Franziska Bellinger,
Ricarda Bolten-Bühler,
Matthias Rohs (Eds.)

EB LBL

ADULT EDUCATION RESEARCH ON DIGITALISATION

Concepts – Scopes – Understandings

NED
Netzwerk
erwachsenenpädagogische
Digitalisierungsforschung

wbv

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Adult Education Research on Digitalisation

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Preface

Matthias Alke

There is now a broad societal consensus that digitalisation permeates the structures, cultures, and processes of all areas of life and work – including those of adult education. In this context, adult education assumes a particular societal role: it is challenged to support individuals, organisations, and entire sectors in dealing with digital transformation. The individual and collective experiences during the COVID-19 pandemic have made it clear how indispensable adult education is for developing media competencies, fostering critical engagement with digital technologies, advancing pedagogical innovations, and, more broadly, contributing to social inclusion within the digital transformation process.

With the ongoing advance of digitalisation and the prominent role of adult education, new areas of research and new questions are continuously emerging. Even prior to the pandemic, a network to bring together scholars engaged with digitalisation phenomena in adult education was established within the German-speaking research community. Initial findings from research projects and discussions within this network were published in 2021 in Volume 42 of the series *Erwachsenenbildung und lebensbegleitendes Lernen* under the title *Erwachsenenpädagogische Digitalisierungsforschung. Impulse – Befunde – Perspektiven*.

The present second volume, published in the same series and edited by *Franziska Bellinger, Richarda Bolten-Bühler*, and *Matthias Rohs*, documents the ongoing engagement with the implications of digitalisation in and for adult education. While the first volume outlined the contours of this emerging field of research with its diverse perspectives and reference levels, the focus here lies on a critical and constructive discussion of concepts, scopes, and understandings of digitalisation that shape research, educational practice, and policy alike. With this thematic orientation and an English-language focus, the editors aim to intensify exchange with international research approaches and communities. This is particularly important given that, due to the unique characteristics of national adult education systems, scholarly discourses and professional communities remain strongly isolated from one another. In addition to fostering international dialogue, the editors also seek to position adult education more precisely in relation to media education. Both disciplines address digitalisation phenomena in education and share manifold connections and intersections. However, from the perspective of the editors, discourses and research in media education have so far concentrated primarily on the learning and educational processes of children and young people, with too little focus on adulthood. The volume therefore also aims to promote synergies and dialogue between the two disciplines.

Against this background, the twelve contributions by 26 authors in this volume offer diverse insights into current questions, research projects, and empirical findings.

They are grouped into three categories: *Teaching and Learning, Programs and Institutions,* and *Theories and Methods.* The contributions are situated within both adult education and media education while simultaneously seeking to connect with other relevant reference disciplines in order to further sharpen concepts and understandings of digitalisation in adult education. As already evident in the contributions to the first volume, interdisciplinarity constitutes an important approach in adult education research on digitalisation. Particularly noteworthy are several contributions that address methodological, theoretical-methodological, and research-ethical issues. Digitalisation shapes not only the practices and policies of adult education but also research itself: digital technologies open up new methods of data collection and analysis, while at the same time transforming established approaches.

The three dimensions of this volume – internationalisation, disciplinary positioning, and the methodological embedding of adult education research on digitalisation – thus point not only to current questions and challenges for research and the discipline. They also document ongoing transformations within adult education research and highlight the central role of network structures in facilitating exchange and advancing the field. These elements constitute a particular strength of this volume.

Finally, the contributions vividly illustrate how disciplinary transformation processes unfold in practice and which developmental pathways are chosen by members of the discipline. They invite both national and international audiences across different fields to engage actively in the discourse on adult education research on digitalisation – and to participate in shaping future disciplinary trajectories.

Acknowledgement

Like all books, this anthology was only possible thanks to a wide range of support. First and foremost, we would like to mention the Adult Education Digitalisation Research Network (NED), which provides the framework for this anthology. The encouragement from its members was decisive for the motivation to tackle this project. Many of the authors come from the network and are active in it. Their suggestions for topics and articles characterise this book. We are particularly pleased that many young scientists have contributed. The good co-operation with all the authors has made our work much easier. Last but not least, we would particularly like to thank the reviewers. Their willingness to support us and their valuable feedback contributed significantly to the quality of the book.

The editors

Franziska Bellinger, Ricarda Bolten-Bühler and Matthias Rohs

Network for Adult Education Digitalisation Research
The Network for Adult Education Digitalisation Research (NED) operates within the Adult Education Section of the German Educational Research Association (GERA) | Deutsche Gesellschaft für Erziehungswissenschaft (DGfE). It was established on 25 September 2019 during the annual conference of the Adult Education Section of the German Educational Research Association (GERA) | Deutsche Gesellschaft für Erziehungswissenschaft (DGfE) in Halle (Saale), Germany. NED is an informal association of researchers and practitioners with a shared interest in continuing education research, particularly in the context of digital media and digitalisation. During the realisation of the book project, the network was coordinated by Franziska Bellinger (University of Cologne) and Ricarda Bolten-Bühler (Euro-FH European Fernhochschule Hamburg). In November 2025, the coordination was taken over by Sophie Lacher (RPTU University of Kaiserslautern-Landau) and Kim-Maureen Martin (German Institute for Adult Education – Leibniz Centre for Lifelong Learning).

https://nedswerk.de/en/

Introduction

The Indispensable Engagement of Adult Education with Digitalisation: Contextualising the Need for Research and Networked Exchange

Franziska Bellinger, Ricarda Bolten-Bühler and Matthias Rohs

The pervasive and accelerating wave of digitalisation is profoundly reshaping societies, economies, and individual lives. Consequently, the field of adult education finds itself at a critical juncture, tasked with navigating both the immense opportunities and significant challenges presented by this transformation. For adult education to engage deeply and critically with digitalisation, it needs to stem from several interconnected dimensions:

Firstly, the socio-economic imperative is undeniable. Rapid technological advancements are continuously reshaping labour markets, calling existing skills into question and giving rise to new competency requirements (Cedefop, 2025; OECD, 2023). Adult and continuing education is uniquely positioned to facilitate lifelong learning, upskilling, and reskilling, thereby enabling individuals to navigate evolving career pathways, maintain employability, and contribute to economic innovation and resilience. **Secondly**, the engagement of adult education with digitalisation is paramount for fostering social equity and inclusion. While digital technologies offer immense potential for democratising access to information and learning opportunities, they also carry the risk of exacerbating existing inequalities, leading to a "digital divide" (Matzat & Ingen, 2020; Lythreatis, 2022). This divide is not solely about access to technology but also encompasses digital literacies, skills, and the confidence in using digital tools effectively (Vuorikari et al., 2022). Adult education plays a crucial role in bridging this gap, ensuring that all individuals, irrespective of socio-economic background, age, or prior educational attainment, can develop the necessary media competencies for full and active participation in an increasingly mediatised society. **Thirdly**, digitalisation offers unprecedented opportunities for pedagogical innovation and transformation within adult education itself. This affects levels of infrastructure and organisation as well as teaching and learning processes. Digital tools and platforms can transcend the traditional spatio-temporal constraints of learning. They can offer pathways for personalisation, provide access to a wide range of learning resources, and facilitate new modalities for collaborative knowledge construction and learner interaction (e.g. Behrend et al., 2024). Exploring and understanding how these technologies can be effectively and ethically integrated to enhance learning processes, improve learner engagement, and cater to diverse learner needs is a core task for adult education research and practice.

Fourthly, a substantive engagement with digitalisation extends beyond the instrumental adoption of technologies to encompass the cultivation of critical media literacy. This involves empowering adults to not only use digital tools but also to critically evaluate digital information, understand issues of data privacy and algorithmic bias, recognise misinformation, and reflect on the broader ethical and societal implications of technological advancements. Such critical capacities are fundamental for informed and responsible citizenship in the 21st century (e.g. Vuorikari et al., 2022).

In light of the complex and evolving demands placed on contemporary adult education, rigorous scholarly inquiry and sustained international dialogue – both among researchers and between academia and practice – are of critical importance. In this context, scientific engagement is not primarily aimed at offering direct solutions to specific practical problems, but rather at addressing concrete challenges arising from the field, analysing the multifaceted opportunities and risks associated with digitalisation, and encouraging critical reflection on affirmative or technocentric positions.

A central concern lies in uncovering the often hidden or implicit effects of digitalisation, particularly with regard to its influence on power structures within the adult education landscape. These dynamics have profound implications for preserving and advancing an open, pluralistic, and participatory educational environment – one that fosters equitable access to learning opportunities and protects individuals from unbalanced or manipulative influence. Key areas of inquiry therefore include the identification of factors that enhance learning processes and outcomes in digital contexts, the exploration of avenues to increase educational access through digital means, the development of ecologically sustainable approaches to digitalisation in adult education, and the delineation of competencies required for individuals to critically and productively engage with digital tools and infrastructures.

At the same time, it is essential to formulate normative visions and utopian perspectives: What might adult education look like in a digitally transformed society? Where should the boundaries of digitalisation be drawn? Which challenges necessitate new technological solutions, and what ethical frameworks should guide their development and application? Ultimately, this raises the fundamental question: What constitutes a humane and socially just approach to digitalisation in adult education?

Importantly, digitalisation does not only impact educational practice – it also fundamentally reshapes the conditions and methodologies of adult education research itself. The emergence of new digital practices in this research area gives rise to new research questions and methodological challenges. At a meta-level, this prompts reflection on several fronts: Which new phenomena in adult education practice demand scholarly attention? What innovative methodological approaches are required to study them? How do digital research tools alter the epistemic landscape of adult education research? And which new forms of insight become possible through digital technologies?

These inquiries unfold within an exceptionally dynamic and volatile context, characterised by rapid technological innovation (e.g. MOOCs, generative AI, platform-based learning environments), shifting actor constellations (particularly from the pri-

vate sector), and acute societal disruptions (e. g. the COVID-19 pandemic). Although difficult to anticipate, such developments exert substantial influence on the adult education sector.

Understanding and researching these powerful, diverse phenomena requires the consolidation of research capacities and expertise. This is essential not only for a more comprehensive grasp of evolving educational practices, but also for fulfilling what Hans Jonas (1984) referred to as the "imperative of responsibility"– namely, the ethical obligation of science to critically engage with the societal consequences of technological progress.

In 2021, the Network for Adult Education Digitalisation Research (NED) published its first edited volume, which offered a foundational overview of the emerging field of adult education research on digitalisation within the German context (Bernhard-Skala et al., 2021). The primary objective of this publication was to render the diverse and multifaceted research activities in this domain visible and accessible, thereby fostering dialogue with the broader educational sciences and encouraging interdisciplinary engagement.

This second volume, titled "Adult Education Research on Digitalisation: Concepts – Scopes – Understandings", brings together a diverse collection of scholarly contributions exploring the multifaceted dimensions of the dynamic interplay between adult learning and the digital transformation. The volume is a direct outcome of the aforementioned network NED, which is part of the Adult Education Section of the German Educational Research Association (GERA), founded in 2019. Since then, it has become the largest network within the Adult Education Section and serves as an association for researchers and practitioners interested in adult education research concerning digital media and digitalisation. The NED actively fosters an exchange of current research findings, methodological insights, methodological reflections, practical experiences, and emerging trends in this evolving field. Key aspirations of the NED include identifying research desiderata, enhancing the visibility of research and practice within this dynamic, also quite normatively charged, domain, and facilitating effective knowledge transfer and scholarly exchange. Furthermore, a central aim is the promotion of critical reflection on the opportunities, challenges, and ethical considerations inherent in the digitalisation of adult education.

The central aim of this volume is to delve into the core **Concepts** that frame our understanding of digitalisation within adult learning and education. It seeks to delineate the various **Scopes** of inquiry, practice, and policy impacted by digital technologies, ranging from pedagogical approaches and learner engagement to institutional strategies, educational policy and societal implications. Ultimately, by examining these concepts and scopes, the contributions herein aspire to foster deeper **Understandings** of how adult education can effectively harness digitalisation to promote lifelong learning, equity, and inclusion in a deeply mediatised world (Hepp, 2021).

Secondly, the aim is to promote international exchange in the field of adult education research on digitalisation. While digitalisation constitutes a global phenomenon, the historically rooted national characteristics of adult education systems, along with

specific terminologies, have contributed to the confinement of scholarly discourse within particular language regions. This has also led to academic engagement with digitalisation-related issues in the German-speaking context becoming relatively isolated. Despite the challenges associated with such transfer processes, the intention is to familiarise the international research community in adult education with scholarly work conducted in German-speaking countries. In doing so, the objective is also to strengthen the connection to international research and foster mutual academic dialogue.

To gain a more nuanced understanding of the current situation, it is necessary to briefly outline the development and constitution of adult education research in Germany. Fundamentally, it must be noted that research in this area is situated within two sub-disciplines – and, accordingly, within two distinct research communities: on the one hand, media education as a cross-cutting field, and on the other, adult education. Both academic disciplines are well established in Germany and can draw upon a longstanding tradition.

