Design of an Educational Platform for Developing Librarians' Digital Competencies

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Abstract: This paper summarizes the results of preliminary research aimed at defining the design requirements for a microlearning application with adaptive features that tailor content to users' individual preferences and prior knowledge levels. The survey involved 395 respondents from among library staff, and the data collected provides crucial insight into the preferences of this specific user group. The results indicate that visual simplicity and a high degree of clarity are key parameters for a successful educational platform. Respondents in the survey clearly preferred a simple, uncluttered design with a minimum of distracting elements. In terms of visual style, a preference for a light mode and an emphasis on readability dominated, even at the cost of displaying less information on the screen at once. The research also identified a need for clear navigation and comprehensible controls. Although standardized icons were found to be highly understandable, most users require accompanying text labels for controls to eliminate uncertainty. The main menu structure with five basic sections (Home, Lessons, Profile, Help, Settings) was evaluated as optimal and user-friendly. In terms of content and pedagogy, the most effective approach appears to be the implementation of microlearning principles, that is, breaking down the curriculum into short, time-efficient blocks lasting 5 to 10 minutes, which allow learners to study at their own pace. Respondents also emphasized the need for personalization, particularly the ability to choose a difficulty level based on their existing knowledge and the automatic adaptation of content format (text vs. video) to their learning styles. The research results show that for the effective development of digital competencies in the library sector, it is essential to design an interface that is intuitive, functional, and respects users' individual time and cognitive capabilities. The findings serve as a direct basis for the creation of a prototype microlearning application with adaptive features that will meet the real needs of library practice in the digital age.

Keywords: Educational Platform, Design, Librarians, Microlearning, Digital Competencies, Adaptive Learning

1. Introduction

The current development of digital technologies and the transformation of information institutions into multifunctional community and informal learning centers place enormous demands on the digital competencies of their staff. In both the European and national contexts, this need is systematically defined by the updated European Digital Competence Framework for Citizens (Cosgrove & Cachia, 2025). In addition to data literacy, cybersecurity, and content creation, it places special emphasis on the ethical and safe use of artificial intelligence and digital well-being (Cosgrove & Cachia, 2025). This phenomenon is particularly pronounced in the Czech library sector. Professionals in the domestic library sector have long since ceased to serve merely as intermediaries for print collections, they are becoming key guides through complex data ecosystems, administrators of local information networks, and instructors in media, digital, and information literacy for the general public.

However, the accelerating pace of technological innovation in the Czech Republic is encountering significant demographic and age-related challenges. Within the Czech socioeconomic context, the library community is characterized by a markedly skewed age structure that skews toward older age groups (Pillerová, 2025).

This is not an exclusively Czech phenomenon. A large-scale DigComp-based study of Hungarian public library staff (N = 1,868) found that many professionals remain at basic or intermediate levels in digital content creation, safety and problem solving, while formal library education is a stronger predictor of advanced proficiency than work experience (Borbély, 2022). A systematic review further showed that although e-learning is the main approach to addressing these gaps, its effectiveness is often limited by workload, insufficient institutional support and poorly designed learning environments (Shahzad et al., 2023).

Continuing professional education thus faces a barrier where generic, technologically complex educational platforms fail to account for the physiological, cognitive, and user-specific needs of older adults. In practice, this

mismatch between interface design and user capabilities leads to premature cognitive exhaustion, demotivation, and an increase in so-called “technostress” (Tarafdar et al., 2019).

The severity of this problem from a demographic perspective is explicitly demonstrated by comprehensive statistical data from the National Library of the Czech Republic, derived from nationwide personnel surveys (Pillerová 2025). According to these empirical findings, the population of domestic librarians is undergoing a continuous aging process: a full 72% of all professional staff are over 41 years of age. The largest age groups are people aged 41 to 50 (30%) and the immediately following category of 51 to 60 (29%). Senior staff over the age of 61 make up a significant 13% of the total workforce, while the share of the youngest generation under 30 has been declining over the long term and stands at a mere 9% (the study also notes a high degree of feminization in the sector, where women account for 85% of employees).

These data clearly demonstrate that the primary users of any newly developed educational system in Czech librarianship are professionals of mature or advanced age. This demographic profile naturally brings with it specific physiological changes, such as a natural decline in visual acuity, reduced sensitivity to color contrast, or specific demands on the motor precision required to operate software controls (Whitenton & Nielsen, 2019). The visual design and interaction architecture of educational systems must therefore strictly adhere to human-centered design methodology and accessibility standards, such as the WCAG 2.2 guidelines, and must not be based solely on the aesthetic trends of young developers (W3C, 2023).

