are several aspects to consider for individualized interfaces. First, users are not typography experts. In a study involving users without disabilities, Wallace [2022] found that the typeface which was fastest read did not match participants' preferences, which might mean that "people do not know what is good for them in terms of font choice for reading" [83]. This is reflected in a study of ETR users: Preferences did not match reading speed [64]. Second, UX research has found that most users stick with the default settings rather than changing them [39]. Third, reading is not the only aspect to be considered, as Nielsen [2022] remarks, "Performing tasks on websites involves reading, but it also requires many more advanced skills, such as navigation, searching, and the ability to judge and make decisions based on what's being read" [37]. Fourth is the technical aspect: Many custom applications do not support standard, system-wide accessibility functions such as zoom, contrast modes, and keyboard controls [43].

In summary, the specific group of ETR users is poorly researched. We do not know what kind of devices they use or how much access to digital media they have, let alone whether the products currently being developed will work for them. ETR design research in print does not take into account digital media and interaction design. Some digital ETR products lack expertise in user interface design and typography, while others lack knowledge of ETR users' needs. This paper contributes to closing these research gaps by focusing on digital design patterns and empirically testing ETR users' interaction with them.

3 RESEARCH METHOD

This study was part of the LeiSAparti-study [79], an interdisciplinary participatory research project at the University of Cologne (Germany). The team consisted of three linguists, three social scientists, one designer, and six co-researchers (see figure 1). The co-researchers were recruited from a university program [76] dedicated to engaging individuals with ID in research projects, utilizing their real-life expertise. All six co-researchers had a cognitive disability and a wide range of additional individual impairments. While most were capable of verbal expression, one participant required translation assistance from a social worker. The multidisciplinary nature and previous ETR experience of all team members strengthened the participatory process, the writing, and design of the test materials. This resulted in five sub-studies, of which the design study is presented here.

This design study is the first study with digital media in a series of studies aimed at identifying how design can contribute to greater inclusion of ETR users. Its main contribution is to explore ETR users' experiences with digital devices and their use of digital design patterns. It builds on and complements previous evidence from printed media. Therefore, we purposefully created realistic test materials to raise the ecological validity of the study. The creation of these materials was entirely guided by the participatory design process mentioned above, with the notable inclusion of co-researchers using ETR. Although this approach allowed us to acquire novel insights into ETR users' interactions with digital media, it also limited our possibility to systematically compare different digital design patterns for identical purposes (e.g., whether gesture-based zooming or a dedicated zoom menu is preferable). We will return to these reflections in the limitations section.

3.1 Test materials

The test materials were designed through a participatory design process (PD). The co-researchers opted for a website, while scientists also wanted PDFs that could be forwarded or even printed. The co-researchers favored a 'scientific' looking design and selected a clean user interface design based on several examples. In particular, they disfavored an ETR design solution with childish illustrations. In an iterative process, we reduced the information density of the PDF and HTML pages and took into account the specific needs of the co-researchers, such as limited attention span and tendency to lose track (structured and clear layout), low vision (high color contrast and enlargeable type), color sensitivity (use of only one highlight color per chapter), and operation of the smartphone with the nose or with motor impairments (large enough buttons and more space separating clickable areas). The final design was coded according to WCAG accessibility guidelines for testing and is available as supplementary material.

Operating a digital interface successfully requires users to perform tasks involving digital design patterns. A standard website or an interactive PDF contains numerous embedded patterns that facilitate various navigation and usability strategies:

- Scrolling (Observe whether the interface design of digital media is understood, where the user scrolls instead of turning the page)
- Zooming (Examine the use of the magnifying glass icon in the navigation bar in the PDF, or the two-finger pinch gesture on the smartphone)
- Selecting links (Test if a downward pointing arrow or an underline indicating a text-link are understood)
- Operating a menu (Test if the hamburger icon is familiar and whether a visible menu or a navigation overlay is preferred)
- Closing menu (Check if the capital X 'close icon' is familiar and used)
- Using the back-to-top button (Investigate if icon 'go-to-top'—arrow within a circle pointing upwards—is used)

These digital design patterns were selected for our test as they turned out to be useful for tested materials during the participatory design. The first questionnaire confirmed that the test participants did use standard websites and thus might be familiar with standard digital design patterns. Accordingly, we formulated tasks (see table 1) along an expected test scenario, requiring the participants to either use the defined digital design patterns or find alternative approaches. The rationale was to assess the utilization of patterns and their impact on successful interaction. We designed two variants to allow testing an visible menu (variant A, see figure 2 against a navigation overlay (variant B), see figure 3. Both variants are available as supplementary material and can be accessed via these links: variant A [47] and variant B [48].

3.2 Procedures

The test consisted of three on-site sessions. In the first session, ethical consent was obtained and the reading test and socio-demographic questionnaire were completed (including data on access, digital devices, applications used, personal settings, perceived difficulties with digital media, and support). The questionnaire on