As of 2005, the number of professorships in media education in Germany was reported to be 28 (Pietraß & Hanawald, 2008), while the field of adult education currently comprises 87 professorships (approximately 100 when including Austria and Switzerland) (Rohs, Ebner von Eschenbach & Lacher, i. Dr.). Within the respective sections of the German Educational Research Association (GERA), around 450 scholars are affiliated with media education and approximately 530 with adult education. Nevertheless, engagement with digitalisation remains a marginal concern within both research domains.

Media education in Germany has predominantly focused on children and young people, whereas adult education research has, until relatively recently, addressed issues of digitalisation only sporadically and this only by a limited number of scholars. It is worth noting, however, that the challenges posed by digitalisation for adult learning were already acknowledged at an early stage in both fields. Beyond the phase of programmed instruction in the 1970s, the proliferation of computers in both professional and private settings during the 1980s gave rise to an increasing number of publications addressing this area – particularly with regard to new competence requirements for adults. Moreover, the potential of digital technologies to support learning processes was (re)discovered.

In practice, however, many digitalisation initiatives in adult education failed to gain traction. This in turn contributed to the peripheral position of the topic within research for an extended period. While higher education research experienced a veritable e-learning boom from the early 2000s onwards, adult education did not see a comparable surge until the mid-2010s. However, since then, momentum has grown, driven in particular by the COVID-19 pandemic and the rapid development of artificial intelligence.

In line with the established research fields of adult education, the field of research on digitalisation in adult learning can be differentiated as follows:

1. **Teaching and Learning**
   This area examines, among other aspects, the use and impact of digital applications in adult education, as well as the didactic and ethical implications of digitalisation for teaching and learning processes.
2. **Learners: Addressees, Target Groups, and Participants**
   This strand investigates the demands placed on learners in navigating digital learning formats, patterns of use of digital learning tools, perceptions of educational offers related to digitalisation, informal learning with digital media, and the implications for educational equity.
3. **Institutions, Partnerships, and Support Structures**
   This dimension explores the impact of digitalisation on adult education institutions, the development of (new) forms of cooperation, and the consequences of digital transformation for organisational structures, business models, and service provision.
4. **Formats and Content Areas of Adult Education**
   This field analyses changes in the thematic focus of adult education offerings in relation to digitalisation, including emerging thematic priorities and shifts in content.
5. **Personnel in Adult and Continuing Education**
   Research in this area focuses on changes in competence requirements and digital skills, the evolving roles and self-conceptions of adult educators, as well as the training and professionalisation processes in the context of digital transformation.
6. **Systemic Developments in Adult Education**
   This area addresses questions relating to changing governance structures in adult education, the influence of private-sector actors, regulatory frameworks (e. g. data protection legislation), and the emergence of (both state-run and commercial) platforms for the distribution of educational provision.
7. **Historical Research in Adult Education**
   This field investigates developments in the aforementioned areas and examines the state of digitalisation-related issues at various points in recent history.
8. **Disciplinary and Methodological Research**
   This area focuses on the impact of digitalisation on the thematic scope and research questions within adult education research, on issues of methodology and methods in the field, as well as on the development and transformation of research infrastructures in adult education.

The contributions compiled in this second volume illustrate the breadth of research questions currently being addressed in the field. However, due to the nature of the publication and the extensive scope of the research landscape, they necessarily remain fragmentary. Nevertheless, they offer valuable insights into the ongoing discourse, as well as into the themes and questions currently shaping the research agenda. The authors represented in this volume mirror the diversity of scholars engaged in adult

education research on digitalisation. Notably, many of them are still in the process of academic qualification, which we regard as particularly encouraging. In the following, we provide a brief overview of the individual contributions:

The **first part** focuses on research in the area of teaching and learning. The micro-didactic level has traditionally been the subject of intensive scholarly investigation in adult education. The effects of digitalisation are particularly immediate in this domain, often creating an urgent need for action and decision-making. The use of digital tools in teaching has also given rise to a wide range of empirical contexts, offering rich opportunities for research.

The contribution of *Sabine Digel and Carmen Biel* discusses the potential of AI-based platforms regarding the professional competence development of teachers in adult and continuing education. In order to enable the teachers to learn in an individualised and adaptive way, the authors address the question of how an AI-based platform can be designed in a learner-oriented manner. They follow a design-based research approach in order to develop and evaluate the potentials of a learner centred AI-based platform for continuing education of teachers. Their analysis shows that the platform has the potential to enhance the professional competence of teachers, yet the integration of AI-components also brings barriers and raises questions on ethics, data protection, and learners' competence in dealing with AI.

Josephine Jahn, Philipp Oberparleiter and Bernhard Schmidt-Hertha address the gap between the significant potential of Virtual Reality (VR) in adult education and its often-weak pedagogical foundation. To bridge this divide, they analyse VR through established frameworks like constructivism and experiential learning. The authors argue that for VR to be more than a novelty, its implementation must be guided by robust instructional design. While acknowledging benefits, they also highlight remaining challenges like accessibility, ultimately calling for systematic research to ensure VR genuinely enhances learning.

In their article, *Ines Himmelsbach, Tjard de Vries, Michael Doh, Siglinde Bröder, Linda Grieser and Christina Klank* present a case study of the research project "Digital educational processes for older adults in senior-specific forms of housing" (DiBi-Wohn). The project DiBiWohn is characterised by the combination of empirical educational research, gerontology and media education in assisted living and long-term care institutions. Through the case study the authors show how data and theory triangulation can contribute to gaining additional knowledge of the use digital technologies by vulnerable age groups.

The **second part** brings together contributions situated at the meso- and macro-levels. These explore the impact of digitalisation on educational provision, institutions and their forms of cooperation, as well as on issues of policy and governance. In this context, infrastructures– particularly in the form of digital platforms – emerge as a central focus of research.

In her article *Kim Deutsch* explore the pivotal role of adult education in navigating the digital transformation of healthcare. She shows that as tools like telemedicine become common, citizens require new skills to avoid deepening health disparities. Her

analysis underscores the responsibility of educators to provide targeted training for these challenges. Using qualitative data from a telemonitoring project, it illustrates precisely where educational intervention is most needed.

The contribution of *Franziska Bellinger and Lisanne Heilmann* addresses the growing interrelation between media use and political socialisation in mediatised societies, with a focus on adults. It highlights the central role of social media – especially TikTok– in shaping political learning and opinion-formation, noting how platform dynamics and emotionalised narratives facilitate the spread of right-wing populism. The article advocates integrating media and political education, drawing on Negt's concept of democratic education, and outlines core competences for critical-reflexive political media literacy. Recommendations are offered to help adults counter populist messaging and support democratic engagement online.

The following article from *Lisa Breitschwerdt* explores how adult and continuing education (ACE) organisations design media-supported formats and address related needs. Based on a literature review and a case study from German-speaking contexts, it highlights the importance of coherent instructional planning, transparent communication, and support for learner self-regulation. Organisations face challenges such as limited resources and balancing local missions with wider market demands. The article underscores the need for advanced media-didactic skills and identifies areas for further research, particularly in programme development and participant behaviour.

In her contribution, *Nora Leben* explores how educational platforms navigate the tension between global technology trends and local regulatory frameworks. Focusing on the German public education sector, her work explains the specific adaptations platform operators must make. The findings show that these platforms develop unique incentive structures to create network effects. This process ultimately transforms them from potential marketplaces into digital public infrastructures designed to guarantee access.

Jula Koller and Ulrike Krein examines the governance and policy dimensions of digitalisation in adult and continuing education (ACE). Situated in a structurally diverse system, ACE faces strategic and practical challenges brought on by digital transformation. The study highlights the growing need for coordination among key actors – shaped by legal, political, and discursive roles – and notes a lack of comprehensive research in this area. Based on a systematic international literature review, the article offers an overview of current research on policy and governance with a focus on the actors shaping digital change in continuing education.

The **third part** engages at a meta-level with theoretical conceptual clarifications and the impact of digitalisation on adult education research. These fundamental questions, raised by the digital transformation, underscore the significance of digitalisation for the field of adult education.

The first article of this part by *Henrik Weitzel and Joshua Wilhelm* examines the impact of generative AI (GenAI) on adult education, focusing on emerging competence needs and the risk of deepening digital inequalities. It highlights how AI influences teaching practices, institutional structures, and access to learning, while stressing

the importance of critical, ethical, and inclusive AI literacy. The article also identifies barriers to GenAI access at macro, meso, and micro levels and argues for targeted educational strategies and policies – such as the European AI Act – to ensure equitable participation in a digitally transformed society.

The next article, written by *Falk Scheidig*, explores how digitalisation is reshaping research in adult education. It highlights three key developments: the emergence of new research questions, the availability of novel digital data sources, and the rise of innovative methodological approaches. Drawing on current studies, the contribution discusses how these changes are transforming the ways in which adult education is investigated and understood.

Katrin Buntins, Anna Heinemann and Insa Reichow address the research-practice gap as a central challenge for educational research in their contribution. Focusing on digital adult education, they argue that it is crucial to transfer insights from practice and research in order to gain knowledge for the development of new (learning) technologies. Based on an interview study, they outline difficulties in communication between researchers and practitioners, that are rooted in the different roles of the actors and the expectations they have of each other. They underscore the necessity for further research on collaborative approaches between research, practice and technological development.

The contribution of *Gregor Dutz, Kristin Skowranek and Anke Grotlüschen* addresses the growing need to understand how adults engage with generative AI by proposing a specific research framework. They detail a privacy-friendly method using screen capture and automated transcription to analyse user interactions with tools like ChatGPT. This approach is designed to reveal the concrete challenges users face, laying the groundwork for developing effective educational support in the age of AI.

We hope you find these contributions insightful and that they will offer a deeper understanding of digitalisation research in the field of adult education in Germany.

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**Part One
Teaching and Learning**

Empowering Learners to Deal with Artificial Intelligence

Requirements and Findings on the Development of AI-Based Continuing Education Platforms

Sabine Digel and Carmen Biel

Abstract

As society changes, the importance of lifelong learning is constantly increasing. This is also bringing the professional development of teachers in adult and continuing education into focus, who often undergo self-directed further training and access online-based formats. The article provides insight into the potential of AI-based continuing education platforms to support individualised and adaptive learning and emphasises that the development of such platforms must be in line with didactic concepts.

Based on constructivist approaches, a learner-focused, AI-based adult and continuing education platform to enable self-directed learning is developed and evaluated in the course of a design-based research approach. Overall, it has been shown that the AI-based platform has the potential to support the professional competence development of teachers by enabling individualised learning paths and promoting self-determination. At the same time, it is crucial to make the use of AI technologies transparent in order to promote their acceptance and reflective use.

Keywords: Artificial intelligence, individualised and adaptive learning, AI transparency, professional competence development of teachers, adult and continuing education platform

Zusammenfassung

Im Zuge gesellschaftlicher Veränderungen nimmt die Bedeutung des lebenslangen Lernens stetig zu. Dies rückt auch die Professionalitätsentwicklung von Lehrenden in der Erwachsenen- und Weiterbildung in den Fokus, welche sich häufig selbstgesteuert weiterbilden und dabei unter anderem auf online-basierte Formate zugreifen.

Der Beitrag gibt Einblick in das Potential KI-basierter Weiterbildungsplattformen zur Unterstützung individualisierten und adaptiven Lernens und betont, dass die Entwicklung solcher Plattformen im Einklang mit didaktischen Konzepten erfolgen muss.

Auf Basis konstruktivistischer Ansätze wird eine lernerzentrierte, KI-basierte Weiterbildungsplattform zur Ermöglichung selbstgesteuerten Lernens entwickelt und im Zuge eines Design-based Research Ansatzes begleitend beforscht. Insgesamt zeigt sich, dass die KI-basierte Plattform das Potenzial hat, die professionelle Kompetenz-

entwicklung von Lehrenden zu unterstützen, indem sie individualisierte Lernwege ermöglich und die Selbstbestimmung fördert. Gleichzeitig ist es entscheidend, den Einsatz der KI-Technologien transparent zu gestalten, um deren Akzeptanz und reflektierte Nutzung zu befördern.

Schlüsselwörter: Künstliche Intelligenz, Individualisiertes und Adaptives Lernen, KI-Transparenz, Professionelle Kompetenzentwicklung Lehrender, Weiterbildungsplattform

1   The Potential of AI in ACE Platforms[1]

Due to constant change in societal demands like digital transformation, shortage of skilled workers and the so-called megatrends, lifelong learning as well as adult and continuing education (ACE) in general are becoming guiding principles of German education policy with its proclaimed goal of becoming a republic of further education (BMAS/BMBF, 2025). Within this context, the role of teachers in ACE also becomes more important and they must continually adapt their learning offers to the current issues and relevant settings of lifelong learning. This usually implies for them the need to engage in professional development to meet the demands and to become and remain adult learners themselves.