1.1 Problem Domain and User-Specific Considerations

The main research and practical issue addressed in this paper is the lack of design standards for educational interfaces that would reflect the actual needs of older age groups in the Czech library sector. Existing robust educational platforms, including widely used learning management systems (LMS Moodle), tend to be text-heavy, visually cluttered, and have an unintuitive control structure, which contradicts the basic principles of multimedia learning (Mayer, 2020). For librarians who face high workloads and often work in smaller regional institutions with limited opportunities for substitution, studying in such systems represents an additional burden. Instead of absorbing educational content, they must allocate a significant portion of their mental capacity to deciphering a complicated and confusing interface. According to cognitive load theory (Sweller, 2011), there is a rapid increase in external load, which has been shown to reduce computer self-efficacy (Compeau & Higgins, 1995) and triggers a paralyzing fear of making a mistake.

In response to these shortcomings, a project was launched to develop a specialized microlearning web application with adaptive features, designed to effectively build digital skills. However, in order to design a functional visual prototype of the interface, it was essential to conduct robust preliminary research focused on the interface’s ergonomic and aesthetic parameters. The research study thus deliberately distanced itself from the educational content itself and thoroughly analyzed the user preferences of Czech librarians in the area of visual ergonomics. The resulting application design is thus methodologically grounded in empirical requirements gathered from 395 respondents with practical experience.

1.2 Theoretical Foundations: Microlearning, Adaptability, and Cognitive Ergonomics

When seeking the optimal design solution for a demographically specific group such as Czech librarians, it is essential to integrate insights from cognitive ergonomics with modern instructional approaches. Traditional forms of e-learning, characterized by long text-based monologues and robust modules, often encounter working memory limitations in older adults (Sweller, 2011). The concept of microlearning therefore appears to be an effective alternative, defining education as the process of absorbing small, thematically coherent, and time-fragmented units (Hug, 2007). These micro-content blocks (typically lasting 5 to 10 minutes) minimize the risk of cognitive overload and allow users to study flexibly throughout the workday, which directly addresses the needs of library staff with high workloads.

Recent empirical evidence supports this reasoning. A systematic review found that mobile-based microlearning improves knowledge retention and motivation, with interface simplicity and short, self-paced learning as key success factors (Moore, Hwang and Moses, 2024). Similarly, an app-based intervention among older adult care personnel, a workforce comparable to Czech librarians, identified ease of use, accessibility and timely knowledge delivery as critical, with the least digitally experienced employees being most affected by interface friction (Richardson et al., 2023). Zhang and West (2020) further argue that microlearning is most effective when aligned with a competency framework, supporting the proposed platform’s alignment with DigComp 3.0.

The second key pillar of the proposed solution is the adaptability of the interface and content. Adaptive learning systems dynamically modify their behavior, structure, or presentation of information based on the user's individual characteristics, preferences, and current knowledge (Brusilovsky, 2001). A systematic mapping of AI-enabled adaptive learning systems found that adult and workplace populations remain underrepresented despite adaptation based on learners' prior knowledge and preferences (Kabudi, Pappas and Olsen, 2021). The present project addresses this gap.

In the context of developing librarians' digital competencies, adaptability plays a key role in removing barriers and strengthening computer self-efficacy. Older adults exhibit considerable heterogeneity in their initial digital skills. While fixed educational platforms generate fear of failure in less experienced users and boredom in advanced users, an adaptive system can, based on an initial assessment, personalize the difficulty level and tailor the format of educational content (e.g., automatically prioritizing text-based instructions with visual support over dynamic video, or vice versa) to the user's individual preferences. Although the empirical validity of the learning styles model in the sense of fixed cognitive types is questioned in the literature (Pashler et al., 2008), the preference-based selection of content format as a tool for reducing cognitive load and enhancing technological self-efficacy has solid support in the theory of multimedia learning (Mayer, 2020).

From the perspective of cognitive ergonomics and human-computer interaction (HCI), it is crucial that the interface of a microlearning application account for cognitive aging, which is associated with a decline in information processing speed and a reduction in selective attention capacity (Whitenton & Nielsen, 2019). These design implications have since been supported by a systematic review of 132 studies, which identified simplified navigation, larger text and touch targets, high contrast, error-tolerant interaction and clear labelling as key factors for usability among users aged 60 and over, while cognitive overload and low digital literacy remained the main barriers (Amouzadeh et al., 2025).

A minimalist visual style, restraint in color use, and the elimination of redundant decorative elements are not merely aesthetic choices but functional requirements for reducing so-called visual clutter, which has been shown to prolong the time older users spend searching for information on the screen. The comprehensibility of control elements, supported by explicit text labels for icons, then functions as cognitive scaffolding that transforms abstract software operations into understandable actions, thereby eliminating technostress and maximizing user comfort (Tarafdar et al., 2019).

