Course development – lessons learned from usability evaluations

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Abstract—**This article draws on usability evaluations of a behavioural change intervention delivered as a web-based course. Special attention was given to usability as the course is directed at older adults aged 70 and above. Experiences from the usability evaluations in a lab environment and the real world, followed by stepwise refinements, can serve as examples of what must be considered in developing courses for professionals and late-life learners.**

Index Terms—**Usability testing, Inclusivity, Lifelong learning**

I. INTRODUCTION

EVERYONE has the right to equal education. Sweden has complied with the *UN Convention on the Rights of Persons with Disabilities.* According to article 24, "States parties shall ensure that persons with disabilities have access to adult education and lifelong learning without discrimination and on equal terms with others." Swedish universities have, during the past decade, given more consideration to universal design for learning to increase awareness and provide teaching staff and other staff with appropriate support tools.

At the same time, the Swedish government has decided to invest in lifelong learning at Swedish universities, aimed primarily at professionals but also non-professionals in the later part of life (Lund University, 2023). The latter group, similar to younger students, is diverse (e.g., regarding sensory function, cognitive abilities and motor control) and maybe to a greater extent because of primary and secondary ageing changes. Primary ageing changes refer to those that occur due to the passage of chronological time, while secondary ageing changes are related to lifestyle choices, diseases and accidents.

Teaching older adults with little or no experience using a digital learning platform or enroling in a university course involves several challenges relating to technology use. Therefore, the following must be considered as they influence older adults' willingness to learn to use something new (Czaja et al., 2019): 1) the perception of usefulness (seeing the benefit of the technology), and 2) the perception of ease of use (is it something they could learn to use?). Previous research shows that the key is to provide instructions, because older adults are "less likely to approach something new by trial and error" (Czaja et al., 2019).

I recently developed a behavioural change intervention, '*Light, activity and sleep in my daily life*', delivered as a nine-week web-based course. The course consists of nine modules aiming to encourage changes to routines and in the home. Various learning strategies are included in the course, such as reading and listening to factual information, doing practical exercises (using a test kit containing lamps, a sleep mask, a checklist for the inventory of a room, a cap, a notebook, and a sleep diary), recording diaries, and reflecting on goal setting and implementation intention by creating if-then plans. Special attention was given to usability as the course is directed at older adults aged 70 and above. Experiences from the usability evaluations followed by stepwise refinements can serve as examples of what must be considered when late-life learners are the target group.

II. PROCEDURE, PARTICIPANTS AND SETTING

This article draws on material collected in a lab during one week in October 2021, three weeks in February 2022, and the field from September to November 2022. A user-centred iterative design approach characterised the study design (Nielsen, 1993). (Complete results of the lab study are reported elsewhere (Gerhardsson et al., in press).)

A. Lab Study

In the lab study, usability of the online content was tested in two rounds in a full-scale model of an apartment, including direct video observation, questionnaires and exit interviews asking about what device they used, general opinions, 'perceived ease of use', 'perceived usefulness' and other concerns (Davis, 1989; Nie et al., 2020). Participants were three experts, e.g., on accessibility, in the first round and six persons (age 70) representing the target group in the second round. To guide the experts' notetaking in the first round, they received a checklist including guiding questions based on ten heuristic design principles developed to identify user problems (Nielsen & Molich, 1990; Nielsen, 1994). Target users in the second round did not receive a checklist but were asked to pay attention to: 1) readability (e.g., difficult words or phrases or incomprehensible text), 2) whether the course was easy to use (e.g., instructions for the online assignments), 3) whether they would be able to do the home assignments.

B. Field Study

After course refinement based on the participants' feedback, the web-based course was tested for usability and feasibility by eight older adults in a field study. Collected material consisted of questionnaires, face-to-face interviews and observations at home to identify usability problems. In addition, field notes were continuously taken from

enrolment to post-intervention evaluations.

For this article, the focus of the analysis of participants' feedback and field observations was on 'engagement' – one of the categories of Universal Design for Learning Guidelines (CAST, 2018). Providing multiple means of engagement captures the 'WHY' of learning and entails providing options for recruiting interest, sustaining effort and persistence, and self-regulation.

III. FINDINGS AND DISCUSSION

A. Lab Study

Ten heuristic design principles (Nielsen & Molich, 1990; Nielsen, 1994) were used as a checklist by the experts in their evaluations in round 1. Results are displayed in Table 1. One example concerned inconsistency when using 'buttons' and 'text links' (principle *#4 Consistency and standard*). Another example was a bit unclear instruction in one of the quizzes, and not understanding the purpose of the test kit from start (principle *#10 Help and documentation*).

The target users in round 2 found few usability problems in the adjusted version of the course material. Problems concerned the following sub-categories of 'perceived ease of use': graphical design (formatting text), information design (difficulty in finding one's way back after clicking a text link) and interaction design (insufficient steps in assignment instructions) (see Table 2). These sub-categories reflect three aspects of design (originally developed for the design of web sites by Söderström, 2001): 'graphical design' – refers to liking what you see on the web site; 'information design' – refers to finding your way, understanding your current location and where a link takes you; 'interaction design' – refers to doings and actions.