Likewise, the form of occupation of ACE teachers is very heterogenous in the different contexts of ACE (public, denominational, corporate, market) and especially in the public context there are a lot of precarious occupations. Therefore, personal professional development competes with the occupation, which leads many ACE teachers to a more autodidactic approach in their professional development. Autodidactic formats include guiding literature, methodological literature, but also online-based formats that are offered in learning platforms (Schrader et al., 2019, pp. 796–798). The latter could offer opportunities for highly individualised and flexible learning paths as well as adaptive use for ACE teachers (Rohs, 2019, p. 134), which could be further facilitated by using artificial intelligence (AI) within these platforms.

The distribution of AI in ACE platforms varies greatly depending on the context we focus on. Rather big market players like Coursera, LinkedIn Learning and the like are frequently using AI for several different things, e.g., recommendation purposes, dropout estimates or automated testing. In-company/vocational training or private ACE institutions are also much more likely to use AI in their learning management systems and adaptive training platforms. Publicly funded ACE on the other hand still lags a bit behind. There are political funding initiatives and a willingness to experiment but all too often the lack of resources (regarding funding, personnel, and infrastructure) leads to a more selective application of AI in platforms and the use of learning

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1   When using the term platform in this article, the authors refer to learning managements systems or similar technical infrastructures that are hosted on the internet, that offer learning material in any media form.

platforms in general. However, particularly this public sector could benefit from the use of AI due to its heterogeneous nature.

Individualisation usually takes place through a variety of learning offers and content recommendation, which helps the learner to decide which content might be suitable next. This element of decision making and the option to choose if a recommendation is accepted or not is an important component of individualisation. Ideally, the recommendation already takes learners' prerequisites into account (Digel et al., 2023). Traditionally, a human teacher is responsible for the individual content recommendation. Due to the advances of ICT enabled learning, individualisation is becoming more and more dynamic and digitally supported. AI assists this further by enabling the analysis of learner data in real time. In general, more data analysis leads to shorter recommendation cycles and more potential decision points in the learning process. This forms the basis for an adaptive learning.

Adaptive learning is a concept with a long tradition (Bartolomé et al., 2018) and furthermore emerges in research and practice in line with digital transformation. It aims to provide each learner with even more specifically tailored learning experiences to suit their personal needs. Adaptive systems take learners' behaviour or preferences into account when providing recommendations. However, all too often the competence level of a learner and their understanding of the presented content as well as their familiarity with the learning environment itself is not considered in the adaptation process (Chen, 2008, p. 788).

To summarise, AI can help make learning processes in educational platforms more individualised and adaptive, which is especially fruitful for learners as ACE teachers with different needs and learning capacities. Furthermore, it makes learning more motivating and effective in reaching learning goals (Holmes et al., 2019). AI supported platforms can help make ACE more accessible and flexible overall, which is particularly beneficial for professional development and lifelong learning.

However, the added value of AI to enable individualised and adaptive learning depends on the chosen approach, which should be fundamentally considered regarding the target group and the intended use (Kerres & Buntins, 2020). This is where didactical concepts are needed, which can bring about suitable regulations and promote a responsible use among learners.

The contribution examines the overarching question of how an AI-based ACE platform can be designed in a learner-focused way in order to achieve the highest possible acceptance among ACE teachers as learners and to empower them in organising their learning in a self-directed and self-reflected way. In the following, existing approaches and open questions regarding the design of learner-focused AI-based cross-provider ACE platforms are considered. Building on this, didactic principles are explored and questions accompanying the development of a sustainable design are derived. In order to answer these questions, studies that were used for formative evaluation are presented. Finally, the results are discussed in relation to the initial ideas and framework.

2   Empowering Learners – Existing Approaches and Open Questions

The literature shows mixed results regarding the effectiveness of AI-based forms of learning compared to traditional methods. Success depends heavily on didactic design, learner motivation and support systems (Kirkwood & Price, 2014). There is a need for strategic and systematic development of AI-based ACE platforms that takes both technological and didactic aspects into account. This includes appropriate empowerment and competence development for ACE teachers as learners so that they can use the services in a reflective manner.

According to Herringer (2024), empowerment can be understood from a psychosocial perspective as self-enabling and increasing of autonomy and self-power. Concepts of learner empowerment aim to encourage learners to discover their own strengths and provide them with assistance in acquiring self-determination and learning autonomy. The design of AI-based ACE platforms is therefore about encouraging active participation. When dealing with AI in ACE platforms, learners are not only users, but also designers and critics. Their role is crucial if the technology is to be used in a sensible and ethical way. In the sense of a partnership between human and AI, the ACE teachers as adult learners should be the starting point for the description of requirements and implementation of AI components, and questions of transparency and data ethics, self-control and usability should be focused on (Borgwardt, 2020).

In the current discourse, AI is seen as having potential and – based on the opportunities and risks – challenges for a learner-focused design of AI-based ACE platforms are formulated. In the following, the central arguments are listed and starting points for a suitable conceptual framework are derived.

ACE teachers are highly individual in their learning prerequisites. Because there are no formal requirements to meet when teaching in ACE in Germany (Schrader et al., 2019), there is great heterogeneity of educational backgrounds and professional experience among ACE teachers and it is hardly possible to meet the different needs with standardised offers. Addressing ACE teachers as learners, differentiated learning opportunities in terms of content and levels, which can be accessed via different learning paths appear to have great potential.

If – which is rare – recommendations are used in ACE platforms, individual recommendation types are usually used on the basis of content-related criteria or the usage behaviour of the mass of learners. Individual learner profiles and learning behaviour have hardly been considered to date (Biel et al., 2019). ACE teachers as learners bring a wealth of knowledge and experience, which should be acknowledged and incorporated into the learning process. Learning should be connected to real-life situations and personal goals, making it meaningful and motivating. Data-based AI decisions can reveal patterns in users' learning behaviour and derive precise adaptive recommendations. By analysing learner data the learning process can be individually adapted to the needs and learning level of the learner. This means that learners receive exactly the

content to suit their competence level, which can make learning progress more efficient and increase motivation to learn (Baker, 2025; Siemens, 2013).

A further point is that the algorithms and data evaluations can also contribute to a restriction of the diversity and individuality of the learning offer. The standardisation mechanisms used in AI cannot always reflect the entire complexity of learning prerequisites or preferences of ACE teachers and compare their analyses with existing learning offers selected by comparable users. This approach in turn leads to a uniformisation of the proposed educational offer. Even if rule-based AI is particularly important when new educational offerings are set up and little user or learning data is available and educational goals such as expanding or deepening skills are linked to the learning offerings (Knijnenburg et al., 2022), users should be able to view and understand the stored rules and mechanisms from an ethical point of view in order to be able to give their informed consent to the application. This transparency is an essential requirement for the confident use of AI components. It can also promote the acceptance of the AI components – which is particularly important for an offer for ACE teachers, as many of them have limited experience with online learning or learning management systems (Autorengruppe Bildungsberichterstattung, 2020).

Furthermore, a lack of transparency and "blind" trust in the AI components harbour the risk of learners abandoning decisions and becoming dependent on the technology. If AI systems intervene heavily in the learning process, learners could become disempowered and lose their ability to make decisions independently. They could rely too much on the AI and thus limit their independence in learning. As a result, AI can have an impact on learners' ability to reflect. AI can lead to learners reflecting less on their own because the AI already provides ready-made answers or recommendations. This could impair the development of teachers' own judgement and critical thinking competences (Selwyn, 2019).

To avoid the loss of self-determination and autonomy, as well as foster the learning motivation of the users, the role of the learner in ACE platforms needs to be specifically addressed and explainable AI needs to be used to make the underlying models and mechanisms of AI understandable (Gunning, 2017). Explanations – in the form of supplementary information about the implemented AI components and their work, as well as the presentation of decision-making paths – can be used to inform learner and promote trust in the AI (Holmes et al., 2021). So explainable AI can assist learners' agency and responsibility for their own learning. Implementing interactive interfaces with options and explanations about the consequences associated with them, can foster the metacognitive reflection of learning decisions and learning processes (Bull, 2020).

To be able to use AI support in a self-directed manner, learners should have a sound AI literacy: 1. Learners should understand the basic concepts and technologies behind AI in order to be able to assess its strengths and limitations. This promotes critical awareness and responsible use, which is also essential in terms of legal and ethical implications (Siemens, 2013). 2. Learners should know how AI technologies are used in education platforms and be able to use them in an active and creative way to promote (their) individualised and adaptive learning by making self-determined

learning decisions and taking targeted learning paths (Holmes et al., 2019). 3. Finally, learners need a pronounced ability to reflect in order to assess the appropriateness of standardised learning suggestions and to assess the automated feedback as well as to constantly monitor themselves in their learning decisions, learning processes and learning outcomes (Selwyn, 2019).

Regarding the design of AI-based ACE platforms, it seems important to preserve the human factor, promote self-determination and actively involve learners in the learning process in order to ensure a balance between technological support and personal autonomy. The AI within ACE platforms should not be used to relieve learners of decisions and thus human intelligence. Rather, learners should be supported in the sense of a "human-AI partnership" to make the best learning decisions for their needs and competence development (Borgwardt, 2020, p. 381).

It requires a pedagogical approach that provides an appropriate framework for the use of AI in ACE platforms including the clarification of the role and the necessary competences of the learners. Referring to the discourse outlined above, the following relevant design parameters for AI-based ACE platforms can be identified:

1. Conscious design of the learning environment: infrastructures with differentiated learning content and paths that take individual resources and needs into account.
2. Ensuring data protection and transparency: informing learners about the use of their data, over which they themselves can retain control.
3. Promoting self-determination and autonomy: empowering learners to make their own decisions and shape the learning process in a self-directed manner.
4. Further development of AI literacy: using AI to build competences such as critical thinking and to promote reflection to accompany learning.

The design parameters show the way for the development of the learner-focused AI-based cross-provider ACE platform to enable individualised and adaptive competence development of ACE teachers, that is pursued in interdisciplinary project teams with the participation of the two authors of the contribution.

3   Conceptual Framework to Design a Learner-Focused AI-Based Cross-Provider ACE Platform

Regarding the landscape of ACE in Germany, one can find a large number of – partly topic-specific, partly provider-specific – platforms to promote the competence development of ACE teachers. But there is a lack of cross-topic and cross-provider solutions that help to integrate offerings from existing platforms and enable individualised and adaptive learning. Furthermore, the courses available for competence development for teachers are often based on step-by-step models of expertise development. They therefore have a linear structure and do not take sufficient account of the heterogeneous background and different competence profiles of ACE teachers. With regard to the po-

litical strategies to strengthen the accessibility and interoperability of the national education infrastructure in Germany as well as to promote acceptance and sustainability among train-the-trainer providers in the field of ACE, it is advisable to take the existing ACE platforms into account and enrich them with AI components to promote individualised and adaptive learning.

As a conceptual basis, constructivist teaching-learning approaches can provide reference points to describe the role of the learner in more detail and to didacticise the learning process between instruction and construction. In constructivism, learners are responsible for their own learning and organise it in a self-directed and exploratory manner. The learner is not a passive recipient of knowledge, but constructs his understanding through his own experiences, reflections and interactions with his environment. In the constructivist view, the learner is assigned the following role: The learner is active (the learner discovers, explores and interprets learning content independently), self-directed (the learner shapes his learning process on his own responsibility) and critical (the learner questions and reflects on his experiences) (Fosnot & Perry, 1996). Individual prior knowledge plays a central role here, as new knowledge builds on existing knowledge. ACE teachers already have a wide range of experiences that they bring to the learning process and through which they construct new knowledge. They actively reflect on their learning processes in order to create meaning and integrate knowledge into their professional and personal context (Siebert, 2012).

Didactic approaches to promote self-directed learning can be used as a theoretical basis for the design of AI-based education platforms that aim to enable autonomous learning processes and emphasise the relevance of goal setting and self-reflection by learners (Knowles, 1975). Self-directed learning is understood as an active process in which learners are at the centre and take responsibility for goals, content, methods and the learning process. In order not to overwhelm learners with self-direction and to support them in the learning process aligned with their needs, instructional guidance as well as feedback on learning outcomes which is recommended as an orientation aid and to maintain learning motivation can be used (Arnold et al., 2018, pp. 126–127; Kerres, 2018, pp. 145–146).

If learners are to be empowered to deal autonomously with the AI components in an ACE platform, it is not only necessary to make the implemented mechanisms and their significance for learning transparent, but also to promote the ability of learners to use their own resources to set learning goals and to shape their learning process (related to working environments see Spreitzer, 2007, pp. 7–8).

The authors are engaged in the development of a learner-focused AI-based cross-provider ACE platform to support the professional development of ACE teachers, in which the outlined conceptual foundations are taken up and are transferred into a technical infrastructure for individualised and adaptive learning. The learning offer consists of modularised learning units across different training providers, which can be combined into learning paths. The focus of the didactic approach is on the AI-based empowerment of ACE teachers as learners, who should be able to make independent learning decisions and engage in self-directed learning.

In the following, three main components will be presented. The first component is a multi-agent system (MAS) that provides recommendations for further learning. The second one is a digital competence map which acts as visual representation of achieved competences. The third one is the use of explainable AI to promote transparency and informed decisions of learners.