1.3 Research Objectives and Research Questions

This study represents the initial empirical phase of the broader development and testing of a planned educational platform. Given the demographic characteristics and risks of cognitive overload among Czech librarians described above, a preliminary quantitative study was conducted. Its primary goal was to identify key user requirements for the visual, typographic, and didactic-interactive design of the interface. A total of 395 practitioners actively participated in this survey, providing a sufficiently robust data set to clearly define the research problem.

In order to transform the complex set of collected empirical indicators into comprehensive design recommendations, the research project was broken down into three key research questions:

- RQ1 (Visual-Aesthetic Domain): What parameters of visual ergonomics, typography, and color schemes do Czech librarians prefer in order to minimize eye strain and external cognitive load?
- RQ2 (Interaction-Orientation Domain): What architectural structure of navigation and what approach to the design of control elements (including iconography and textual contextualization) ensure optimal orientation and a sense of user confidence?
- RQ3 (Didactic-Content Area): What structural and time allocations for educational modules and what forms of content personalization correspond to the needs and capabilities of adult learners in the library sector?

2. Methodology

Given the nature of the research problem and the need to obtain a robust data set from a broad range of respondents, a quantitative research strategy was chosen, utilizing a questionnaire survey method, which was supplemented by a qualitative content analysis of open-ended responses.

2.1 Research Design and Data Collection Tool

Empirical data were collected using a specially designed, non-standardized questionnaire that was distributed electronically. The instrument was intentionally designed without demographic or professional questions (such as age or years of experience), as the overall demographic profile of the target group has been comprehensively and explicitly mapped over the long term by the National Library of the Czech Republic's comprehensive personnel surveys (Pillerová, 2025).

The questionnaire directly operationalized the research questions (RQ1–RQ3) through 19 items (including 12 icon-comprehensibility test items) structured into three thematic blocks:

- Visual-Aesthetic Domain and Cognitive Ergonomics (RQ1): Evaluated preferences regarding interface simplicity, visual clutter, typography, and color schemes.
- Interaction-Oriented Architecture and Navigation (RQ2): Assessed navigation clarity, confidence in digital environments, preference for text labels over standalone icons, icon comprehension, and the five-section menu layout.
- Didactic Structure and Personalization (RQ3): Examined interest in microlearning modules, preferred content formats, self-paced learning, and personalization options (e.g., difficulty levels, offline PDF downloads).

The questionnaire combined closed-ended questions with single- or multiple-choice options, supplemented by five-point Likert scales (expressing the degree of agreement or preference from "strongly disagree" to "strongly agree") and a total of six open-ended text questions allowing for detailed responses from the respondents.

2.2 Research Sample and Data Distribution

The target population of the research survey consisted of professionals in the library sector in the Czech Republic. The questionnaire was distributed using a method of complete purposive sampling. The director of the Library Institute of the National Library of the Czech Republic actively collaborated on the development of the application and the conduct of the research; through her and using the Library Institute's official communication infrastructure, the electronic questionnaire was distributed directly to all library institutions throughout the Czech Republic. This centralized approach ensured the maximum possible reach across the entire network of Czech libraries (from regional and specialized institutions to small regional branches). In total, N = 395 respondents actively participated in the survey by fully completing and submitting the questionnaire. Given the widespread distribution through the Library Institute of the National Library of the Czech Republic and the established demographic structure of the sector (see Chapter 1), the resulting dataset can be considered a highly representative sample reflecting the actual composition of the workforce in Czech librarianship.

2.3 Data Collection and Processing

Data collection took place between February 1 and February 28, 2026. After collection was completed, the data were exported to XLSX format, and then checked, cleaned, and coded. Given the descriptive and exploratory nature of this phase of the research, descriptive statistics were primarily applied (absolute and relative frequencies, means, medians). The results were then visualized using graphs and tables, which form the basis for the following chapter, Results.

3. Results

The presentation of the empirical study's results is systematically divided into three sections that directly correspond to the research questions. A total of N = 395 fully completed questionnaires were analyzed.

3.1 Visual-Aesthetic Aspects and Cognitive Ergonomics (RQ1)

Research has confirmed the critical need for visual minimalism. On a five-point scale (1 = lowest, 5 = highest), 57.4% of respondents rated their preference for a simple design at the highest level, as illustrated in Figure 1.