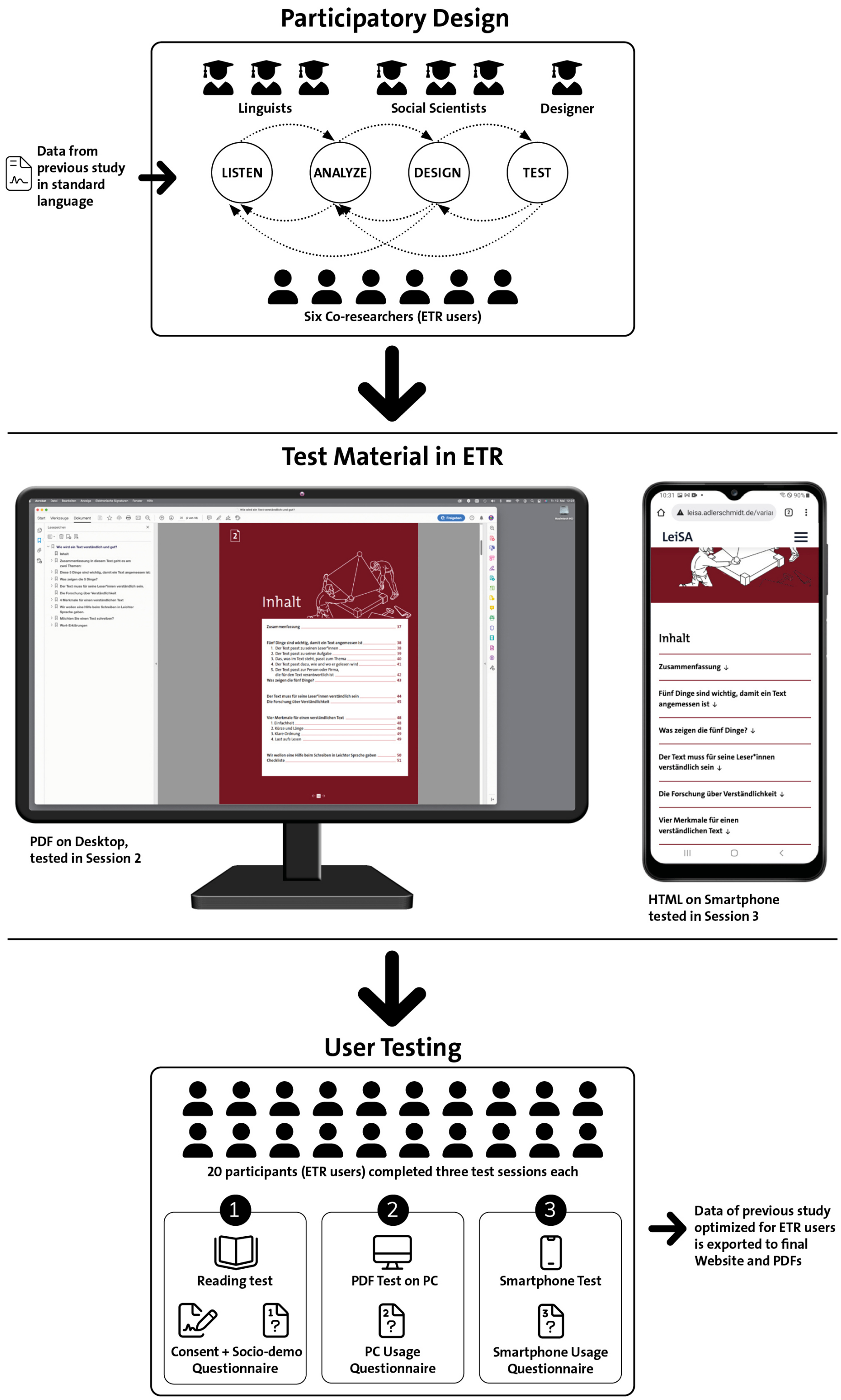

Figure 1: Study set-up: Test material in ETR was created through a participatory design process and tested with 20 ETR users.

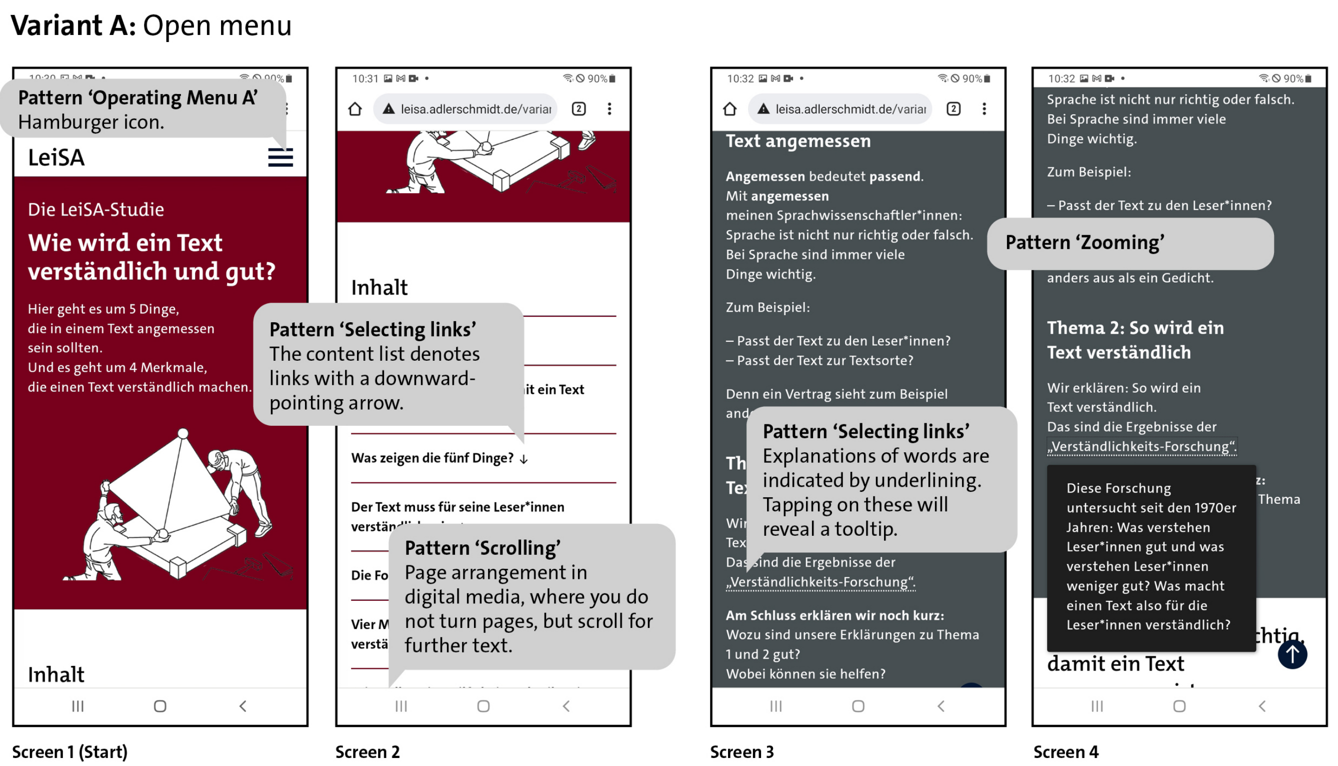

Figure 2: Smartphone test screens with design variant A (visible menu) embedded in functional homepage.

Task	Pattern	Rationale	Screen	Variant
Please go to content list. (Inhalt)	Scrolling Operating Menu A	Which path is taken? (scrolling/selecting hamburger)	1	A
Is the type size big enough? Can you enlarge?	Zooming	Is the two-finger gesture for zoom used? (For PDF: is the navigation bar used?)	1	A
Please go to entry summary. (Zusammenfassung)	Scrolling Selecting links	Is entry found (scrolling)? Link recognized and selected?	2	A
Please go to the word explanation. (Verständlichkeits-Forschung)	Selecting links	Text-link with dotted line used?	3	A/B
Please close the menu.	Closing menu Scrolling	Which path is taken? (Selecting background double tab/scrolling)	4	A/B
How do you get back to the table of contents?	Using the back-to-top button	back-to-top button used? (PDF: Interactive arrow on each page)	4	A/B
Something changed. Can you find the content?	Operating Menu B	New navigation used? (Via button or top bar)	5	B
Please close the window.	Closing tabs	Close button used?	6	B
Please go to beginning.	Back-to-top button	Navigating arrow used?	7	A/B
Please close the window.	Closing tabs	Close button used?	8	A/B

Table 1: Tasks for both tests. The related screens of the smartphone test are shown in figure 2 and 3.

PC use and visual knowledge of PDF navigation bar icons was administered in the second session, prior to testing the PDF on a PC. In the third session, we administered the third questionnaire asking about the visual familiarity of the smartphone icons in a schematic drawing and thus in context, and performed the test on a smartphone. The questionnaires were designed in ETR and are available as supplementary materials. The choice of test devices was based on the participatory design, the results of the first questionnaire, and data from the Swiss Ministry of Health [74]. We attached a PC keyboard and a Logitech optical mouse to our computer and selected a Samsung Galaxy A12 for the smartphone tests. These are