3.1 Multi-Agent System

MAS are a research area of distributed AI. A MAS has several different agent types that each serve a different purpose. This specific MAS can be connected to platforms that offer learning units for professional development of ACE teachers and has two agent types that are of particular interest within the context of this contribution: the pedagogical agent and the learner agent.

The pedagogical agent gathers information about the learning units lying in the connected platforms through metadata[2] attributed to these units. The metadata provided comprises, for example, information about the used media type, difficulty level or to which competence and its development the learning unit is seen to contribute to. Apart from this metadata information, the pedagogical agent has access to a curriculum (as didactical framework) as well as a competence model (GRETA) that addresses pedagogical competences (e. g., group communication, diagnostics, learner counselling, teaching methods, learning with digital media, etc.) (Alberti et al., 2022).

The learner agent is created for each individual registered learner, stores information on the learner and builds an individual learner model for them. This happens through profile entries (e. g., occupation, interests, work experience, learning prerequisites, etc.), interaction data within learning units and sequences as well as testing data from assessments (Krause et al., 2022).

The pedagogical agent communicates with the learner agent and aligns data from both (learner profile, learning progress, interaction data, competence alignment, curriculum location) and forms recommendations as well as provides sequences of learning units to meet learners' needs. The human learner is then directed and redirected to the different learning units across platform borders. In case there is not enough learner data (yet), the pedagogical agent is provided with initial rules (as a knowledge-based approach) for recombination and recommendation purposes to bypass the cold start problem.

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2   Metadata is a data structure that offers information about other data and that is needed e. g., for recommendation processes.
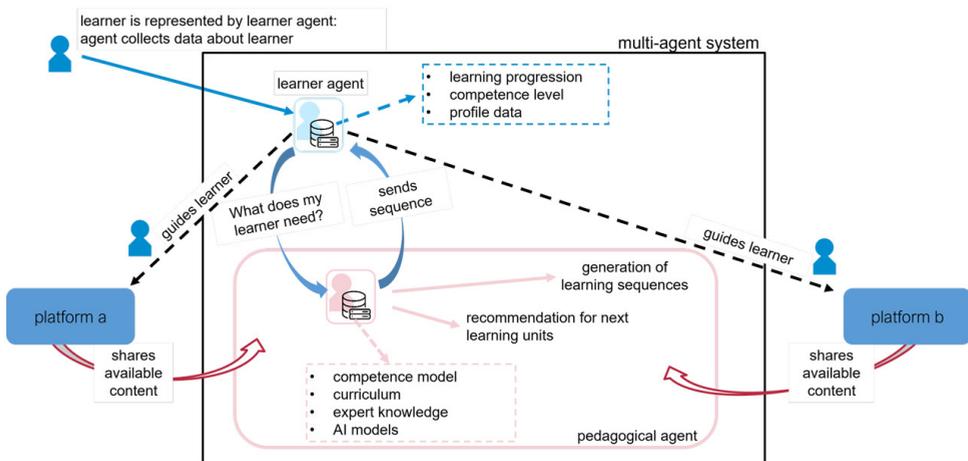
Figure 1: Simplified schematic representation of the multi-agent system and the affiliated platforms (own illustration)

3.2   Digital Competence Map

The second development provides a visual representation of a learners' competence development that aims at helping the learner reflect on already achieved competences and identifying competence gaps.

The digital competence map is filled by successive approaches: (1) Filling a self-reporting tool that helps to draw (initial) conclusions about a learners' level of pedagogical competence, (2) completing (recommended) learning units in affiliated platforms and (3) completing assessments. All three approaches are based on the GRETA competence model (Christian et al., 2024).

During the self-reporting phase, the learner is given a couple of statements to each GRETA competence on which they must rate themselves on a 4-point scale that is roughly based on the learning objective taxonomy by Anderson and Krathwohl (2001). After the self-reporting, they are presented with a first visualisation of their digital competence map which can already be downloaded. This is on the one hand used for reflection purposes by the learner but also as a starting point for the recommendation process which takes place across the connected platforms that also reference the GRETA model. The goal is to help achieve higher levels of competence in areas that need improvement. Furthermore, if learners do not just want to self-report on their competence but gain micro-credentials for their competence level, they can either do this by completing learning units to log their development or by completing assessments to validate their competence level (Christian et al., 2024).

Figure 2: Exemplary Digital Competence Map after self-report (Author's own illustration)
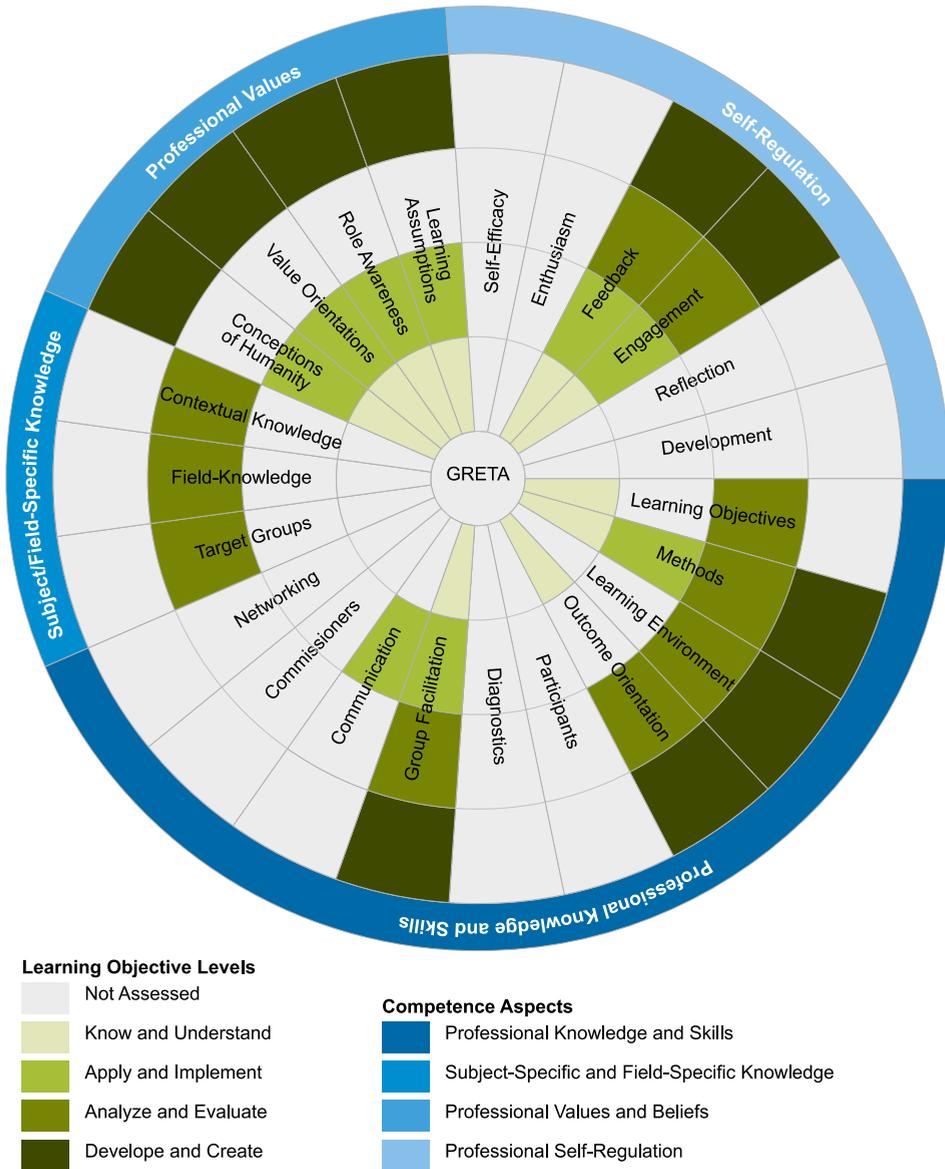
3.3   Explainable AI and Informed Consent of the Learner

For the integration of the AI components into the cross-provider ACE platform, it was necessary to find a middle way between "disempowerment" and "autonomy" of the learners in accordance with the requirements and needs of the target group, which corresponds to moderate constructivism and the concept of self-directed learning. Trans-

parency in the process is crucial for the acceptance, as the ACE teachers need to understand the reasoning behind the AI-based rules and mechanisms.

Across the board, learners can give their informed consent to the general use of their own profile data, learning data and learning results as well as the data of other learners for the recommendations they receive. By enabling or disabling checkboxes, learners will have the flexibility to adjust their preferences at any time (Digel et al., 2023). To give the learners an overview of how (de-)activating the checkboxes affects the receipt of either only content-based or individualised and adaptive learning recommendations, the underlying mechanisms will be explained in the form of a visualised learning journey.

Starting point to individualise the learning offers is a profile page for the voluntary disclosure of socio-demographic characteristics and learning preferences which can be (de-)activated for use as a basis for the recommendations that learners receive.

Furthermore, on the learning status page with the competence map-based recommendations, it can be (de-)activated whether the learning results should be used for recommendations at all and, if so, for suggestions for a) deepening competences at higher levels or b) expanding competences to other competence facets and areas.

By offering supplementary explanations that clarify the rationale for the use of profile data and learning results for individualised suggestions as well as presenting multiple possible pathways for further learning and explaining their goals, the learners are empowered to take responsibility for their own decisions. In this regard, AI is seen not just as a tool for delivering information but as an expert that aids self-directed learning.

Successfully dealing with the heterogeneity of ACE teachers in a learner-focused design of an ACE platform requires flexible and adaptable didactics that are tailored to the individual characteristics of the learners. The concept of so-called 'opportunity-use models of the effects of teaching' is used as a basic heuristic for analysing how AI components and their integration into the ACE platform should be designed in order to achieve the most positive effects for learners (for basic information, see de Haan, 2020). These serve to understand the relationship between educational offerings, their use by learners and the resulting effects. The learning prerequisites and the learning activities of the users are central influencing factors for the reaction to the offer and the interaction with the offer. The reaction and the interaction in turn determine the effect. The opportunity-use models of the effects of teaching are not only used in educational research (Helmke, 2012) but also serve as design and evaluation models for the development of recommendation systems and AI-based educational platforms (Knijnenburg et al., 2012). Based on the data, the pedagogical agent gathers (learner profile, interaction data, learning results) questions concerning the interaction of the learning content and learning environment with data belonging to the learners and their learning can be addressed.

With recourse to the conceptual foundations, the following questions are addressed during the design and answered in the course of the evaluation accompanying

the development of the AI components and their integration into the platform infrastructure:

- What requirements should the AI-based individualised and adaptive ACE platform meet in order to be attractive to teachers as a continuing education offering as well as effective for learning?
- How is the transparency and explanation of the AI used in the ACE platform perceived from the learners' perspective?
- To what extent are learners enabled to engage in self-directed learning that includes making independent learning decisions and shaping the learning process in a self-directed manner?
- To what extent does the design of the AI-based ACE platform promote the development of competences such as critical thinking and self-reflection to accompany learning?

The answers to the questions are intended to help to design the AI components and platform infrastructure in a way that is both needs-based and conducive to competence development.

4 Methodical Approach

In view of the heterogeneous provider landscape and the different prerequisites and interests of the target group, a design-based research approach is chosen for the development of the AI components and their integration into the cross-provider ACE platform, in which members of the target group are involved in the development and an evaluation of the resulting concepts and prototype implementations takes place in order to develop a solution that is as learner-focused as possible.

By linking science and practice, the transfer of results from research and development projects into practice is to be promoted. To this end, a design process is defined in which relevant problems from educational practice and their contexts are first analysed. Based on this, a decision is made as to what form the development result should take (Edelson, 2002). In order to continuously scrutinise the progress and direction, the development is iterative and accompanied by formative evaluation. Analysis and revision alternate. The viability of prototype solutions is evaluated step by step and the knowledge gained is incorporated into the subsequent product design cycles in order to be able to develop needs-based and sustainable educational platforms (Bereiter, 2002, pp. 3–4).

The evaluations accompanying the development of the learner-focused AI-based ACE platform addressed in this contribution should serve to ensure the quality of the design. Based on a needs analysis as well as studies on usability, acceptance and learning success, the potential of AI to support users' learning decisions and learning trajectories is examined. The results of the investigations are used to develop a prototype ready for operation. In the following, the needs analysis and the studies are presented

in an overview and their key findings are reported. The detailed results of each investigation will be published separately. The key findings form the basis for the concluding discussion of the design's potential for self-directed learning of ACE teachers within the platform.

4.1 Needs Analysis

The development of a prototype for the ACE platform began with an analysis of the needs, interests, and wishes of ACE teachers. This analysis utilised a triangulation of qualitative and quantitative data to capture a range of perspectives and identify specific design elements (Flick, 2017, p. 5). An online survey aimed at understanding needs and requirements was conducted, complemented by a qualitative focus group that facilitated discussion and reflection on design features.