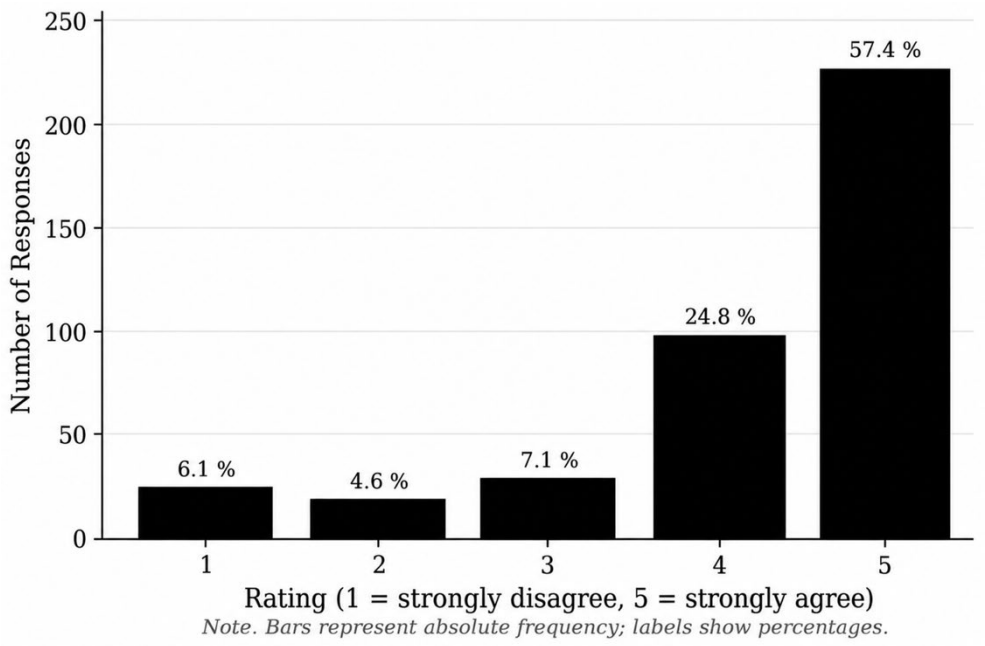


Figure 1: Preference for a simple, uncluttered interface

When it comes to typography, the largest group of respondents (38%) took a neutral stance on font size, but a total of 43.5% (the sum of scores 4 and 5) prefer a larger font even if it means less information (Figure 2). Qualitative data (Questions 9 and 19) supplement this requirement with the need to use a single consistent sans-serif font and ensure high text contrast against the background.

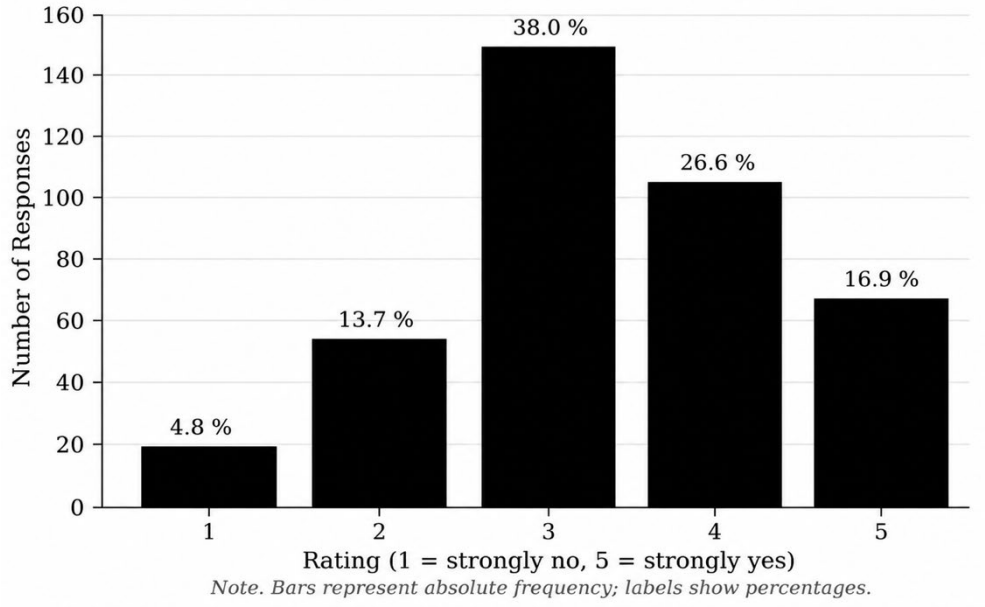


Figure 2: Preference for larger, readable font

Light mode dominates in terms of color scheme (68.1%) as presented in Figure 3. However, the open-ended responses (Question 19) indicated that users would welcome a dark mode as an optional alternative for those with low vision or for working in the evening. In their additional comments, respondents explicitly warned against “aggressive” and “intense” colors (e.g., neon shades) and animated elements, which they consider highly distracting.

