



# Universal access in the information Society (2001–2021): knowledge, experience, challenges and new perspectives

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Following the creation and nurturing of a niche scientific community, in the late '90 s the emerging interdisciplinary field of “Universal Access in the Information Society” had reached a turning point and the time had come for the establishment of the necessary publication channels. While a few conferences and workshops had sprung, mainly in Europe, already since the early '90 s to cater for the need of dissemination of research results in this field, a reputable journal was needed for the field's growth, but even more importantly, for its expansion by attracting the interest of young scientists.

Established in 2000, with its first issue appearing in 2001, the Springer UAIS Journal has provided an archival publication channel for the discussion and advancement of theoretical and practical aspects of universal access in the information society. Overcoming the natural and anticipated teething problems in the first couple of years of its operation, the UAIS journal has grown stronger year after year, now reaching a 5-year Impact Factor of almost 2.

This journal addresses the accessibility, usability, and ultimately, acceptability of Information Society Technologies by anyone, anywhere, at any time, and through any media and device. The journal focuses on theoretical, methodological, and empirical research, of both a technological and non-technological nature, that addresses equitable access and active participation of potentially all citizens in the information society, featuring papers that report on theories, methods, tools, empirical results, reviews, case studies, and best-practice examples.

Two decades later, several questions arise from the viewpoint of Universal Access. Have Universal Access approaches been fruitful? How can the knowledge and experience acquired from such approaches be applied to the new technological environments? What are the promises and challenges that intelligent technological ecosystems bring with regard to universal access?

This Special Section, celebrating the 20 years of the UAIS Journal, aims to provide insights into new inquiries as well as consolidate current knowledge and experience in Universal Access and propose new perspectives and approaches for the near and the longer term future.

Six articles have been accepted for this Special Section.

The first paper, *Is there an imbalance in the supply and demand for universal accessibility knowledge? Twenty years of UAIS papers viewed through the lens of WCAG*, by Frode Eika Sandnes, aims to provide an analysis of universal access knowledge as reflected in the papers published in UAIS. To this purpose, UAIS papers indexed in Scopus were analysed using bibliometric methods, aiming to assess the balance of research into the main areas of accessibility, the impact of this research, and how the research profile varies over time and across geographical regions. The WCAG taxonomy of accessibility was used for the analysis, namely ‘perceivable’, ‘operable’, and ‘understandable’. The results confirm the expectation that research into visual impairment has received more attention than papers addressing ‘operable’ and ‘understandable’. However, papers focussing on ‘understandable’ attracted more citations. The breakdown of research efforts appears consistent over time and across different geographical regions. The paper concludes with recommendations on how to address the identified imbalance.

The following three papers address an application domain which has emerged as particularly relevant for Universal Access, namely education.

What do faculty members know about universal design and digital accessibility? A qualitative study in computer science and engineering disciplines, by Norun Christine

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Sanderson, Siri Kessel and Weiqin Chen, investigates the status of universal design and digital accessibility knowledge among faculty members, as well as practical knowledge of how to make learning materials and courses accessible for more students. The research followed a qualitative approach involving 35 faculty members in higher education institutions (HEIs) in Norway and Poland. The data was analysed using thematic analysis. From the results it emerges that most participants lack sufficient understanding of digital barriers and assistive technologies, and very few are aware of legislation and guidelines related to universal design. Most importantly, the majority lack practical knowledge on how to make digital learning materials and courses accessible. These findings indicate that there is a gap between legislation and implementation when it comes to making digital learning materials accessible in higher education, and training is necessary to increase understanding and practical knowledge.

The second paper dedicated to Universal Access to education, *Mind the Gap: Improving Universal Access to Higher Education Fostering Time Management Skills* by Bernardo Tabuenca, Wolfgang Greller, and Dominique Verpoorten, addresses self-regulated learning competences and in particular time management. In the reported study, 348 students covered a course through two conditions: the control group attended the semester in the usual way, while students in the experimental group were weekly invited to estimate and log their workload and time allocations, via tools provided on their mobile devices. While no major difference in time management and learning performance was observable, data reveals that perceived time allocation and prescribed study-time differ substantially. These results raise questions, on the students' side, about the potential of qualitative (self-inputted) learning analytics to raise awareness on where time investments go. On the teachers' side, the results highlight the need to better plan the curricula workload specifically for first-year students.