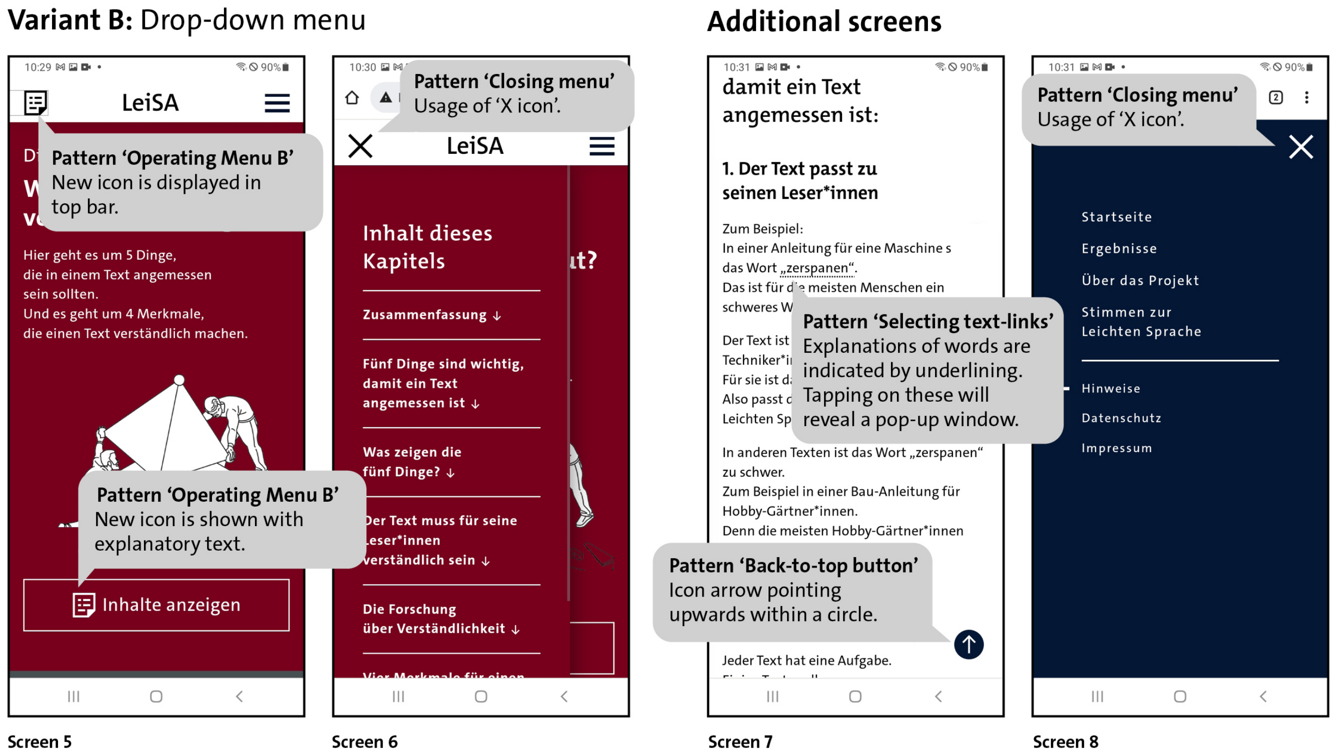

Figure 3: Smartphone test screens with design variant B (navigation overlay) embedded in functional homepage.

typical devices used by ETR users and thus contribute to the high ecological validity of our study.

3.3 Ethical approval and ethical consent

Ethical approval was granted by the medical faculty's ethics committee of the University of Cologne, reference 20-1591-1, 26 July 2021. For our participatory approach, it was crucial that people could choose to take part in the study, have rights over their data, and be able to withdraw, regardless of their legal status. Hence, we developed a consent form in both ETR and standard language that meets legal requirements and is accessible to ETR users and their legal guardians.

3.4 Data measurement

Based on a previous study, the 'lea diagnostic tool' was chosen to determine reading level [30, 31]. Quantitative user data was collected using the three questionnaires described above, and testing was conducted using read-aloud tasks as described in table 1. Additional qualitative data was gathered through participatory observation and structured interviews. While questionnaires only capture reported behavior, participatory observation documents behavior in vivo, and interviews capture data from the participants directly after the interaction [28]. We decided to keep the test situation as unintrusive as possible, and thus only recorded audio of the tests since, in previous studies, ETR participants expressed discomfort with videotaping. This also reinforces the validity of the study.

3.5 Test Participants

We collaborated with a facility for people with disabilities [70] to recruit 20 ETR users (16 men and four women, between ages 19 and 60, average age 33.4). The majority (17) lived in the institution, two with their parents, and one in assisted living. None of them had any school certificate. Sixteen participants work in workshops for people with disabilities (metal, gardening, agriculture, home economics). The remaining four participants are unable to work and are in the support center. All participants have diagnosed ID along with individual additional impairments. Caretakers assisted in selecting individuals with low reading skills who could envision using a digital device. Our subsequent reading test specified their reading abilities, which often differed from the caretakers' estimations, as evidenced by 'lea' results. 'Lea' reading levels range from 1 to 6, with 'lea'-level 6 corresponding to level 1 of the International Adult Literacy Survey [30]. The majority of the participants had 'lea'-level 3 or 4 (see table 2). Level 3 readers could read individual words in the context of sentences and follow simple instructions, especially with images. Level 4 readers could pick out individual words from a text, recognize structures of simple forms, and extract one to two directly contained (verbatim) or indirectly contained pieces of information from short and simple texts with explanatory images [30].

Code	Age	lea-Level	Internet Access	Access to devices			What do you use the digital device for? (Consolidated from Q1, Q2 and Q3)
				Smartphone	**PC**	**Tablet**	
PU12	30	4		Xiximi Redmii 9c	Yes		WhatsApp, Facebook, Google, music, YouTube, videos (only Smartphone, never PC)
200	37	3-4			Yes, at home	Yes	Websites, Google, YouTube
ME	52	3	Yes		TNT		Websites, Google, sports, TV, music videos, YouTube
F7	47	5	Yes	Samsung Galaxy A12		Yes	Websites, WhatsApp, Facebook, Google, YouTube, news
T93	28	3-4	Yes	Apple iPhone 12 pro	Yes		Websites, WhatsApp, Facebook, Google, Instagram, Tik-Tok, YouTube, banking
M87	34	3	Yes	Huawei	Yes		Websites, WhatsApp, Facebook, Google, films, games (only Smartphone, never PC)
C31	30	3	Yes	Samsung Galaxy A20E	Yes		Websites, WhatsApp, Facebook, Google, farming game watch judo, Kicker, FC Bayern, train app
A10	37	3		Oukitel			Websites with caretakers on PC, calls on phone, alarm
B5	31	4	Yes	Samsung Galaxy S20FE	Yes		Websites, WhatsApp, Facebook, Google, games, news
FR10	26	3-4	Yes	'To hang around'	Yes, at home		Websites, WhatsApp, Google, handicraft instructions
MR1	39	4-5	Yes	Huawei P30 light	At home		Websites, WhatsApp, Facebook, Google, news, games, YouTube, Netflix, Instagram
ML	25	3	Yes	Samsung			WhatsApp, Google, phone calls, Wikipedia
27C	20	2	Yes with carer	Samsung			Websites, WhatsApp, Google, online-shopping with carer
ABC	40	3-4	Yes with carer	Huawei P19		Yes	WhatsApp, Facebook, Google, photos, cooking app, flower app
10	60	4-5	Yes	Redmee (xiaomi)			WhatsApp, Facebook, Google
A3	29	2-3	Yes	Do not know which	Yes, at home		Websites, Google, films, information about actors, Wikipedia
A2	30	4-5	Yes	iPhone 6			Websites, WhatsApp, Goggle, chatting, gaming, watching series and films
28B	24	4	Yes	Samsung			Websites (cars), YouTube, farming and other games, watching series and musicals
M7	19	4				Yes	Gaming (on tablet)
MC14	30	3	Yes	Samsung Galaxy A12			WhatsApp, Facebook, Google (news and tattoos), watch YouTube and Netflix, dating portals, soccer and fight games

Table 2: Age, lea reading level, access to the internet; and devices, applications, and usage.