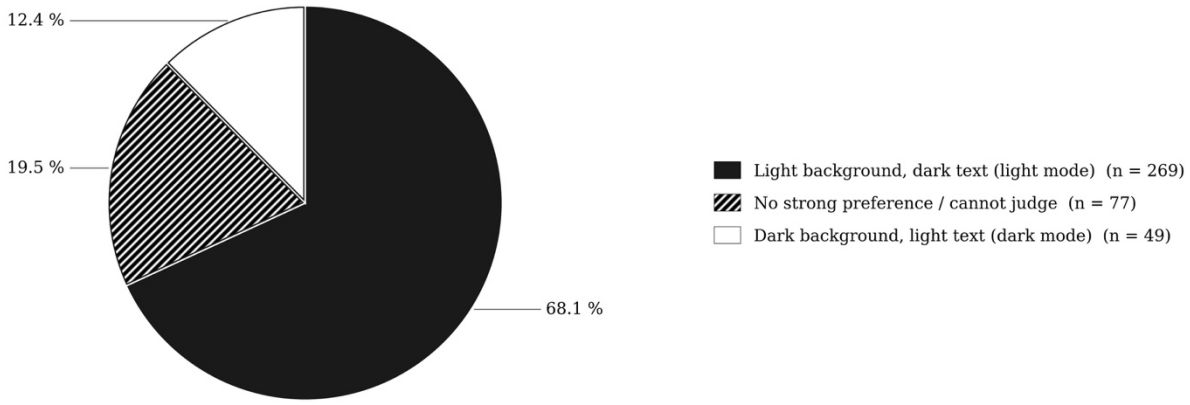


Figure 3: Preferred colour scheme

3.2 Interaction-Oriented Architecture and Navigation (RQ2)

Most librarians rate their ability to navigate new applications as good, with 48.6% experiencing no difficulty and 47.1% reporting some initial difficulty (Figure 4). Nevertheless, the proposed menu structure with five sections (Home, Lessons, Profile, Help, Settings) was accepted with a high degree of agreement (87.1%), as depicted in Figure 5.

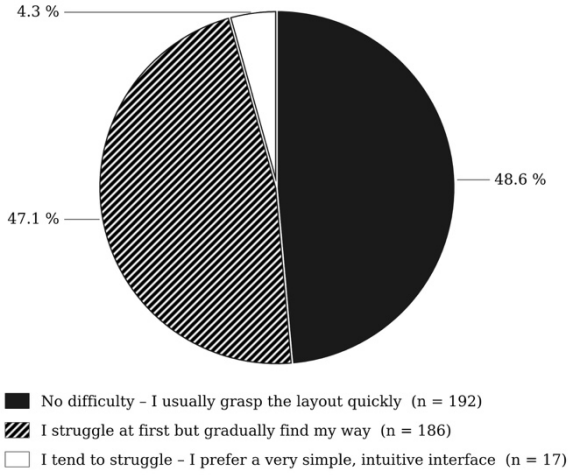


Figure 4: Self-rated ability to orient in a new application

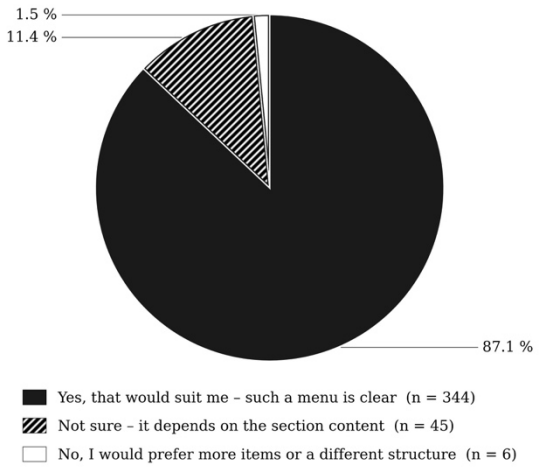


Figure 5: Clarity of 5-section main menu

An analysis of 73 relevant suggestions for improving navigation (Question 9) revealed that the most common request is for the implementation of a search bar (full-text search with autocomplete). Other priorities include:

- Breadcrumb navigation and a fixed ("pinned") page header for quick navigation.
- Chapter titles instead of mere numbering (e.g., "Digital Security" instead of "Lesson 1").
- Horizontal layout (inspired by websites like Seznam.cz, which 82 respondents cited as a model for an easy-to-use website).

A key finding concerns the use of icons. Although standardized icons (magnifying glass, house, gear) show a recognition rate of over 90%, recognition of the "task" icon (pencil) dropped to 57.2% (Figure 6). Furthermore, when asked about overall interface preferences (Question 5), 60.3% of respondents strongly preferred that graphical icons always be accompanied by explicit text labels.