In spring of 2023, 118 ACE teachers participated in the survey, with approximately 30 % having up to 15 years of working experience and 70 % having more than 15 years. 25 % of the participants were associated with community providers (e. g., churches), another 25 % with state providers (e. g., adult education centres), and a further 25 % with corporate settings. The remaining 25 % were self-employed. The survey included Likert-scale questions addressing general requirements, features for selecting and recommending offerings, and options for assessing and certifying competences. Data from closed questions were analysed using descriptive statistics, while open-ended responses were summarised and quantified.

A three-hour focus group session with 22 participants took place in March 2023. Most of them provided courses for state (approximately 65 %) or community providers (around 20 %). The focus group emphasised dialogical exchange and group discussions to generate insights that would be less accessible without interaction. Participants engaged in two rounds of brainstorming in small groups, identifying key points in the larger group regarding essential considerations for designing learning offerings on a cross-provider platform, with a focus on motivational, emotional, and cognitive aspects. The data were documented using a Miro board and audio recordings, and coded through content analysis.

The findings from the survey and focus group provide information on the first question what requirements should AI-based individualised and adaptive continuing education platforms meet to be attractive to ACE teachers as a continuing education offering as well as effective for learning.

For the respondents, the ACE platform would be particularly attractive if it enabled them to develop their own skills in a targeted manner (M = 3.88; SD = .67; scale 1 = does not apply at all to 4 = applies completely). For this, the respondents need learning opportunities of different sizes (M = 3.56; SD = .61) and formats (M = 3.50; SD = .75). It should be possible to complete them at different levels of difficulty (M = 3.25; SD = .79). In order to be able to individualize the learning opportunities, the respondents would like comprehensive selection options (M = 3.81; SD = .76) as well as filter options (M = 3.33; SD = .68). When asked which tools could be used to help them find learning recommendations suitable for their purposes, opinions differed – as the high standard

deviation shows regarding the estimations for a) questions for self-reflection (M = 2.81; SD = 1.02), b) self-testing of competencies (M = 2.50; SD = 1.09) or c) simulations based on exemplary cases (M = 2.40; SD = 1.20). On the other hand, there is no dispute that there should be tools for assessing learning prerequisites and learning levels in order to obtain adaptive learning recommendations (M = 3.89; SD = .58). All respondents are of the opinion that such forms of assessment enable them to focus their learning more specifically (M = 3.91; SD = .80) and make it more effective (M = 3.67; SD = .95). A high added value is attributed to visualised representations of competence maps (M = 3.82; SD = .77). The respondents are of the opinion that these can contribute to the transparency of the learning concept on which the platform is based (M = 3.79; SD = .85) and support users' learning decisions (M = 3.67; SD = .89). Respondents tended to find an interactive design of the competence maps (competence fields as clickable filters) helpful in order to be shown variants of learning offers (M = 3.71; SD = .91).

Two subjective statements from participants in the focus group vividly reflect the overall mood (translated by the authors):

> "In order to gain further competences in a targeted manner, the platform should have a plausible and transparent framework and classification, that can be understood quickly and that enables needs-based access for ACE teachers according to their teaching fields and contents."

> "I need to be able to assess at a glance what the platform has to offer me and how I can put together my own learning content and paths. That's what the tools should do, no more and no less. If AI is used, I want to be told how it works, why and what added value it brings to my learning."

The results indicate that ACE teachers have a strong interest in AI-based components that are helpful for a competences development in a way that meets their specific needs. For the design of the first prototype of the ACE platform, two key principles had been established: 1) standardisation of the offerings and 2) flexibility in the learning experience. The standardisation of the learning offers serves as a foundation for an engaging presentation and targeted professional development. To align with the respondents' desire for structure and focused selection, it is essential to implement clear and consistent categorisation systems in the design of AI-based ACE platforms. This will ensure that the differentiated individual learning options are presented in an organised manner and contribute to a shared objective (Ehlers, 2009, pp. 11–14). The design features of autonomy and opportunities for exploration address the underlying didactical concept of the infrastructure, thereby linking back to the theoretical assumptions introduced earlier. Specifically, the self-directed learning approach is well-suited to provide users with the freedom they need while also facilitating precise selections through explanations, entry aids, and assessments, as well as promoting goal-oriented learning paths. This approach should ensure that the varying prior experiences and support needs of users are equally addressed, enabling adaptive learning for all.

4.2   Studies on Usability, Acceptance and Learning Success

Studies on usability, acceptance and learning success were carried out in autumn 2023 and summer 2024 to accompany the development of the ACE platform.

The first study addressed the second question on the subjective evaluation of the transparency and explanation of the AI used in the ACE platform. It was realised as a think aloud study that focused on the specific use of the platform prototype. The sample comprised 75 ACE teachers comparable to the sample of the needs analysis. They were given tasks to find learning recommendations on the ACE platform and were asked to reflect aloud on how they coped with using the platform. Once they had completed the tasks, they filled out an open-ended reflection questionnaire on their overall view of the AI-based platform use. This consisted mainly of open questions and provided space to reflect on the usability of the platform as well as the benefits of interacting with the AI components. The following results were obtained via think-aloud protocols and the coded and quantified results of the content analysis of the written reflection.

The introductory explanations of how and why AI is used in the infrastructure were rated as absolutely relevant for understanding and confidence-building. Around 30 % of the study participants found it superfluous to be given a choice of learning recommendations and provided with explanations of the associated learning objectives because they blindly trust the system, but the other two thirds welcomed these reflection impulses as helpful in order to be able to consciously choose interesting learning offers and paths. The integrated feedback on task results was unanimously perceived as appreciative and motivating. It was noted that this could be more individualised and more detailed in relation to the specific learning status in order to increase the personal learning yield. Own data sovereignty was seen as crucial for the acceptance of AI support: the study participants want to decide for themselves what information about their person and their own learning is processed and what consequences this should have for recommendations. Moreover, all participants report that the information given to explain the use of AI within the platform gave them the impetus to think about the added value of AI and to make conscious decisions when using it.

The second study focused on questions three and four relating to self-directed learning and development of critical thinking and self-reflection as dimensions of AI literacy. Once again, 60 participants were recruited, reflecting the heterogeneity of ACE teachers in Germany in terms of educational backgrounds and professional socialisation. Following a two-month trial period during which the learners used the ACE platform to develop their competences, they were asked about their learning outcomes using an open-ended reflection questionnaire and assessing the increase of their ability to use the AI components in a self-reflective manner during the trial-period via a second questionnaire with closed Likert-scaled questions. A qualitative content analysis was used to gain the results of the written reflections. The closed questions were analysed using descriptive statistics.

The results testify to the general added value of the concept of self-directed learning implemented in the platform infrastructure. At the same time, it is clear that

around a quarter of the study participants asked would need more dialogical support in order to be able to select learning opportunities in a targeted manner and to receive reassurance regarding the "right" decision in the course of the learning path taken. Half of the participants are clearly in favour of the fact that the designed form of AI-based decision-making authority is exactly the right balance between external control and autonomy for them. A further quarter would like even more autonomy or would like to make their own learning decisions entirely without AI.

According to the results of the rating of the increase of critical thinking and self-reflection skills by using the AI-based infrastructure, that quarter of participants highly interested in their autonomy combines ACE teachers with low and high self-attribution of AI literacy. This once again illustrates the importance of the acceptance of AI for productive use in ACE platforms. Overall, all study participants stated that their understanding and ability to deal with the AI components increased as a result of using the infrastructure. They also stated that the decision-support function had prompted them to reflect on their own learning and that they had learned to question their own learning more critically.

For the further development of the prototype, the findings point to the chosen didactical constructivist and self-directed approach as a viable theoretical basis for the ACE teachers as learner (Siebert, 2012) and the relevance of learner empowerment to promote self-reflected dealing with the AI-based platform (Spreitzer, 2007). AI can support learning on platforms by providing recommendations and automatic feedback. To enable learners to use AI independently, it's important to make its mechanisms transparent and help learners set goals, make decisions, and actively shape their learning process according to their needs. At the same time, the findings illustrate that the diversity of ACE teachers as learners (Schrader et al., 2019) can only be met with a variety of design options in order to not only provide a range of approaches for individualised learning and offer flexible options for the use within one's own learning (Digel et al., 2023), but also react adaptively to the learning processes and competence growth of the heterogenous levels of AI literacy of ACE teachers (Chen, 2008, p. 788).

In accordance with the underlying approach of design-based research as well as to ensure the quality of the product, the lines of further development described here must be reflected in the further implementation process of the designed ACE platform through renewed validation with the target group in order to promote a suitable form for competence development of ACE teachers and its dissemination in continuing education practice.

5   Discussion

The results obtained from the basic survey of needs and the studies accompanying development illustrate the interest of ACE teachers in AI-based platforms to develop their competences in line with their needs. The standardisation of the connected learning offer is the linchpin for a convincing presentation and targeted further training. Clear

and consistent category systems are necessary in order to meet the desire for structuring and targeted selection and to ensure that the individual learning opportunities, which should be as differentiated as possible, are based on a common reference model.

The added value of such a learning infrastructure lies in the individualised learning experience, which users can decide for themselves and which thrives on a diverse offering in which everyone can find what they are looking for (Rohs, 2019, p. 134). Autonomy and exploration as design options address the question of the didactic concept on which the ACE platform is based. Regarding adult learning, constructivist approaches have been proven to be promising. Constructivism places the learner in the centre and organises learning processes in a self-directed manner (Kerres, 2018, p. 164). This approach integrates individualisation and adaptivity, which suits the heterogeneity of German ACE teachers very well. Individualisation of learning processes through adaptivity often comes with the promise of more fairness and equality (Horvath et al., 2023, p. 34). One of the biggest advantages posed when dealing with adaptive learning is that learners seem to be always confronted with contents and tasks that are in line with their current learning progression and their competence level. This is said to raise the motivation of the learner as there is never a cognitive overload for them and they can fully concentrate on the tasks given by the algorithm (Akhtar et al., 2023, p. 1380).

On the one hand, AI technology thus contributes to the accessibility, individualisation and adaptivity of ACE platforms and promotes the development of ACE teachers' professional competences. On the other hand, however, the technology also brings with its barriers and the use of AI raises questions about ethics and data protection as well as the maturity and competence of learners in dealing with AI.

As shown in the conducted studies as well as known from educational reports, a part of ACE teachers lacks the necessary digital competences to benefit effectively from AI-based continuing education platforms. They have little experience with online-based learning and the use of learning management systems and are not only rather inexperienced but also tend to be reluctant to use AI (Autorengruppe Bildungsberichterstattung, 2020). The algorithms and data evaluations can also contribute to a restriction of the diversity and individuality of the learning offer. The standardisation mechanisms used in AI cannot always reflect the entire complexity of learning requirements or preferences of teachers and compare their analyses with existing learning offers selected by comparable users. Individual needs, critical perspectives or creative approaches are at risk of being neglected, which can restrict learners in their individual development (Selwyn, 2019).

Following on from this, the use of AI in education raises questions about data protection and the ethical use of data. As AI systems often rely on collecting and analysing large amounts of personal data to provide individualised learning experiences, there is a significant risk that this sensitive information could be misused or inadequately protected. If data security guidelines are insufficient, learners' privacy will be violated and the loss of trust in AI-based ACE platforms gets promoted. Moreover, ethical concerns arise regarding informed consent and the legitimate questions whether learners are fully aware of what data is being collected and how it will be used? William-

son & Piattoeva (2021) emphasise that guarding data privacy is essential to prevent exploitation and to maintain trust. Therefore, it is crucial to establish clear regulations and transparent data practices to protect learners' rights and uphold ethical standards in the integration of AI in ACE platforms.

For pedagogical settings, the lack of face-to-face interaction is also discussed as a significant critical element in the use of AI. Although an AI-based platform can provide valuable data and give general advice, it does not replace the interpersonal conversations and peer exchanges that are essential for teachers' professional development. Face-to-face interactions allow ACE teachers to reflect on experiences, discuss individual challenges and collaborate on solutions, which is difficult to replace with mere data and automated feedback. Schön (1983) emphasises that reflection and learning in a social context play a central role in professional development. Brockmann & Dörfler (2013) also emphasise that the exchange with colleagues not only expands knowledge, but also strengthens motivation and confidence in one's own pedagogical practice. While the use of AI can be supportive, the interpersonal component remains essential to ensure holistic and sustainable competence development of ACE teachers. Without this personal interaction, there is a risk that important social and emotional aspects of teacher professionalism are neglected, which could affect the quality of teaching and teacher development in the long term.

Based on the results of the evaluation of the designed learner-focused AI-based cross-provider ACE platform discussed in this article, it can be concluded that the integration of AI into ACE platforms requires a well thought-out and strategic approach. This is the only way to make the most of the many opportunities and minimise potential risks.

There is a clear need for further research projects to better understand the effectiveness, safety and ethical aspects of AI use in this context in detail. Future studies should include samples that are as large and representative as possible in order to be able to draw reliable conclusions. There is also a need to develop appropriate frameworks and guidelines to ensure the responsible use of AI in ACE platforms. It seems important to preserve the human factor, promote self-determination and self-reflection as well as actively involve learners in the learning process in order to ensure a balance between technological support and personal autonomy. Overall, it seems to be clear that technological support through AI can only be successful if it complements human interaction and does not replace it. Future developments should therefore always aim to empower learners while providing them with the assistance they need for a successful learning journey.