3.6 Data analysis

We used the grounded theory (GT) method by Strauss and Corbin [72] as it allows combining qualitative and quantitative data [35] and takes advantage of the theoretical sensitivity a design researcher contributes by professional experience [72]. In the quantitative analysis, all questionnaires, task results, and audio recordings were analyzed and phenomena were extracted. The phenomena were further enriched using the qualitative GT method, which codes full transcripts in three stages, alternating between collecting and analyzing data until theoretical saturation is reached. Strauss and Corbin [1996] state "saturation means that no additional data are being found whereby the sociologist can develop properties of the category" [72]. In the first stage, codes describing user behavior were extracted and categories were synthesized (open coding). Secondly, multiple coding paradigms were used to organize the categories (axial coding). Finally (selective coding), core categories were identified that explain the phenomenon under study [71]. After analyzing 12 transcripts from six participants, we found that we had reached theoretical saturation. We were able to describe in depth the core categories 'access', 'user side', and 'product aspects'. The user side consists of personal variables such as reading level, digital literacy, visual knowledge, and user strategies. The product side is characterized by visual design and technical accessibility.

4 RESULTS

4.1 RQ 1: Usage of digital devices and limitations

The institution only provides Wi-Fi access at the caregiver's PC within the residential groups. Nevertheless, 17 out of 20 people (85%) stated they have access to the internet and 85% own a smartphone (see table 2 for details). While 50% said they had access to a PC in the questionnaires, the interviews revealed that this is limited to

Code	Do you get help?	Help for what?	What is difficult on Internet (Q1) / Smartphone (Q3)?	Did you change settings?	Do you order online?	Do you download?
PU12	No		Nothing at all / pass words	No	No, ONLY with carer	No
200	No		Nothing / –	No	No, I am not allowed to do business	No
ME	No		Pop-ups, fields opening / –	Larger type	No, only with carer	Yes, music games
F7	Yes	Installing	Understanding / settings	No	Yes	No
T93	No		Nothing / nothing really	No	Yes	Yes
M87	Yes	Learn apps	Finding things / crash when too hot	No	No	Yes
C31	No		By now I know my way around / –	No	Yes	Yes
A10	Yes	Ordering	Reading / low battery	Larger type	No	No
B5	No		Nothing / when I do not know when it crashes	Larger type	No	No
FR10	Yes	Searching	Nothing / annoying (WhatsApp) ads and pop-ups, if it does not work	No	Yes	No
MR1	No		Finding / nothing at all, if I cannot read, image quality, When I drop it	Larger type	Yes	Yes
ML	No		Security / –	No	NO!	NO!
27C	Yes	Ordering	Don't know / small, fine letters	Larger type	No, ONLY with dad	Yes, photos
ABC	No		Searching / nothing	No	No	Yes
10	Yes	Smartphone	– / PIN, dead spot Wi-Fi	Larger type size	No	No
A3	No		Slow, bugs, broken / nothing	No	No	Yes
A2	Yes	Everything	– / when it does not work, pages blocked, forgot my PIN again	Larger type, contrast, text is read	No	No
28B	No		– / loading, when I am stuck, updates	Larger type size, text is read	No	Yes
M7	No		– / –	No	No	No
MC14	No		Finding things on pages, ads / nothing	No	No	No

Table 3: Assistance, perceived difficulties, change of system settings on own device, online orders, and downloads.

occasions when their family or carers shop online with them. In one case, the machine at work (TNT) was considered a PC.

Only seven participants (35%) got help from friends or family (see table 3). Official training is scarce or even not encouraged as one participant without their own smartphone reported: *I said I wanted a smartphone. Sarah gave me hers and said, So, now you write. [...] I tried something and almost deleted the phone (ME-3:314).* Only participants who live in assisted living receive training. This enabled a user at the age of 60 who received his first smartphone six months prior to acquire skills in a short time. They could not use the PC, but were trained enough to pass a smartphone test: *It's good that this assisted living project exists. We are looked after twice a week by people who are trained to do this (10:572).*

External expectations, advice, and bans often significantly impact the participants' activities and experiences using the internet. This is reflected in the emotional responses to the answers about whether participants download files (55% never) and order online (75% never), as well as in the tests. The risk of falling into debt was conveyed by the tutors—sometimes with drastic examples (like *stealing* for participant 27C)—and internalized or sometimes bypassed, as the following example shows. The participant vehemently refused to download a PDF on their device and explained: *No, no, because I have a partner contract with my mother. [...] my mother pays THE contract. When I download something, and it's the wrong thing, then my mother... pays more money. That's why I don't download anything. Except for free apps. That's what I download... but I read through it first (MC 14:334ff).*

When the ETR users commented on the personal use of their smartphones, the applications installed on their own devices were standard applications chosen according to personal interests. For example, one participant described a farming game, where they can overcome the limitations of their work environment and make independent game-related decisions: *It's so much fun. This is my fence that I built myself* (C31: 459). For others, the smartphone enables privacy (10) or exchanging affection (27C). Despite reading difficulties, only two persons had a text-to-speech-reader installed, 40% changed the system settings to a larger font, and no one used other assistive technology. This confirmed our decision to investigate the use of standard digital design patterns. Difficulties reported were finding and understanding information, technical issues, pop-ups, ads, and bugs. Six participants (30%) found *nothing* or *nothing at all* difficult.

4.2 RQ 2: Understanding and employment of digital design patterns

4.2.1 Visual knowledge of icons. Often, the only visual representation of a digital design pattern is a small icon, like the hamburger menu's horizontal bars on a mobile interface or the zoom indicator