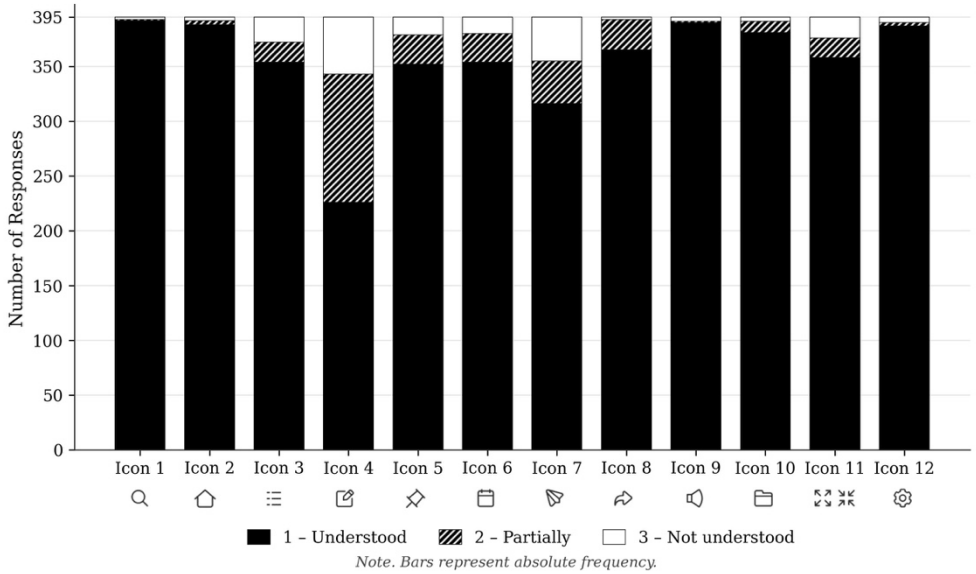


Figure 6: Icon comprehension rating across 12 tested icons

3.3 Didactic and Content Structure and Personalization (RQ3)

Respondents expressed exceptional interest in microlearning, a total of 88.1% (the sum of "Definitely yes" and "Somewhat yes" responses) would welcome lessons in 5–10-minute segments (Figure 7).

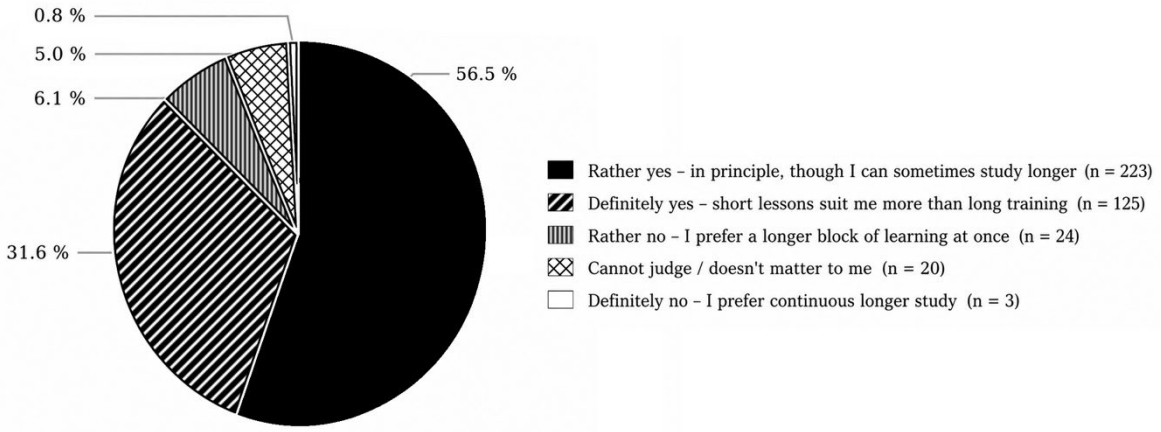


Figure 7: Interest in microlearning (5-10 min lessons)

As depicted in Figure 8, when it comes to preferred content, text-based materials (78%) and interactive elements (73.7%) dominate, followed by video (65.6%). App personalization is considered particularly important when it comes to selecting the difficulty level (62.3%).