The subsequent paper, *Exploring acceptance of intelligent tutoring system with pedagogical agent among high school students*, by Hanjing Huang, Youjie Chen and Pei-Luen Patrick Rau, investigates learner acceptance of Intelligent Tutoring Systems (ITS) based on the Technology Acceptance Model (TAM), as well as the effects of pedagogical agents on learners' acceptance of ITSs. A total of 102 high school students were recruited to use an ITS incorporated as a pedagogical agent in their educational process to learn mathematics over a nine-day period. The results reveal that students' perceived usefulness had the largest effect on their intentions to use the ITS. Furthermore, the social presence of the pedagogical agent had a significant effect on students' perceived usefulness. Additionally, interpersonal attraction of the agent had a significant effect on its perceived ease of use. This study's empirical findings provide implications

for both theoretical research and the practical development of ITSs.

The next two papers deepen an issue which has acquired increasing importance in the context of Universal Access over the past years, namely media accessibility.

The first paper, *Universal Access: User Needs for Immersive Captioning*, by Chris Hughes, focuses on building a prototyping framework for immersive captioning following a user-centric approach, with the aim to identify how to display captions for an optimal viewing experience. The first part of the article presents the state of the art for user requirements identifying the reasons behind the development of the prototyping framework. The second part of the article describes the two-stage framework development. The article concludes with a list of functionalities, resulting in new caption modes, and the opportunity of becoming a comprehensive immersive captions testbed, where tools such as eye-tracking or physiological testing devices could be used to assess captions across any device with a web browser.

The second paper, *Novel Software for Producing Audio Description based on Speech Synthesis Enables Cost Reduction without Sacrificing Quality*, by Sawako Nakajima and Kazutaka Mitobe, presents a prototype for high-quality and efficient Audio Descriptions production software based on speech synthesis. The prototype includes dedicated interfaces for AD-script entry, frame-by-frame insertion-point settings, speech rate settings, and volume settings with audio waveforms. In evaluations conducted using trailers, the AD production software successfully reduced cost by eliminating the modification time conventionally required by the film producer and sound engineer; additionally, the film producer's quality assessment increased by 5% relative to existing standard synthesized-voice ADs. Finally, challenges and potential areas of improvement with the software were evinced from the participating audio describers.

The paper *Stories, journeys and smart maps: an approach to universal access* by Xi Wang, Danny Crookes, Sue-Ann Harding and David Johnston, addressing Universal Access to cultural heritage, proposes a new approach to universal access based on the premise that humans have the universal capacity to engage emotionally with a story, whatever their abilities. The approach is to present the "story" of museum resources and knowledge as a journey, and then represent this journey physically as a smart map. The approach is applied through the creation of a smart map for blind and partially sighted visitors. The results of a reception study show that the approach enabled participants to experience significant emotional engagement with museum resources. The smart model also gave users a level of control over the AD which gave them a greater sense of empowerment and independence, which is particularly important for visitors with varying sight conditions. The conclusion is that the proposed approach has considerable potential as an approach

to universal access, and to increase emotional engagement with museum collections.

Finally, the Communication *Intelligent environments for all: a path towards technology-enhanced human well-being*, by Laura Burzagli, Pier Luigi Emiliani, Margherita Antona and Constantine Stephanidis, moving forward from the Design for All paradigm, discusses how the latter can be revisited under the perspective of technology's usefulness and contribution to human well-being. In order to achieve these objective, it is claimed that the design of Assistive Intelligent Environments needs to be centered around the well-being of people; the technological environment should be orchestrated around such activities and contain knowledge about how they are performed and how people need to be supported to perform them; the environment should make use of monitoring and reasoning capabilities in order to adapt, fine-tune and evolve over time the type and level of support provided; and finally, the applications should also support the possibility of contact with other people, who in many cases may be the only effective help. The need for integrating Artificial Intelligence capabilities in

assistive intelligent environments is also discussed, based on the complexity of the human problems to be addressed and the diversity of the types of support needed. The proposed approach is exemplified and illustrated through the experience acquired in the development of four applications, addressing vital aspects of human life, namely nutrition, stress management, sleep management and counteracting loneliness. Finally, based on the acquired experience, the need to take into account ethical values in the development of assistive intelligent environments is discussed.

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