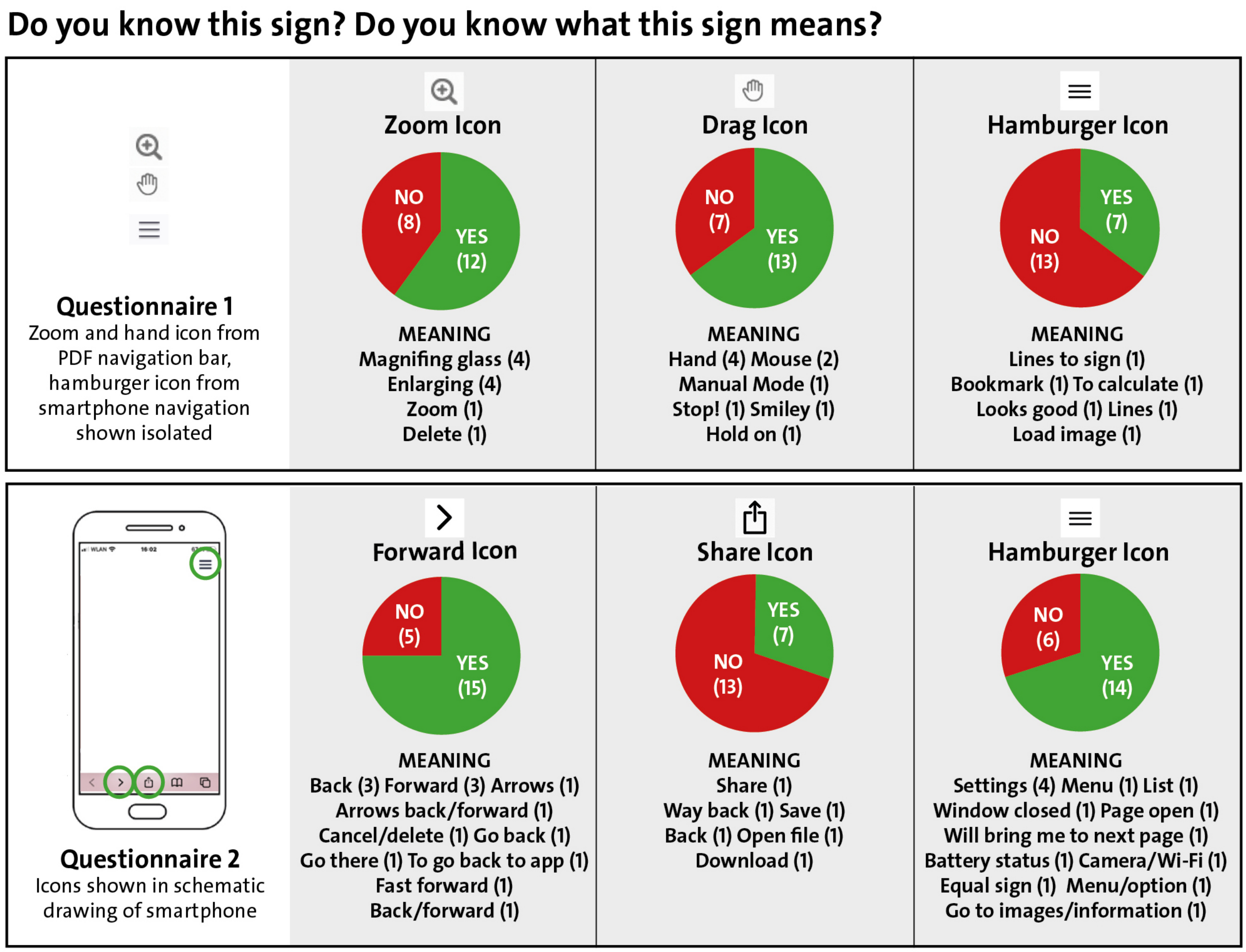

Figure 4: The visual knowledge of icons that represent design patterns, when shown isolated (Questionnaire 1) and in a schematic drawing (Questionnaire 2).

of a magnifying glass circle-and-stem with a nested plus sign on a PC interface. In the second questionnaire (see figure 4), we asked about the familiarity and representation of the icons. In contrast to our co-researchers, only 45% of the testers correctly described the zoom icon as an enlarging tool, and the hand icon was often read as a literal *hand* or even as a *stop sign*, (or interpreted in line with the familiar TNT machine user interface as *manual mode*). The hamburger icon was somehow familiar, but only 10% had a vaguely correct association (*mark, load images*). The other 40% made a (wrong) literal interpretation such as *lines to sign* or *something from math* (equals sign).

Even in the third questionnaire, where the icons were shown in context, the hamburger icon was only correctly classified by 15%. Spatial and contextual memory seemed to play a role in the 30% of wrong answers that associated the hamburger icon with *settings, battery status, Wi-Fi, or camera*, functions that are usually displayed in the top right-hand corner. However, actual menu use in the test was much more successful than the isolated visual query suggested: 90% clicked on the hamburger icon and operated the menu, but when asked what it was, only 25% could correctly explain. As an entity, the functional design pattern 'menu' appears to be familiar (see figure 5).

4.2.2 Operation of PDF on PC: Unexpected problems. The PDF on the PC proved to be much more difficult for our participants than for the ETR co-researchers involved in the participatory design. Regardless of their reading level, 50% of the test persons were unable to complete the tasks, because, for example, the PDF software froze (in four cases). Some participants accidentally opened windows such as additional tools, developer tools, or shortcuts, and could not close them. On smartphones, however, most participants were able to complete the tasks.

4.2.3 Operation of digital design patterns on smartphone. All participants were able to scroll and select links on smartphones. Some had motor difficulties with selecting, though those did not impede them from solving the tasks. The close button was familiar: 80%

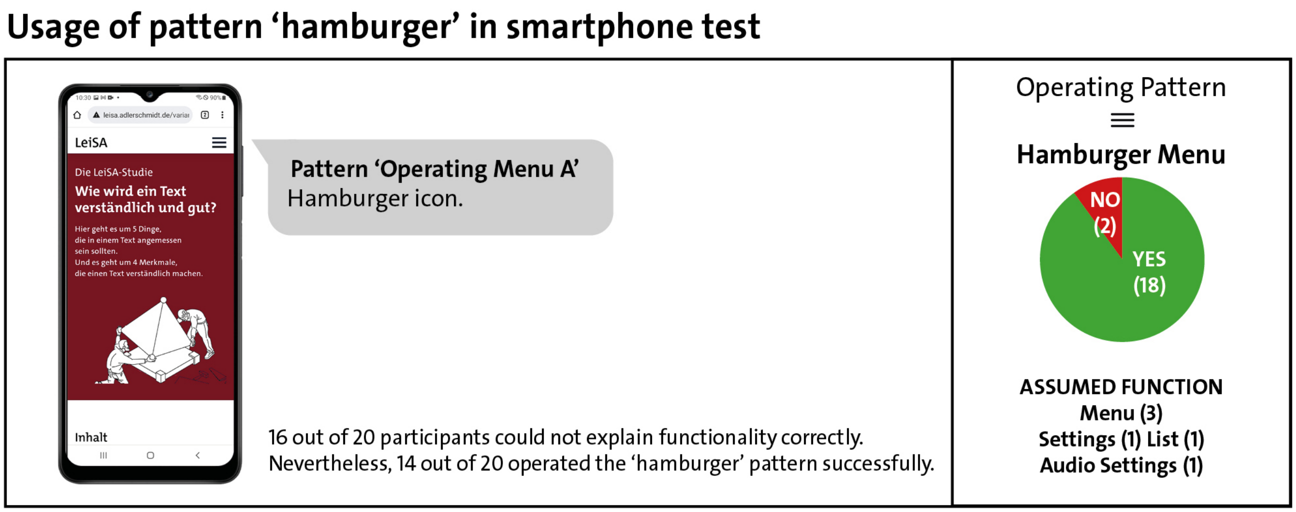

Figure 5: The actual usage of the pattern 'hamburger' in the smartphone test.

used it and some could describe the icon. Indeed, having a dedicated close button turned out to be vital for interaction design: 80% tapped on underlined words to open explanatory contextual menus. Difficulties in closing the window without a dedicated close button showed up: 45% clicked on the background, 30% scrolled, and 15% failed to close the window. The back-to-top button was less familiar—only 45% used it for navigating directly back to the top (see figure 6).

Regarding the visible menu or navigation overlay (see figures 2 and 3 and for results figure 6) there were no clear preferences for any variant. The main arguments in favor of variant B were the ability to reduce the text, while variant A has the advantage that everything is immediately visible and participants expected fewer operational problems. Yet we observed that the prominent button with abundant design was used by 85%, while the icon at top left was only used by 10%.

4.3 RQ 3: Indications for helpful digital design patterns

We observed several strategies of the co-researchers and participants that may be able to guide the design of digital design patterns.

4.3.1 Reading on the smartphone is perceived as easier. Large amounts of texts overwhelm ETR users, as this response to screen 7 in figure 3 shows: *«anxiously resistant» Should I read the whole thing? (MC14:239).* Learning to read on paper was often a frustrating experience: *I hate reading. I don't go to school anymore (M87:288).* That being said, reading on the smartphone was more fluid, and one participant stated: *I'm really good with the phone. It's the easiest for me than using the computer or writing or reading on paper (MC14:150).* Digital reading can be an opportunity for ETR readers to improve reading, as it is associated with leisure and is less biased.

In addition, written text has further qualities, as the following examples show. First, it creates lasting visual memories. One might think that text could be replaced by audio messages to avoid strenuous reading, for example in WhatsApp communication. However, even at reading level 2, text messages to loved ones were used in conjunction with emoticons and audio messages and were proudly presented (27C). Another aspect is to feel included. One participant stated they did not want to receive any different emails than their sports colleagues without impairments do, and rather extracted the important information (names and dates) by skimming the difficult text (C31).