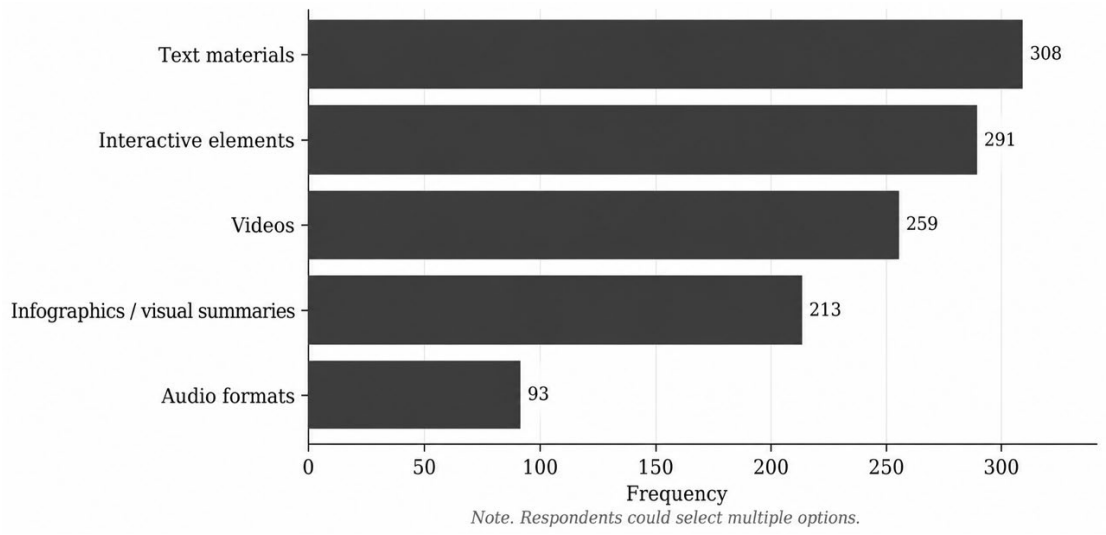


Figure 8: Most benefical content formats

In response to the open-ended questions (16 and 18), respondents overwhelmingly (128 mentions) emphasized the need to download materials (PDFs) for offline study and printing. Other frequent requests included:

- Gamification: Motivation through progress indicators, point collection, or a "roadmap" (inspired by the Duolingo app, which 26 respondents cited as a positive example).
- Flexibility: The ability to pause a lesson and return exactly to where the user left off.
- Practicality: Immediate feedback after completing a test and the option to consult with a tutor via a discussion forum.

When analyzing experiences with other systems (Question 17), the existing platforms were criticized for being overly theoretical and "outdated" (e.g., older courses in Moodle). In contrast, users appreciate modern, fast-paced, and thematically well-defined courses (e.g., projects on osveta.gov.cz or Seduo).

4. Discussion

This study provides empirical insights into the specific user requirements of Czech librarians in the areas of cognitive ergonomics and the interaction design of educational platforms. Given the significantly skewed age structure in this sector (Pillerová, 2025), the findings critically reflect theoretical frameworks related to cognitive aging and technostress (Tarafdar et al., 2019; Whitenton & Nielsen, 2019).

One of the most significant findings in the area of visual ergonomics (RQ1) is the respondents' strong emphasis on interface minimalism, simplicity (Figure 1) and high color contrast (Questions 9 and 19). These preferences directly correlate with Richard Mayer's multimedia principles (2020), specifically the principle of coherence, according to which people learn better when redundant and distracting elements are eliminated from the interface (referred to by respondents as "aggressive colors" or "flashing animations"). For older adults, who experience a natural decline in selective attention, visual restraint acts as a primary protective factor against premature cognitive exhaustion (Sweller, 2011). The observed preference for light mode (68.1%) presented in Figure 3 with the option to manually switch to dark mode (identified in the supplementary text section) aligns with the recommendations of Whitenton and Nielsen (2019) for the design of web interfaces intended for older users, where fixed dark modes can impair readability for people with visual impairments (e.g., astigmatism).

In terms of interaction architecture (RQ2), the research highlighted the phenomenon of technological uncertainty. Although the comprehensibility of standardized icons was high (Figure 6), the fact that 60.3% of users requested an accompanying text label (Question 5) indicates a need for so-called cognitive scaffolding. This converges with the review evidence of Amouzadeh et al. (2025), in which explicit labelling and error tolerance emerged as recurring requirements for users aged 60 and over; the present data extend that evidence from consumer and health applications to the domain of professional continuing education. An isolated icon (e.g., the pencil icon for editing, which showed a drop in comprehensibility to 57.2%, as demonstrated in Figure 6) causes older users to fear making a mistake, which demonstrably reduces their technological self-efficacy and induces technostress (Compeau & Higgins, 1995; Tarafdar et al., 2019). The proposed five-section structure of the main menu (Figure 5), which received overwhelming support (87.1%), together with the request for the

implementation of full-text search (Question 9), confirms that a shallow and transparent information architecture is key for this target group. The inspiration drawn from the Seznam.cz portal in the open-ended responses points to the validity of Jakob's Law of Usability – users prefer interfaces that function the same way as systems they are already familiar with (Whitenton & Nielsen, 2019).