Based on participant feedback, physical meetings were added to the course to enable further shared experiences and socialising with course participants. The revised and current version of the course consists of the following learning activity types based on the Conversational Framework (Laurillard, 2002; 2012): *acquisition* (receiving information through reading, watching and listening to course materials provided on the digital platform), *practice* (improving skills through trying out what the course participants have learned), *production* (applying the knowledge to create a tangible outcome, e.g., a home lighting design), and *discussion and collaboration* (working with others and the opportunity for peer feedback).

There were unexpected problems regarding course enrolment. To access the course on the digital learning platform at the university, students need a university account. Before the visits to the full-scale model of an apartment in the lab, all participants received temporary usernames and one-time passcodes from the university with standardised instructions on how to create their password and log into the course. The university administrator received telephone calls from three participants, and I gave support to one participant in-person and to another via telephone. Another participant had managed to create a password but missed that she had to click on 'accept' to become a course participant.

B. Field Study

All eight participants completed the web-based course. Seven participants had made light-related changes in their homes, and five had changed their routines, suggesting 'engagement' in terms of relevance and motivation.

I used the following procedures as the course leader to promote and encourage continued participation:

1) continuously monitoring participants' submitted tasks and the weekly evaluations on the digital learning platform,

2) sending personal text messages over the phone after each completed course week and feedback on submitted weekly evaluations on the digital learning platform to encourage participants to stay on pace (both personal and automated encouragement have been shown to increase intervention adherence in the context of internet cognitive behavioural therapy (Furukawa et al., 2021)),

3) providing personal regular technical support at the senior citizen meeting point to one of the participants who lacked an Internet connection at home,

4) distributing the course content in print to two participants before each weekly course module, as they preferred to read paper printouts but did not have a printer,

5) including two physical course meetings.

Two course participants explicitly expressed that they appreciated meeting the others. Two participants thought it was inspiring to hear about the experiences of others. One participant found a radio broadcast too long, whereas another enjoyed listening to all the broadcasts. Another participant, with busy days, found the course too demanding in terms of time. One participant felt disengaged reading the four final modules on sleep. However, when giving an overall evaluation, two were satisfied with what they had learnt and six were very satisfied.

C. Lessons Learned

In each iteration of the course development, many lessons were learned, and actions were taken to improve the design. Below is a selection of lessons learned which can help educators develop web-based courses in general, directed at late-life learners in particular:

• The Conversational Framework helped design a learning environment including several learning activity types that cater to individual learning differences.

• A user-centred iterative design approach can be incorporated into the development of a web-based course, using a checklist including guiding questions based on 10 heuristic design principles supplemented by interviews.

• Written standardised university instructions for online course enrolment must be considered in late-life learning. If the instructions are not tailored to the target users, course enrolment might cause unnecessary computer anxiety.

IV. CONCLUSION

The findings confirm what is already known, although only sometimes practised in educational environments, about the need for usability testing (Czaja et al., 2019; Matre et al., 2019). The findings can also be valuable for educators developing lifelong learning courses as diversity can be even broader among professionals and late-life learners concerning educational level, previous experiences and individual differences.

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TABLE I
MAIN PROBLEMS WITH EXAMPLES, IDENTIFIED IN ROUND 1 WITH THREE EXPERTS, AND ADJUSTMENTS.

Category[a]	Examples of problems	Adjustments
#2. Match between system and the real world	Choice of words and the use of difficult technical terms.	Replaced certain words to more commonly used words, technical terms better explained (e.g., circadian, chronotype, lx), removed too technical terms (suprachiasmatic nucleus).
#4. Consistency and standards	Inconsistency when using 'buttons' and 'text links'.	Consistent use of 'buttons' and text links in written instructions.
	The acronym 'pdf' in parentheses is missing in the link text when linking directly to an external PDF	Include the title of the document and 'pdf' in parentheses in the link text or link to internal only PDF.
#5. Error prevention	Error message when not ticking any of the response options in multiple-choice questions.	Error message when not ticking any of the response options in multiple-choice questions.
#8: Aesthetic and minimalist design	Repetition of information on quiz pages.	Reformat quizzes.
	Image description explaining image content is repeated in the body text (detected when using the speech-to-text software).	Shorten image descriptions.
#10. Help and documentation	A bit unclear instruction in one of the quizzes.	Clarification of quiz instruction to increase comprehension.
	Not understanding the purpose of the test kit from start can be puzzling.	Explain the purpose of the test kit.
	Not switching off the electric lighting while taking daylight measurements with the downloaded light app (direct observation).	Clarification of written instructions ('complete the assignment during the daytime and do not forget to switch off the electric lighting before taking the measurement').

TABLE 2
MAIN PROBLEMS WITH 'PERCEIVED EASE OF USE', IDENTIFIED DURING INTERVIEWS AND OBSERVATIONS IN ROUND 2 WITH SIX TARGET USERS

Category	Examples of problems	Possible solution
Graphical design	Web pages containing several paragraphs need graphical elements to direct and capture the reader's attention.	Use boldface to highlight new content when subheadings are not appropriate.
Information design	Difficulty to find one's way back to the previous web page after clicking a text link, e.g., when a pdf-document opens in the same browser tab (direct observation and interactions with participants in the test apartment).	In the introductory module describing how to navigate, insert a new sub section explain the different types of text links.
Interaction design	Insufficient written step-wise instructions for one of the online assignments.	Add one more step in the instructions.
	Insufficient instructions for downloading and using the light app for iPhone (direct observation and interactions).	Clarify instructions, use bold-faced text for critical instructions and add images with screenshots of the app.