4.3.2 Strategy: Orientation on visual hints and spatial memory. Co-researchers and test participants relied heavily on visual cues and spatial memory, sometimes to avoid reading. One participant scanned the content list of the PDF (see figure 1, test material PDF on desktop) for the first letter (in this case, 'L') and navigated extremely fast to the content (in this case, chapter '4. Lust auf Lesen'). They explained their strategy: *Lust... you said 'L' and zzzzt «pantomiming how they then found the word on the screen that starts with L» — I saw it and I knew that's it (C31:297).* During the interviews, they explained relying on spatial memory for interacting with a menu: *I go there, «counting off» one, two, yes, in the third (C31: 470ff).* They claimed more reading wasn't necessary when strong visual hints exist (such as lists with various word lengths or that are numbered) or when spatial or contextual memory allows them to navigate to menu items rather than unnecessarily reading all text.

Similarly, another participant's favorite application was a clothing brand for construction workers [73]. The state-of-the-art UX design caters to the low reading skills of presumably foreign-language speakers and reinforces all entries with icons (e.g. delivery status with an icon of a van). They read otherwise difficult words fluently since they knew the icon and its meaning, such as 'Warenkorb' (shopping basket).

4.3.3 Strategy: Selection of text via image–headline combination. The headline–image combination appeared several times during the interviews when showing personal favorites. For example, it was used to find news about a rapper by using the image search in Google: *This is Bonez MC (MC14:463)* and then reading the headline

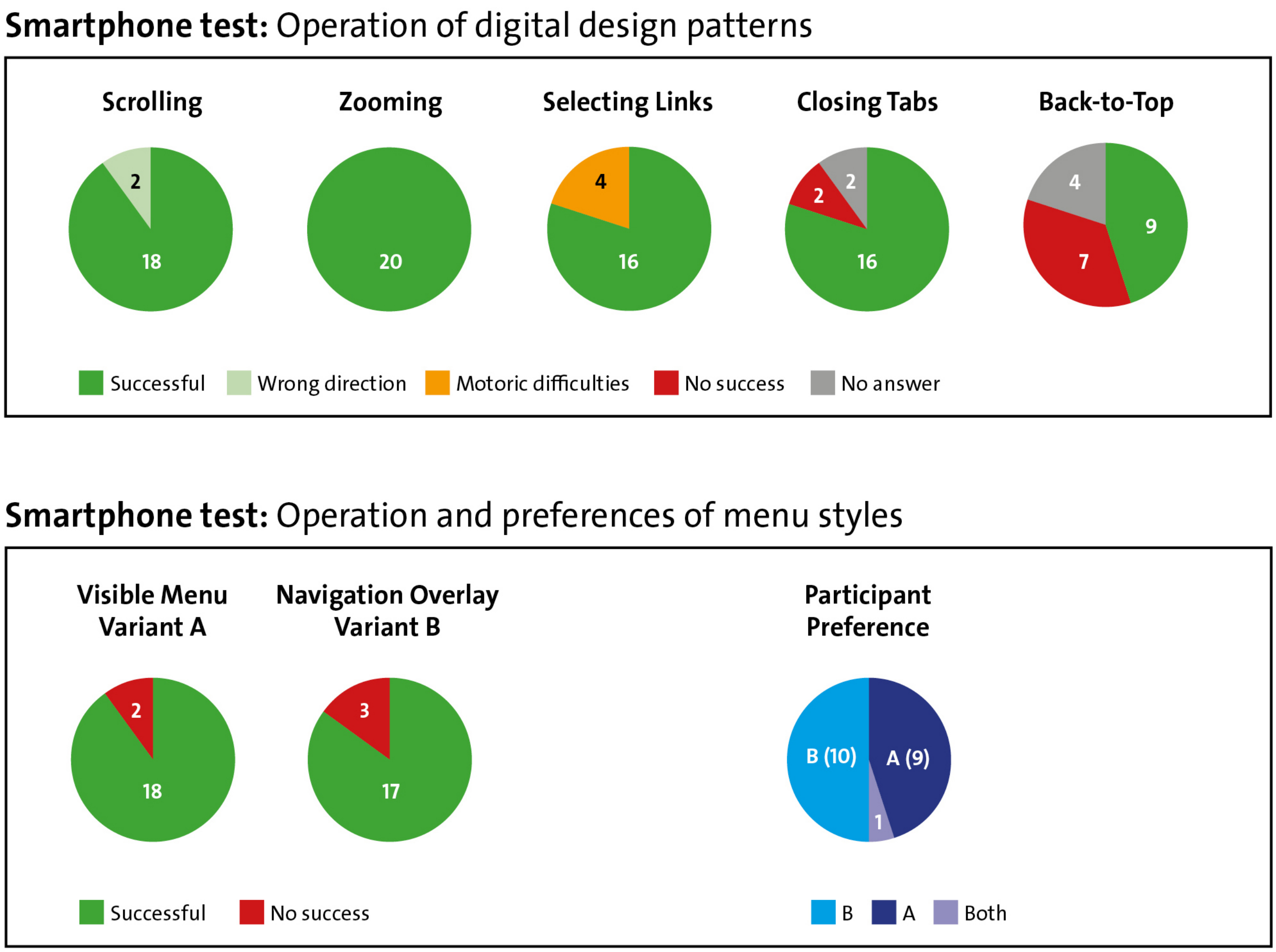

Figure 6: The operation of digital design patterns in the smartphone test.

and choosing the article. The picture and the short text gave them preliminary information. The design pattern 'headline' was familiar and used for orientation within texts: *Where do I start reading? With the headline? (MC14:212).* After confirming, they read by starting with the headline (see screen 7 in figure 3).

4.3.4 Strategy: Clever combination of the functionality of two apps. We have often observed the smart use of (limited) digital knowledge. For example, one participant (reading level 2) showed a strategy during the interview to motivate their father to download a film. In a first step, the participant typed the movie title into Google with a spelling mistake ('Soma' instead of 'Sommer'). The application showed text-image combinations and, in a second step, entries with corrected spelling. Consequently, they could see the 'Soma Festival' and the 'Sommer Film' with images, and chose the image they recognized. They forwarded the link with its attendant text they themselves would never be able to type through WhatsApp. The interaction went smoothly: *On Google, so there was nothing difficult to find (27C-3:181).* With their limited digital knowledge of two applications and some persistence to overcome false results, they achieved their goal.

4.3.5 Text reduction strategies. We observed various strategies to reduce the amount of text to read. 40% used the smartphone settings to produce larger type size on their device. In the smartphone test, the two-finger pinch gesture for zoom was often used when reading became tedious. At the same time we observed that small type could be well read (e.g. in folder names) and therefore assume text enlarging is a strategy to reduce the amount of visible text, and thus the perceived extraneous cognitive load. This is in line with an observation on plain language, where users preferred large type, not because they could not read small type, but because it made them feel there was less text on the page to cope with [84]. Another strategy was to revisit texts, breaking the reading process up into several steps: *I am usually too lazy to read. (M87-3:235). Sometimes I give up. [. . .] When I feel good again, I keep trying (M87:299ff).*