6   Conclusion and Outlook

The use of AI in ACE platforms offers many opportunities to individualise learning, make it more adaptive and expand access to the competence development of ACE teachers. However, there are also challenges for the technical and didactical implemen-

tation of AI components in the ACE platforms. The use of AI brings along acceptance problems and usability barriers among ACE teachers that need to be countered with transparent and target group-oriented didactic concepts. It is necessary to create regulatory frameworks and explaining information to build trust in the systems and empower learners to handle the AI. The integration of AI into ACE platforms should be strategic in order to maximize its potential. Using the design-based research approach to combine development with formative evaluation including the target group, can help to ensure a learner-focused orientation of ACE platforms and their sustainability.

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Constructivist and Experiential Learning in Virtual Reality

Future Perspectives for Adult Education Research

Josephine Jahn, Philipp Oberparleiter and Bernhard Schmidt-Hertha

Abstract

As digital technologies continue to reshape the educational landscape, Virtual Reality (VR) has emerged as a promising yet underexplored tool in adult education. While VR-based learning environments offer immersive, interactive, and experiential opportunities, their pedagogical potential remains underexplored within theoretical frameworks. This paper addresses this gap by analysing VR through the lenses of constructivism and experiential learning theory (ELT), both of which emphasise active knowledge construction through engagement and reflection.

Drawing on interdisciplinary perspectives, the article identifies key desiderata for integrating VR into adult education research, highlighting the need for robust instructional designs grounded in established learning theories. While VR facilitates experiential, avatar-based, and simulation-driven learning, challenges such as accessibility, cognitive overload, and curriculum alignment remain. The paper argues for systematic empirical research to assess the conditions under which VR can meaningfully support learning processes and ensure that its implementation moves beyond technological novelty to pedagogical effectiveness.

By critically examining the alignment between VR affordances and adult learning principles, this paper contributes to the broader discourse on digital learning innovation. It highlights the need for further research into instructional frameworks, educator competencies, and ethical considerations in AI-enhanced VR environments. In doing so, it lays the groundwork for future advancements in adult education where immersive digital experiences are used to promote deeper learning and skill acquisition.

Keywords: Virtual Reality, Avatar-Based Learning, Experiential Learning, Digital Learning, Educational Technology

Zusammenfassung

Die Bildungslandschaft befindet sich durch den Einzug digitaler Technologien in einem tiefgreifenden Wandel. In diesem Zusammenhang erweist sich Virtual Reality (VR) als eine vielversprechende, aber bislang wenig genutzte Möglichkeit für die Erwachsenenbildung/Weiterbildung. Obwohl VR-gestützte Umgebungen immersive, interaktive und erfahrungsbasierte Lernmöglichkeiten eröffnen, ist ihr pädagogisches

Potenzial noch unzureichend ausgeschöpft, theoretisch fundiert und empirisch untersucht.

Der vorliegende Beitrag adressiert diese Forschungslücke, indem er VR aus der Perspektive konstruktivistischer und erfahrungsbasierter Lerntheorien analysiert.

Aus interdisziplinärer Perspektive identifiziert der Beitrag zentrale Desiderate für die Integration von VR in die erwachsenenpädagogische Forschung und betont die Notwendigkeit fundierter didaktischer Konzepte, die auf etablierten lehr-/lerntheoretischen Ansätzen basieren. Während VR erfahrungs-, avatar- und simulationsbasiertes Lernen ermöglicht, bestehen gleichzeitig Herausforderungen wie begrenzte Zugänglichkeit, kognitive Überforderung und curriculare Anschlussfähigkeit.

Der Beitrag plädiert daher für eine systematische empirische Forschung, die untersucht, unter welchen Bedingungen VR einen sinnvollen Beitrag zu Lernprozessen leisten kann.

Durch die kritische Betrachtung der Passung zwischen Potenzialen von VR und den didaktischen Prinzipien der Erwachsenenbildung/Weiterbildung leistet der Artikel einen Beitrag zur weiterführenden Diskussion um digitale Bildungsinnovationen. Im Zentrum stehen dabei Fragen nach didaktischen Rahmenkonzepten, notwendigen Kompetenzen pädagogischer Fachkräfte sowie ethischen Implikationen KI-gestützter VR-Lernumgebungen. Damit wird ein Fundament für zukünftige Entwicklungen in der Erwachsenenbildung/Weiterbildung gelegt, in der immersive digitale Erfahrungen gezielt zur Förderung des vertieften Lernens und nachhaltigen Kompetenzerwerbs eingesetzt werden.

Keywords: Virtual Reality, avatarbasiertes Lernen, erfahrungsbasiertes Lernen, digitalisiertes Lernen, Bildungstechnologie

1 Introduction

The rapid advancement of digital technologies has significantly transformed educational landscapes, introducing new ways of teaching and learning. In this context, Virtual Reality (VR), in which learners interact through digital representations, has emerged as an innovative tool in adult education (Mystakidis, 2022; Radianti et al., 2020), as it provides immersive, interactive, and collaborative learning experiences (Fromm et al., 2021; Makransky & Petersen, 2021). Despite its increasing prevalence, the full potential of learning in VR remains underexplored, particularly in relation to its theoretical underpinnings and implementation in adult education (Mayer et al., 2022).

Research on digital learning emphasises the importance of integrating established educational theories into emerging technological applications (Chen, 2010; Makransky & Petersen, 2021). However, many VR implementations lack a clear theoretical foundation, limiting their pedagogical effectiveness (Marougkas et al., 2023; Radianti et al., 2020). To address this gap, this paper examines VR through the lens of constructivist and experiential learning theories, both of which highlight the importance of active, experience-based knowledge construction (Dewey, 1916; Kolb, 1984). This paper aims to

contribute to the discourse on digital learning in adult education by addressing three key research questions:

1. What opportunities do VR environments offer for implementing experiential learning processes?
2. What research gaps arise from constructivism and the approach of experiential learning in the context of VR for adult education research?
3. How can these open questions be addressed?

The paper develops its argument through a series of well-defined sections that examine different dimensions of the topic. Section 2 provides an overview of the current state of VR in adult education, including practical applications and scientific findings. Section 3 presents the theoretical foundations of constructivist and experiential learning, demonstrating their relevance to digital learning environments. It explores how these theories can be applied to VR, identifying opportunities and challenges for their integration into adult education. Finally, Section 4 discusses the research desiderata that emerge from these analyses and proposes ways to address them in future research.

By combining theoretical perspectives with empirical insights, this paper seeks to advance the understanding of VR and its role in shaping the future of adult education. Ensuring a strong theoretical foundation for this digital tool is essential for maximising its pedagogical potential and fostering meaningful, experiential learning processes (Chen, 2010; Makransky & Petersen, 2021).

2   The Current State of Virtual Reality in Adult Education

To date, the relevance of integrating VR into learning and educational processes with the help of digital applications is not only steadily increasing (mmb Institut GmbH, 2022; Mystakidis, 2022), but is also gaining scientific attention (Radianti et al., 2020). However, the advantages of learning in VR compared to other digital learning formats have not yet been fully explained (Mayer et al., 2022).

VR originated in the second half of the twentieth century (1960s) as text-based multiuser worlds, going on to the now simultaneous and interactive multiuser virtual worlds (Wang & Burton, 2013). This led to the first applications in education, primarily in flight simulation and flight training in the 1980s, and later expanded to biology and physics education in the early 1990s. During this time, the first implementations took place mainly in higher education, as financial constraints limited access to technical equipment in other educational sectors. Since then, the last 30 years have seen great growth and, above all, wider availability of VR, including in adult education, as previous restrictive barriers have been mitigated by broader internet connectivity and decreasing technology costs (Merchant et al., 2014).

VR is broadly defined as the generation of an artificial, interactive environment that exists parallel to the real world outside virtual environments (Zernig et al., 2022; Zobel et al., 2018). From an educational perspective, VR enables learners to engage in dynamic, interactive experiences with (interactive) things and other (interactive) avatars

in the virtual world that transcend traditional learning formats. This is fostering deeper cognitive processing and increased retention of learned material (Fromm et al., 2021; Makransky et al., 2019). Additionally, a particular advantage of learning environments in VR is their ability to replicate real-world scenarios that may otherwise be inaccessible due to cost, logistics, or safety concerns (Schwan & Buder, 2002). For example, training scenarios in hazardous industries, such as firefighting or chemical engineering, can be safely simulated in virtual settings (Zernig, 2020). It is important to note that virtual environments can be made available to learners in all fields, either synchronously or asynchronously.

Teaching and learning in VR can occur in both immersive and non-immersive setups. This means that learning in VR is not limited to desktop-based systems (e. g. computers, laptops or mobile devices) but extends across various VR implementations such as VR glasses. Depending on the system's setup, users can immerse themselves in these environments using technical devices and, in some cases, interact with embedded objects (Zernig et al., 2022). A key characteristic of – not only virtual reality but also other educational media – is that its educational effectiveness is not dictated by the specific technical access method employed (Zernig, 2020).

For some VR applications, another defining feature is the embodiment of learners through (human-based) avatars. This digital representation fosters engagement and personalisation, allowing users to navigate the learning space in a way that mirrors real-world interactions (Christou, 2010; Schwan & Buder, 2002). The range of embodiment of the learners is part of the virtual immersion. So, for example, only a half-body representation (e. g. torso and hands) can affect the walking experience in virtual worlds (Matsuda et al., 2021). Further, the appearance of the embodied avatar affects the experience in virtual worlds (Girvan, 2018) and in this case also the immersion of the learners. In this context, we define avatar-based environments as a distinct type of VR in which learners are visually represented by full-bodied, human-based avatars within a virtual setting. The presence of a (human-based) avatar enables learners to see themselves represented in the virtual environment, which enhances identification with the learning content and supports cognitive and social engagement (Zernig, 2020). Avatar-based VR applications enable personalised learning experiences by allowing users to navigate and manipulate virtual environments freely (Christou, 2010; Kritzenberger, 2009). Furthermore, avatar-based environments facilitate interactive learning experiences by enabling real-time communication and cooperation among learners (Zernig, 2020). These environments allow users to participate actively in social interactions and simulations that may not be feasible in traditional educational settings. The ability to manipulate and engage with digital objects while interacting with virtual peers makes avatar-based learning particularly effective for complex skill acquisition and experiential training (Chee, 2001; Schwan & Buder, 2002).

The different terms in the context of VR are not always used consistently. Given the lack of a universally accepted definition of virtual reality, scientific literature often adopts its own working definitions, depending on the research context. In this article, we apply a broad understanding of VR that encompasses various forms of immersive technologies relevant to adult education. Accordingly, we have included studies that

align with this broader conceptualization, even though they may refer to different technical implementations of VR (e. g. avatar-based platforms, simulations, or other immersive environments). This approach was necessary, as research on the application of VR in the field of educational science is still limited. Therefore, a more inclusive perspective allows for a comprehensive overview of existing empirical insights and theoretical considerations. Therefore, Figure 1 shows which subject is being referred to in this article. We focus on VR in the context of adult education. VR applications can be avatar-based, but they can also be implemented differently, as is the case with simulations, for example.

Figure 1: Subject of the contribution (XR = Extended Reality; AR = Augmented Reality) (Author's own illustration)

2.1   Use of VR in Adult Education

The integration of VR in adult education has significantly expanded in recent years and differs greatly across different domains (Zernig et al., 2022). VR is particularly prevalent in professional training, medicine, and engineering, where virtual simulations facilitate learning in risk-free environments (Mayer et al., 2022; Radianti et al., 2020). In medical education, VR-based training is used for surgical simulations, allowing for the safe repetition of (Bric et al., 2016), while in vocational training, this environment serves as an interactive platform for skills development (Jahn & Oberparleiter, 2024; Kim et al., 2020; Kraus et al., 2025).

However, despite the potential of VR, its implementation in adult education faces several challenges. Financial constraints, technical requirements, the demand for technical expertise, and the necessity for curriculum adaptation pose significant barriers to widespread adoption (Fitrianto & Saif, 2024; Mallek et al., 2024). Additionally, VR-induced motion sickness, cognitive overload, and accessibility concerns highlight the importance of well-designed instructional frameworks (Jensen & Konradsen, 2018; Schwan & Buder, 2002). Addressing these challenges requires a structured approach that incorporates pedagogical best practices, ensuring that VR serves as a meaningful and effective educational tool.

2.2   Research Findings on VR in Adult Education

The scientific discourse on VR reveals a diverse range of perspectives. While numerous studies highlight the benefits of immersion in virtual environments, including increased engagement and motivation (Makransky & Mayer, 2022), others caution that mere exposure to VR does not automatically enhance learning outcomes (Jensen & Konradsen, 2018). Thus, scientific evidence on the effectiveness of learning in VR is very heterogeneous, not least because of differences in design and didactic implementation (Plass et al., 2020). Therefore, effective learning in VR is contingent upon the instructional strategies employed and the extent to which learners can actively engage with the content (Makransky & Petersen, 2021).