The didactic dimension (RQ3) revealed a clear rejection of robust and rigid educational modules of the type found in traditional LMS platforms like Moodle, which respondents criticized in their open-ended responses for being confusing and outdated (Question 17). The overwhelming consensus on the implementation of microlearning in Figure 7 (88.1% for sessions lasting 5–10 minutes) reflects librarians' high workload and limited working memory capacity when absorbing complex technological content (Hug, 2007). The magnitude of this preference exceeds the levels of acceptance reported by Richardson et al. (2023) in a comparable older workforce, which may reflect the higher baseline information literacy of library professionals. Conversely, the demand for downloadable PDF materials identified here has no counterpart in that study and appears to be profession-specific — plausibly a reflection of the professional habitus of staff whose daily work is organised around print collections. Requests for personalized difficulty levels and automatic adaptation of content format (text vs. video as depicted in figure 8) confirm the theoretical premises of adaptive learning (Brusilovsky, 2001) as a tool for inclusive skill development. A significant and unforeseen finding in the questionnaire (derived from open-ended questions 16 and 18) was the overwhelming demand for downloadable PDF materials for printing. As this preference was not reported by Richardson et al. (2023), it may represent a profession-specific characteristic reflecting library staff's habitual reliance on print-based resources during learning.

4.1 Limitations of the Research and Future Directions

The main limitation of this study is its reliance on self-reported data (respondents' subjective preferences as indicated in the questionnaire). In theory, users may prefer different features than those they actually demonstrate during practical interaction with the software. However, this limitation will be eliminated in the immediately following phase of the project. The empirical data obtained and relevant user feedback (including requests for gamification modeled after the Duolingo app) serve as the direct basis for creating an interactive model and the subsequent high-fidelity prototype of the application. This limitation is consistent with the state of the field: reviews of both adaptive learning systems (Kabudi, Pappas and Olsen, 2021) and age-friendly interface design (Amouzadeh et al., 2025) identify the scarcity of longitudinal usability testing as a systemic weakness rather than a shortcoming specific to this study.

The second limitation is potential self-selection bias in the research sample. Although the questionnaire was distributed widely through the Library Institute of the National Library of the Czech Republic, respondents with higher levels of digital literacy and a positive attitude toward technology may have been more willing to complete the electronic questionnaire. The results may thus underestimate the extent of technological uncertainty and technostress among the least digitally proficient segment of the library population, precisely the group for which the application is primarily intended.

5. Conclusion

This article has successfully achieved its stated objective, which was to define and analyze the specific user, ergonomic, and pedagogical requirements of Czech library staff regarding the design of an educational microlearning application for developing digital competencies. Thanks to the widespread distribution of the questionnaire through the Library Institute of the National Library, a robust dataset was obtained from N = 395 respondents, which exhibits a high degree of representativeness with respect to the actual demographic composition of the Czech library sector.

The research clearly demonstrated that generic, visually saturated, and text-heavy e-learning platforms cannot be used for the effective education of a demographically older and operationally busy population of librarians. A successful design must strictly adhere to the principles of cognitive ergonomics, inclusive Human-Centered Design, and accessibility standards (WCAG 2.2). The key parameters for the successful implementation of the application in practice are:

- Visual simplicity: A minimalist interface in light mode with high contrast, free of distracting dynamic elements.
- Cognitive ease of navigation: A shallow menu structure (5 sections), graphic icons supplemented with explicit text labels, and the integration of robust full-text search.

- Microlearning pedagogy: Fragmentation of course material into short, 5- to 10-minute blocks that allow for flexible, self-paced study without disrupting the institution's operations.
- Adaptive personalization: Difficulty level selection based on an initial diagnostic assessment, choice of content format (text/video), and support for offline study (PDF downloads).

The findings represent a significant contribution to the discussion on methods of professional education for adults in information institutions. The findings of this study were directly applied in the design of the conceptual architecture of the system under development and serve as an empirical basis for the creation of a visual prototype of an application that will genuinely contribute to the systematic and stress-free development of digital competencies (in accordance with the DigComp 3.0 framework) in library practice in the digital age.

Acknowledgements

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Ethics Declaration

Participation in the research was voluntary. All participants were informed about the purpose of the study and agreed that the collected data could be processed and used for research purposes. The questionnaire responses were collected and processed in accordance with applicable data protection regulations and were used anonymously in the analysis and presentation of the results.

AI Declaration

DeepL was used for initial translation support during manuscript preparation. All translated text was subsequently reviewed, revised, and where necessary modified by the author. No AI tools were used for generating research content, analysis, or conclusions.

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