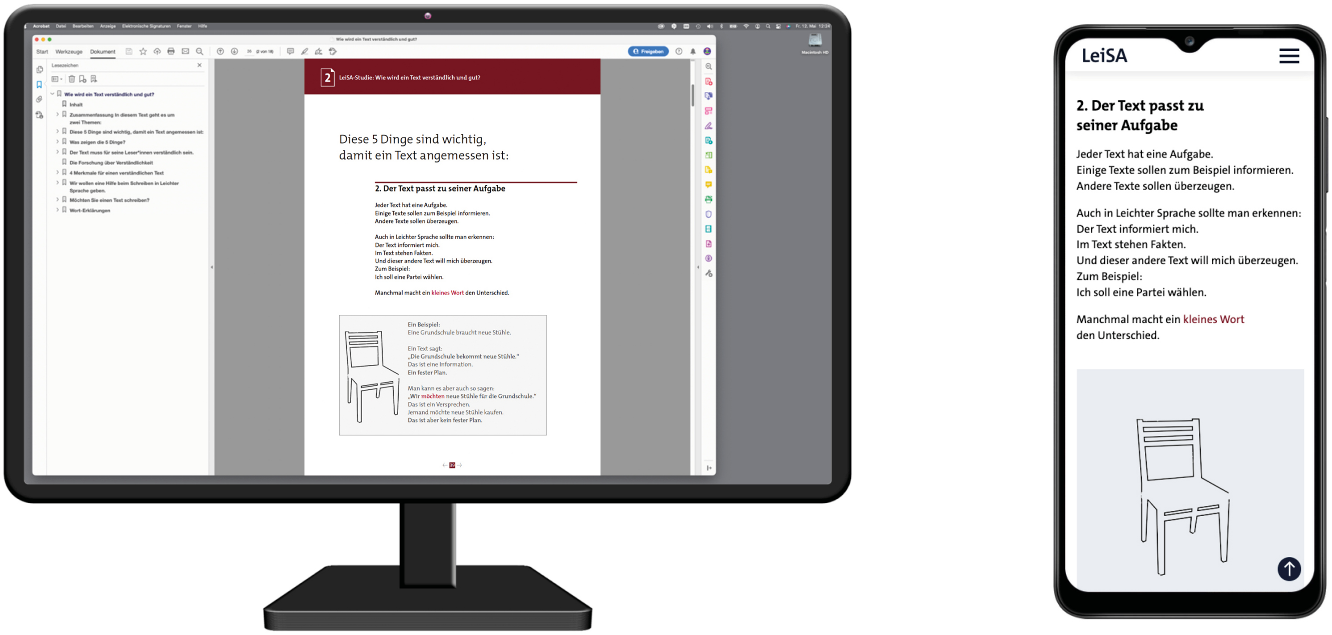

Figure 7: The screens of the PDF (left) and smartphone (right) differ in terms of cognitive load. The desktop screen displays more text and control bars which must be understood and managed.

5 DISCUSSION

5.1 Smartphone allows self-determined participation, communication, and media consumption

Our results show that ETR users practice self-determined consumption of movies, music, recipes, sports, and celebrity news on their personal smartphones. To quite an extent they are able to become part of their respective digital communities, participate in age-appropriate activities (dating, gaming, gossip), gather information (news, images, travel and mobility), and communicate with family, peers, and carers. Our participants value and benefit from the use of applications and are highly motivated to overcome challenges, which is in line with the findings of previous studies [33, 67]. ETR users are already active in the online world and our data on internet access show that the strategy of keeping those users away from the internet by means of Wi-Fi restrictions is not feasible in the age of smartphones. Sadly, our research reaffirms that the long-requested digital skills training for individuals with ID, which has been advocated for decades [6, 33, 51, 91], is still not being implemented.

5.2 Digital skills are built using standard applications on personal devices

For ETR users in institutions, most of the learning is self-guided on personal devices, usually smartphones. During their daily use of smartphones, they acquired knowledge of standard digital design patterns. As a result, interaction on smartphones (such as scrolling, zooming, tapping, and menu operations) was mostly successful. In contrast, zooming the PDF on the PC (clicking with the mouse on the zoom icon in the navigation bar) was not a completed action for most. This is consistent with previous research with individuals with ID showing that touch devices offer greater usability compared to a keyboard and mouse. [59]. There were no difficulties with the two-finger pinch gesture for zooming or resizing, in contrast to previous studies [59, 88].

When a pattern was missing (such as the close button in the word explanation window), ETR users would either switch to alternatives or be unable to continue. Less common patterns, such as the back-to-top button, were not familiar. The new icon for overlay navigation was understood with the additional textual information, but only 30% reused it during the test. The hamburger menu was used, even though the hamburger icon could not be interpreted correctly. These results may suggest three things: ETR users have internalized this pattern (even if they cannot express the meaning); that the design of the digital design pattern 'hamburger' follows a mental model; that it adheres to the perceptual system; or any combination of these three factors.

5.3 Design issues on the product side: Interfaces differ in extraneous and intrinsic cognitive load

The more successful test on the smartphone may also be related to the design and the cognitive load it imposes. When we analyzed the designs of our test materials within the test devices, we realized that several factors increase the extraneous cognitive load of PDFs. There are many control bars on a PC and PDF interface which unimpaired users consciously ignore. The ETR participants could not do so, and multiple control bars with additional functionalities were displayed (by default or by accident). On a smartphone screen, there is much less text due to the smaller screen size, and, on newer software and in our tests, the control bars disappear as soon as the user scrolls, reducing the extraneous and intrinsic cognitive load: there is less information to read and digest, and fewer tasks to choose between (see figure 7). Another observation was that the accessible PDF navigation bar was not used by any of the participants. This contradicts the general assumption that accessible PDFs are barrier-free. This was not the case for our ETR users, for whom the additional control bar likely increased the cognitive load.

5.4 Recommended digital design patterns

Back in 2003, Johnson and Hegarty, in their study with young people with ID, discovered that website accessibility was not the main problem (or could be solved by training), but that websites should be more "graphics based". They concluded [2003] that "what is needed is good website design—the creation of interesting content, with good multimedia content and efficient programming" [42]. Since then, accessible programming has improved greatly and ETR users train themselves using their personal smartphones. This strongly suggests that we should be thinking about smartphone optimization and attractive, engaging, and motivating design (as opposed to many of the tools currently being developed). However, insufficient in-depth research has been done on the visual design aspects that help ETR readers. Our study provides compelling evidence regarding the digital design patterns that ETR users learn and find useful, suggesting opportunities for further improvements and research.

We propose a two-step process in line with the findings of cognitive psychology. First, the intrinsic cognitive load should be decreased by reducing the tasks and steps required for interaction. Our study demonstrated how this is possible by investigating ETR users' needs in a participatory design process. Second, the user interface design should be created with a low extraneous cognitive load and the digital design patterns should be optimized accordingly. Both steps are mirrored in the key learnings of a 2022 study that suggested "reducing the number of fields to complete" and "includ(ing) more images and icons to make it more appealing" [27]. For the second step, we suggest taking advantage of ETR users' sensitivity to visual cues. Based on the interaction strategies of ETR users observed in our study, the following general principles should be followed:

- Reduce not only the complexity but also the amount of text.
- Create a clear structure and hierarchy by using the intricate possibilities of typography (such as headlines or image–headline combinations and icons).
- Consider spatial arrangement (within lists or across interfaces).
- Enrich lists with icons to explain content and provide a second path of access (abundant design).