A critical factor influencing learning success in VR is the sense of presence, which refers to the psychological experience of "being there" (Makransky & Petersen, 2021). Studies indicate that higher levels of presence contribute to deeper cognitive engagement and improved information retention (Plass et al., 2020).

The Cognitive Affective Model of Immersive Learning (CAMIL) proposes that VR's effectiveness depends on how well instructional methods leverage the unique affordances of the medium, such as multimodal interaction and experiential learning (Makransky & Petersen, 2021). Research also underscores the importance of integrating established learning theories, including constructivism and experiential learning, to optimize VR's potential in education (Mallek et al., 2024; Schunk, 2012). However, recent systematic reviews suggest that the VR research lacks theoretical and methodological rigor, as many studies focus on the technological aspects of VR rather than its pedagogical implications (Petersen et al., 2022; Radianti et al., 2020).

3 Adaptation of Constructivism and Experiential Learning to Virtual Reality in Adult Education

The discourse on learning in VR must address a dual set of critical questions: first, how the design of VR should be advanced to better reflect learning theories, and second, how VR can be deployed and leveraged to foster learning in accordance with established learning theories. However, a notable gap persists in the theoretical underpinnings guiding the design and implementation of VR (Chen, 2010; Radianti et al., 2020).

Several learning paradigms have been discussed in the literature, with behaviourism, cognitivism, and constructivism being the most established (Schunk, 2012; Schwan & Buder, 2002). Nevertheless, only approximately 30 % of existing studies incorporate an educational theory or framework, leaving many VR-based learning experiences without a structured pedagogical foundation (Marougkas et al., 2023; Radianti et al., 2020). This lack of explicit reference to learning theories is a critical oversight, as theories provide essential frameworks to ensure that VR experiences align with effective pedagogical strategies (Makransky & Petersen, 2021).

Understanding learning theories is especially relevant in VR-based education, as this knowledge helps educators and developers to design experiences that transcend technological novelty and promote meaningful learning (Chen, 2010). Learning is both a process and a product. Yet much of the VR education research emphasises outcomes over the mechanisms of knowledge acquisition (Petersen et al., 2022). Fromm et al. (2021) also emphasise the importance of deliberate design in emerging technologies such as VR, underscoring the need for clear pedagogical objectives. Without a theoretical foundation, VR risks becoming an engaging yet pedagogically superficial tool (Chen, 2010).

Moreover, educators often lack the knowledge, experience, and competencies needed to effectively integrate VR into teaching (Zernig et al., 2022). This challenge calls for didactic models and reference frameworks that ensure pedagogical soundness rather than technological novelty (Fitrianto & Saif, 2024). As Chen (2010) puts it, "tools by themselves do not teach. They have to be carefully and effectively implemented to assist in the learning process" (p. 73). Much like other sophisticated learning environments, VR's effectiveness depends on the strategic orchestration of learner's experiences (Kuna et al., 2023; Schwan & Buder, 2002).

Therefore, this section explores adult education theories to examine their relevance to VR-based educational practices. Theories such as cognitive load theory (Sweller, 1994), the cognitive theory of multimedia learning (Mayer, 2005), and flow theory (Csikszentmihalyi, 2014) offer valuable insights into optimising VR learning experiences (Marougkas et al., 2023; Radianti et al., 2020). For example, cognitive load theory emphasises the importance of managing intrinsic and extraneous loads to enhance learning efficiency. Flow theory explains how immersive VR experiences can support deep learning by balancing challenge and skill (Csikszentmihalyi, 2014). Recently, the concept of social space was introduced to study VR-based workplace learning (Kraus et al., 2025), representing a novel research perspective. Dewey's concept of "learning by

doing" suggests that active engagement in simulated environments fosters deeper learning (Marougkas et al., 2023). Experiential learning theory (Kolb, 1984) further emphasises the importance of learning through direct experience and reflection. The immersive nature of VR makes it particularly well-suited for experiential learning, enabling learners to engage in authentic, hands-on tasks that mirror real-world challenges (Zernig, 2020).

In conclusion, while VR is a promising tool for adult education, its effectiveness depends on the integration of well-established learning theories into the development and deployment of applications. Constructivism and experiential learning, in particular, offer a strong foundation for designing VR experiences that encourage active engagement and meaningful knowledge construction. Aligning VR with sound learning theories is essential to fully realising its transformative educational potential (Chen, 2010; Mallek et al., 2024; Marougkas et al., 2023; Radianti et al., 2020). The following sections will explore the theories of constructivism and experiential learning in detail, examining how these frameworks can be adapted and implemented to address the opportunities and challenges specific to VR-based education.

3.1   Constructivism and VR

The field of adult education is deeply influenced by Malcolm Knowles' theory of andragogy (1973), which highlights the specific characteristics of adult learners (Orozco & Giraldo-García, 2024). This perspective aligns closely with constructivist learning theories, which emphasise the active role of learners in constructing knowledge based on their experiences and interactions with their environment (Arnold, 2003; Siebert, 1997). Constructivism, which has widespread acceptance regarding theories of learning (Dalgarno, 2002), posits that learning is an active and constructive process in which individuals create their own subjective representations of reality. Instead of passively absorbing information, learners engage in an iterative process of integrating new knowledge with prior understanding (Fosnot, 2013; Fosnot & Perry, 1996).

Historically, constructivism has been shaped by several key thinkers. John Dewey (1916) emphasised that knowledge is socially constructed and must be situated within meaningful real-world experiences (Grady, 2003). Dewey's philosophy underscores the necessity of structuring learning around the lived experiences of learners, ensuring that new experiences are related to prior ones while also challenging learners to expand their understanding (Dewey, 1969). These experiences should be structured with consideration of the learners' capabilities and state of preparedness. Dewey stresses that not all experiences are inherently educative. Only those that lead to meaningful learning outcomes contribute to intellectual growth. He states that the creation of a learning environment necessitates the involvement of the entire social system, not just the teacher (Grady, 2003).

Three central principles define constructivist learning: (1) learners construct their own knowledge representations, meaning that there is no singular, objective reality but rather multiple perspectives based on individual experiences; (2) learning is driven by cognitive conflict, where learners identify gaps in their understanding and actively

work to resolve them; and (3) social interaction plays a fundamental role in knowledge construction, emphasising the importance of collaborative learning environments (Dalgarno, 2002).

From the perspective of educational science, constructivist theory offers a highly relevant framework for understanding adult learning in VR (Dalgarno, 2002; Hernandez-Serrano et al., 2000). Winn (1993) was among the first to propose constructivism as a foundational theory for learning in VR, highlighting the compatibility between VR's characteristics and constructivist axioms. Constructivism aligns particularly well with the unique capabilities of VR, where immersive, interactive, and context-rich environments create opportunities for meaningful first-person learning experiences (Chen, 2010; Christou, 2010; Winn, 1993; Zernig, 2020):

1. Situated learning and authenticity are crucial for effective learning in VR. VR can provide spatially anchored experiences that enable learners to engage in authentic tasks within realistic settings (Kritzenberger, 2009).
2. Furthermore, knowledge emerges through interaction and experimentation, ideally supported by VR through multisensory immersion and first-person experiences (Christou, 2010; Zernig, 2020).
3. VR also enables collaborative problem-solving and peer interaction in simulated environments (Petersen et al., 2022; Radianti et al., 2020).

Research on learning in VR increasingly draws on constructivist principles to inform design and analysis. Studies have examined how VR can support inquiry-based learning, peer assessment, and holistic experiential processes (Fromm et al., 2021; Kim et al., 2020). The CAMIL model, grounded in empirical data, provides a framework for designing VR for learning and adopts a constructivist stance by emphasising immersion and interactivity as central to effective VR instruction (Petersen et al., 2022).

3.2   Experiential learning and VR

Experiential learning is a foundational concept in educational science, deeply rooted in the work of John Dewey, Kurt Lewin, Jean Piaget, and, most prominently, David Kolb (Kolb et al., 2014). This perspective conceptualises learning as an active and dynamic process in which individuals construct knowledge through experience and critical reflection, rather than merely absorbing information passively (Kolb & Kolb, 2005; Morris, 2020). It therefore aligns with constructivist learning theory.

Kolb (1984) defines learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (p. 41). His experiential learning theory (ELT) builds on six key propositions (Kolb & Kolb, 2005, p. 194):

1. "Learning is best conceived as a process, not in terms of outcome"
2. "All learning is relearning"
3. "Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world"
4. "Learning is a holistic process of adaptation to the world"

5. "Learning results from synergetic transactions between the person and the environment"
6. "Learning is the process of creating knowledge"

A core element of ELT is the experiential learning cycle, comprising four interdependent learning modes: concrete experience, reflective observation, abstract conceptualisation, and active experimentation (Kolb & Kolb, 2005). These form a continuous spiral in which learners engage in a responsive process of experiencing, reflecting, conceptualising, and applying.

According to Kolb & Kolb (2005), the learning process is driven by two opposing modes of grasping experience (concrete experience vs. abstract conceptualisation) and two opposing modes of transforming experience (reflective observation vs. active experimentation). Learners may prefer certain modes and can be categorised as *watchers* (reflective) or *doers* (active) (Kolb et al., 2014).

Kolb's theory also draws on Lewin's field theory and the concept of life space, emphasising that learning is situated within a dynamic interaction between individual and environment. Learning spaces are not merely physical locations but are shaped by social and experiential factors (Kolb & Kolb, 2005). These spaces should foster psychological safety, mutual respect, and purposeful engagement to enable meaningful learning.

Kolb & Kolb (2005, pp. 207–209) outline principles for experiential learning environments, including:
- "Respect for Learners and Their Experience"
- "Begin Learning with the Learner's Experience of the Subject Matter"
- "Creating and Holding a Hospitable Space for Learning"
- "Making Space for Conversational Learning"
- "Making Space for Development of Expertise"
- "Making Spaces for Acting and Reflecting"
- "Making Spaces for Feeling and Thinking"
- "Making Space for Inside-Out Learning"
- "Making Space for Learners to Take Charge of Their Own Learning"

Although there is little criticism of ELT, empirical research supports its effectiveness. Learners engaged in experiential learning are active participants who construct knowledge in real-world contexts (Morris, 2020).

However, experiential learning also entails challenges. It places high cognitive and emotional demands on learners who must manage uncertainty, novelty, and risk (Morris, 2020). Because it requires metacognitive reflection, experiential learning can be emotionally intense. Therefore, educators play a vital role by guiding learners, supporting resilience, and cultivating an environment conducive to exploration (Morris, 2020; Radianti et al., 2020).

VR-based learning is particularly well-suited for experiential learning, as it enables immersive, context-rich experiences that foster knowledge construction (Fromm et al.,

2021). Its alignment with Kolb's four learning modes makes it a powerful tool for experiential education (Radianti et al., 2020).

The process-oriented nature of ELT (Kolb, 1984) resonates with the affordances of VR, which provides immersive environments that allow learners to actively engage with content and reflect on their experiences (Fitrianto & Saif, 2024; Kwon, 2019; Marougkas et al., 2023). Consequently, experiential learning is widely applied as a learning theory for VR-enabled learning (Li et al., 2019).

A unique advantage of VR-based experiential learning lies in offering access to otherwise inaccessible contexts, such as hazardous environments, abstract concepts, or microscopic systems (Freina & Ott, 2015; Marougkas et al., 2023).

Key elements of experiential learning that align with VR include embodiment, autonomy, collaboration, and reflection:

1. Embodiment: Experiential learning involves sensory and spatial experience. VR supports this through immersive simulations that allow first-person engagement (Chee, 2001; Morris, 2020).
2. Autonomy: VR enables learners to act independently, explore environments, make decisions, and observe the consequences, fostering deep understanding and retention (Chee, 2001; Marougkas et al., 2023). Fromm et al. (2021) note that VR supports free exploration, even in high-risk or hard-to-reach environments.
3. Collaboration: VR supports collaborative learning both synchronously and asynchronously through peer interaction and emerging AI agents in virtual environments (Chee, 2001; Fromm et al., 2021).
4. Reflection: VR environments can incorporate tools for reviewing actions, encouraging reflection that bridges experience and conceptual understanding. The reflective component of experiential learning can be facilitated in VR by providing opportunities for learners to review and analyse their experiences, enabling deeper understanding and meaning-making (Mallek et al., 2024; Marougkas et al., 2023).

A growing body of research has explored the intersection of experiential learning and VR (Fitrianto & Saif, 2024; Fromm et al., 2021; Jarmon et al., 2009; Kwon, 2019). Kwon (2019) found that VR's vividness and interactivity improve learning outcomes by making virtual experiences feel real. Fromm et al. (2021) further elaborated on how VR can support all four stages of Kolb's experiential learning cycle. Their work identified six principles for integrating experiential learning in VR, including

- balancing technical and pedagogical considerations,
- ensuring realism and interactivity and
- cycling between experiential activities in VR and reflective observation outside of it.