Some design choices, such as the cart icon added to the word 'shopping basket', may ostensibly increase the extraneous cognitive load, but the ability to find the correct entry in two ways gives the user confidence rather than relying solely on their poor reading skills. Successful digital design patterns can have a complex typographic design, yet produce cognitive simplicity. To further investigate how design can improve ETR users' interaction with digital media (beyond the general principles above), we suggest that design researchers improve and test standard patterns or create new ones. The visual design is not the only factor that can be improved. The desired focus on smartphone interfaces opens up new possibilities, such as incorporating auditory or sensory cues like vibrations and sounds to confirm actions. It also has limitations (e.g. no mouse-over). Our study has highlighted the potential of the following, specific digital design patterns. Consequently, there is a pressing need for further research to delve deeper into optimizing these patterns for ETR users:

- **Text–image combination**: Participants frequently indicated a tendency to prioritize images, citing instances where images proved pivotal in resolving spelling issues and language difficulties (see 4.2.3. and 4.3.4). This emphasizes the need to research digital patterns where a visual hierarchy is created and facilitate the transition between text and images, possibly through the use of image sliders, image teasers, and hero images.
- **Typographic text structures:** In various instances, reading strategies were guided by emphasized text elements like headlines, lists, or buttons (see 3.3.2). This underscores the importance of expanding typography by incorporating both micro and macro elements to facilitate more efficient content skimming and scanning. One area requiring research is hierarchical typographic text structures, which can convey the text genre being discussed and provide an indication of the content's depth.
- **Text reduction tools:** The test group experienced overwhelm when presented with lengthy texts, often attempting to minimize on-screen text by zooming (see 4.3.1). Nevertheless, when the content held significance for them, they demonstrated considerable persistence by revisiting and thoroughly reading the text. Hence, there is a pressing need to explore digital design patterns in text reduction tools. This includes for example employing accordions to spark interest in reading further, combined with techniques that could encourage immersive reading experiences.
- **Icon–text combinations:** By integrating visual cues like icons alongside text, reading became notably smoother for ETR users (see 4.3.2). Visual elements seem to reinforce the text's meaning. To facilitate glance reading (grasping knowledge in short, focused bursts), researchers should investigate how to incorporate ample design elements within lists, teasers, and tables.
- **Overlays:** The inclusion of word explanations in our test material (see screen 4 in figure 2) indicates a potential for a new approach resembling overlays (e.g. modals or flyouts). Therefore it could be advantageous to explore the feasibility of 'show and hide' functionalities to mitigate increased cognitive load. Additionally, investigating features like text-to-speech capabilities might prove beneficial.

5.5 Limitations of PDFs, participatory design, and customization

Training on a device is key to developing motor skills such as scrolling and clicking a mouse. While the ETR co-researchers were able to operate a PDF on a PC, 50% of the participants failed. Other barriers to the use of PDFs were the strict ban on downloading and the inherent complexity of the design. Although PDFs are the current standard for accessible communication and have the advantage of being accessible for the blind and printable for people without internet access, they are difficult for ETR users to access digitally.

We learned about the limitations of participatory design. The ETR co-researchers had their own PC in their workspace at the university, received training, and were therefore no longer comparable to other ETR users. This limitation goes beyond our study context because it reflects the real situation of ETR production. Most ETR text producers work with the same testers for years, who may build up stronger competencies over time than other ETR users. This further emphasizes the need for extensive testing.

Our findings opened our eyes to the limitations of customization. We realized that new 'special' design could be problematic for ETR users. They have either learned standard digital design patterns already or make use of task-based intuitive comprehension. In the tests, less familiar patterns (such as the 'back-to-top-button') were often not used. In addition, customization will most likely increase the cognitive load, since users must make additional choices and perform additional tasks.

5.6 Limitations of the study

Our realistic test materials include different design patterns and allow for a variety of usability scenarios and interactions. Although this setup allowed us to acquire novel insights into ETR users' interaction (i.e., their use of digital design patterns), its limitation is that we do not have controlled settings with designs that systematically variate one factor. However, we considered it necessary to first understand whether ETR users can manage (or even benefit from) the complex patterns within a 'standard' interface. Based on these insights, research can systematically investigate further variations of digital design patterns.

Another limitation is the comparability of PDFs and HTML pages. We aimed at investigating digital design patterns on both types of digital media in a realistic environment. We therefore opted to test PDFs on a PC and HTML pages on smartphones, based on our ETR co-researchers' typical usage. However, we did not expect the situation of the test participants to be so different from that of our co-researchers, who regularly used computers. In the questionnaires, 50% of the respondents said they had access to a PC. The qualitative data showed that 'access' often meant sitting next to an operator but not training on the desktop. Consequently, their digital skills on the PCs were much lower than on the smartphones, which prevents comparing results from PDFs and HTML pages. For the present paper, we concentrated on digital design patterns for smartphones for this reason, but we think it would be worthwhile to systematically compare and fine-tune the same digital design patterns on both PCs and smartphones to gain a deeper understanding of ETR users' needs.

The study was conducted with German-speaking participants. Further research could look at other languages and show the overarching effects of design.

We would also like to investigate non-intrusive 'visual' recording methods. For our next study, we are experimenting with screen recording to record success times and button sizes for motor impaired users.

5.7 Practical output of the study

Our findings led to the final iteration phase of the interdisciplinary research project. Linguists and social scientists recognized that text comprehension, which was positively tested, was not the only criterion for using the product. The amount of text exceeded the attention span of the test participants and even if they could understand the language, they were unwilling to read the amounts presented. Therefore, we reduced the length of the chapters to a maximum of three screens on a smartphone (up to 80% reduction). The PDFs retained the text length and were designed to make a book of 12 chapters that could be printed and read in small chunks. The final website and PDFs can be accessed via this link [46]

6 CONCLUSION

In our modern digital era, where rapid information exchange occurs through digital devices, ETR users gain enhanced opportunities for societal inclusion through the use of their smartphones. Regrettably, digital training of ETR users for smartphones still barely exists. Findings from the German ETR community align with this notion, showcasing a preference for touchscreens due to their user-friendly nature, offering straightforward spatial arrangements (in comparison with desktop and mouse control), and an obviously partly intuitive navigation approach across various applications. However, there remains a significant gap in research focused on optimizing digital design patterns specifically for ETR users. Our design research provides evidence that certain digital design patterns empower ETR users by offering guided strategies that foster greater independence.

Improving functional independence for ETR users should be addressed from both the user and the product side. Regarding the user side, addressing limited access and digital training is crucial. A noteworthy finding highlights self-directed smartphone training, demonstrated by successful gestures and often successful usage of standard applications. Necessary improvements on the product side, such as optimizing content and visual design within digital patterns, are highlighted by personal strategies for overcoming device and design barriers. Design's pivotal role in augmenting comprehensibility and accessibility for ETR users is evident, gleaned from their significant reliance on visual cues and spatial arrangement. Insights that inform the enhancement of digital design patterns are key findings of our study. The challenge is to develop test materials that maintain ecological validity and incorporate enhanced designs, integrating visual aids such as icons while keeping cognitive load to a minimum. Achieving this balance is imperative for effectively supporting ETR users.

For optimizing digital design patterns (visually), the involvement of design research is crucial, encouraging designers to use their expertise, design insights, intuition, and creativity to improve the user experience for ETR users. Several technical and visual options exist that require designers' input, as described in the aforementioned recommendations. Developing digital design patterns is a multifaceted challenge, as it involves structured thinking in offering hierarchical text–image settings and triggering reading strategies. This complexity highlights how important it is for other disciplines to also harness the skills of designers.

An inclusive approach to ETR interface design requires two key aspects: listening to the real needs of ETR users and fostering collaboration among specialists in copywriting, design, and accessible coding. Because needs can vary significantly, stakeholder involvement from the beginning is crucial in defining needs and restructuring interaction tasks. In summary, optimized digital design patterns facilitate reading and interaction, and can serve as a basis for personalized ETR tools. They also benefit all users with their intuitive simplicity, limited text, clear hierarchical structure, and multiple task completion paths.

In our next study, we aim to create different design iterations using digital design patterns derived from those previously mentioned. We will test specific scenarios that enable independent choices, such as selecting events, confirming dates, or making particular requests.

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