Experimental research suggests that VR fosters experiential learning by enabling learners to perceive virtual tasks as real, thus increasing engagement and retention (Kwon, 2019).

These findings support Disessa's (1986) claim that the quality of experience, rather than the medium (analog or digital), is the key to effective learning. While digital settings may initially seem artificial, well-designed experiences can be equally, if not more, impactful. However, this should not be taken to mean that the medium, such as VR, is irrelevant. On the contrary, the medium plays a decisive role in shaping the conditions under which learning experiences emerge. Therefore, it is precisely the interplay between the design of the VR environment and the quality of the experience that determines the educational impact.

In conclusion, ELT offers a robust framework for designing effective adult learning in VR. By leveraging VR's immersive, interactive, and reflective capacities, educators can promote holistic learning processes. While research supports VR's educational value, further work is required to translate theory into practice, especially in adult education.

Rather than viewing technological limitations as barriers, these challenges should be seen as opportunities for innovation, such as the development of intelligent agents for educational VR (Fromm et al., 2021).

4   Discussion

New technological possibilities, particularly VR, can evoke both fear and fascination while inspiring researchers, learners, and educators. On the one hand, this enthusiasm leads to a great openness to engage with new learning environments, but it also carries the risk of neglecting critical questions about its actual didactic and pedagogical value. This requires a broad and reliable knowledge of the possibilities, design, and effectiveness of these learning environments.

4.1   Desiderata of VR as a Subject of Research in Adult Education

The scientific examination of VR in adult education is still largely in its infancy and appears to be driven primarily by a fascination with its technological possibilities. Several key research gaps remain, many of which are not limited to the field of adult education but apply more broadly to the use of different forms of VR technology in teaching-learning contexts. Six areas in which we see a particular need for research are briefly addressed here.

- To date, only a few studies empirically test learning success in VR – e. g. using pre-post-test designs – let alone investigate the learning effectiveness of individual design elements. In adult education in particular, there is a high risk that the important factor of learner satisfaction with a learning environment will be evaluated as the sole criterion for success and that the contribution of the learning environment to supporting a learning process and thus to promoting knowledge and competence growth will be neglected. Accordingly, studies are needed that systematically investigate the conditions under which forms of VR can make a

sustainable contribution to the achievement of learning objectives (Won et al., 2023; Zernig, 2020).

- To ensure these learning successes, the didactic design of VR and their orientation towards established learning process models (e. g. ELT) must also be considered (Fromm et al., 2021; Morris, 2020). VR environments can provide learners with special experiences that would hardly be possible in traditional adult education contexts or only with a great deal of effort. However, the learning potential of these experiences may remain untapped if they are not integrated into appropriate didactic concepts, for which avatar-based environments offer opportunities that have not yet been the focus of much empirical research.

- In this context, the role of reflection as a core element of experiential learning becomes particularly relevant. While immersive VR experiences can evoke intense engagement and emotional resonance, it is through structured reflection that learners can make sense of these experiences, connect them to prior knowledge, and transfer insights into real-world contexts. However, the specific ways in which reflective practices take place within VR and how they might be deliberately supported are still insufficiently understood. This points to a desideratum for future research and design: how can virtual environments be intentionally structured to facilitate meaningful reflection? Possible avenues include the integration of in-world reflection prompts, avatar-mediated peer dialogues, or designated reflective phases before or after the immersive experience. The understanding and leveraging of these mechanisms is essential for the full realisation of the educational potential of VR technologies.

- However, the interests and prerequisites of the learners are also relevant. In adult education in particular, learning environments cannot be designed according to the one-size-fits-all principle but must be able to be flexibly adapted to the respective needs and requirements of the learners. It is also important to recognise learners' barriers and inhibitions and to react appropriately to them. This is not only about the adaptability and personalisation of learning environments but also about anchoring learning status surveys, interest surveys, and the recording of learners' design wishes in the learning process. After all, VR might not be suitable for all content areas or target groups. More research is also necessary to critically evaluate the limitations of this kind of learning environment.

- The latter point also becomes relevant for program planning in adult education. Here, questions arise: under what conditions, for whom, and for which content might different VR-based scenarios offer an additional value? Furthermore, so far little is known about embedding such VR-based environments in blended learning concepts or about implementing them as one element in a comprehensive learning program. On the institutional level also, certain standards are needed that define which professions and equipment are necessary to offer VR-based education (Oh et al., 2018).

- Finally, teachers play a role in virtual learning spaces also, and the question arises as to their competencies in the design, moderation, and support of learners in VR

(Zernig et al., 2022). To a certain extent, however, it would be possible to build on cross-educational models such as DigCompEdu (Redecker & Punie, 2017) or specific media pedagogical competence models for adult education (Rohs et al., 2019). However, these would then have to be expanded to include the specific requirements of designing learning processes in VR environments. A relevant skill is the ability to adapt one's approach to teaching and learning to a technological environment that enables learners to have personal experiences and design their own learning process. Training programs for educators have to be developed and evaluated that address these kinds of skills and competencies (Fitrianto & Saif, 2024).

4.2   Approaches to Address VR in Adult Education Research

To address the aforementioned desiderata in research on VR systematically, different methodological designs and research foci are required that are theory-based and investigate the conditions and yields of such learning formats. Here we suggest constructivism and experiential learning theory as theoretical points of reference, but of course, other theoretical approaches may also be promising. In the sense of design-based research, research and development processes can go hand in hand here (Chen, 2010). In such a research process, representative surveys of the interests and prerequisites of the respective target groups are just as valid as experimental comparative studies or the recording of usage patterns and individual learning experiences in open surveys. In the sense of a pragmatist understanding of science (Creswell & Creswell, 2003), only the contribution of the respective methodological approaches to opening up the object of research is decisive and not the exclusive focus on experimental or field studies. Nevertheless, pioneering research, in particular from media psychology and media studies, could be a good point of origin for further research on VR-based environments in adult education. Also, interdisciplinary inquiries seem to be promising to bring forward that field of research.

Only when a sufficient number of different studies are available can systematic reviews (Won et al., 2023) and meta-analyses be the next step (Glass, 1976), based on which robust evidence and reliable findings form a solid foundation for the design of VR. However, especially in the field of adult education, the heterogeneity and special needs of different target groups must be considered, as must the different backgrounds of the teachers. A large number of studies and the consideration of existing knowledge on learning processes in adulthood are necessary to meet the requirements of adult education practice and to exploit the possibilities of VR-based learning environments in this area of education.

The rapid development of Artificial Intelligence (AI) is also opening up significantly broader perspectives for VR-based learning environments (Mallek et al., 2024), particularly about the development of adaptive learning opportunities. AI-based evaluations of learning behavior and individual learning status, also referred to as learning analytics, enable automated adaptation of learning environments and digital learning opportunities to the level of knowledge, needs, and learning preferences of learners.

However, this also poses new challenges concerning the handling of the data collected in this way and subsequent ethical issues (Schemmann & Schmidt-Hertha, 2025). This makes it all the more important to have a data protection-informed and ethically reflected scientific examination of the possibilities of AI-based VR. In particular, commercial strategies and the market power of VR providers have to be considered here (Egliston & Carter, 2022).

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'As long as I still can, I'll keep doing it' – Chasing the Odds

A Case Study on Adult Education and Digitisation in an Assisted Living Facility

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Abstract

The project "Digital educational processes for older adults in senior-specific forms of housing" (DiBiWohn), combines empirical educational research, gerontology and media education in assisted living and longterm care institutions. DiBiWohn used both, quantitative and qualitative data for new educational programs and basic research. The aim of this paper is to describe additional knowledge gained using data and method triangulation. A case study elicits the triangulation with data stemming from different work packages and combining it with theoretical aspects of educational research and gerontology using a grounded theory approach. Results show correlations between biographical educational events and the use of digital technologies (ICT). Motives for turning towards ICT are connected with biography and attitudes towards ICT and towards changing self and world relationships are consistent. Thus, data triangulation allows to establish new relationships in data and in this case enables a holistic understanding of the ICT use of vulnerable groups in older adulthood.

Keywords: Gerontology, Case Study, Older Adults, ICT use, Qualitative Research

Zusammenfassung

Das Projekt "Digitale Bildungsprozesse für ältere Erwachsene in seniorenspezifischen Wohnformen" (DiBiWohn) verbindet empirische Bildungsforschung, Gerontologie und Medienpädagogik in Einrichtungen des Betreuten Wohnens und der Langzeitpflege. DiBiWohn nutzte sowohl quantitative als auch qualitative Daten für neue Bildungsangebote sowie Grundlagenforschung. Ziel des Beitrages ist es, den zusätzlichen Erkenntnisgewinn durch Daten- und Methodentriangulation zu beschreiben. Anhand einer Fallstudie wird die Triangulation mit Daten aus unterschiedlichen Arbeitsbereichen durchgeführt und mit theoretischen Aspekten der Bildungsforschung und Gerontologie im Rahmen eines Grounded Theory-Ansatzes verknüpft. Die Ergebnisse zeigen Korrelationen zwischen biografischen Bildungsereignissen und der Nutzung digitaler Technologien (IKT). Die Motive für die Hinwendung zu IKT sind mit der Biografie verknüpft, und die Einstellungen zu IKT und zur Veränderung der Bezie-

hungen zwischen Selbst und Welt sind konsistent. Die Datentriangulation ermöglicht somit, neue Beziehungen in den Daten herzustellen und in diesem Fall ein ganzheitliches Verständnis der IKT-Nutzung von vulnerablen Gruppen im höheren Erwachsenenalter zu gewinnen.

Schlüsselwörter: Gerontologie, Fallstudie, Ältere Menschen, Digitalität, Qualitative Forschung

1   Introduction

The introduction of this paper in this first chapter sets the scope of interest and contextualisation for the later empirical analysis. The chapter starts with introducing backgrounds at the academic intersection of this paper: namely adult education, gerontology, digitisation and the relevance of biography in all that (1.1). The aim is to set the grounds in terms of academic fields and discussion and to then plunge into the project itself (1.2), to explore the research question of the project and that of the paper (1.3). Finally, the introduction spotlights relevant sensitising concepts (3.1) which are later – after introducing the methods (2.) used for empirical analysis of triangulating various data from one particular case from the project with the anonymised name of Mrs. Franke (Chapter 3). A discussion finalises this paper (4.) Adult Education, Gerontology, Biography and Digitisation of older adults – introductory remarks.

In adult education the discussion on ageing often ends when people reach retirement age[1]. But even in self-descriptions of older people themselves, ageing is often postponed, even denied or made less explicit (Graefe et al., 2011; Quéniart & Charpentier, 2012; van Dyk & Graefe, 2012). At the same time, the range of our life experience is probably never greater than in old age. Multidimensionality of the ageing process (ageing on different levels: cognitive, social, psychological and physical) and multidirectionality of ageing (experience of gains, losses and retention in equal measure) explain the vast variety between individuals in old age (Wahl & Heyl, 2015).

But how does this connect to adult education discourses? What can an analysis of biographies of older people contribute to the educational discourse in general and to digitisation in particular?

Within the discipline of educational science, it is debated whether the topic of ageing is a category to educational science at all. This has been discussed since the very beginning of the debate on educational science orientations in ageing issues: The texts by Mieskes (1970) and Lehr (1979) represent this: While Mieskes even emphasises the need for a separate sub-discipline within educational science as 'Geragogics', Lehr, as a gerontologist, relegates educational science to the position of a mere applied science without any knowledge on ageing. Both texts originate from a phase of intensive differentiation and professionalisation in both disciplines. Since then, numerous arguments have been exchanged (Himmelsbach, 2018a, 2018b, 2023; Kern, 2018; Kricheldorff,

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1   For exceptions, Findsen & Formosa (2011).

2018; Nittel, 1999). Looking at educational sciences and especially adult education approaches it is essential to know which include old age in their concepts and are open to relativising the discourse of growth (Steigerungsdiskurs) – typical to educational sciences – with regard to ageing, and thus seek to expand adult education in terms of the finite nature of life (Arnold, 2006) and matters of losses as part of education and learning. Emphasising a discourse on finiteness puts forward the hypothesis that the concealment of death permeates adult education right through to its basic concepts, such as the concepts of 'growing up' and 'adulthood' (Arnold, 2006, translation by the authors). As a result, Arnold calls for a new perspective on the construction of adulthood that is capable of focussing on the multi-integral logics of the life course in integrating departure and farewell (Arnold 2006, p. 24). According to him, older adults are therefore not to be defined by their *otherness (target group approach)*, but by their status as individualised and at the same time socialised adults. In our opinion, the work of sociological and psychological ageing research offers interesting approaches that should also be increasingly taken up in adult education (see 3.1). Dinkelaker's (2018) considerations are furthermore helpful in broadening adult education in the direction of ageing. He describes four figures in the definition of the adult in the modern age: self-determination, experience, reflexivity and ageing. Adults are expected to organise their biographical lives *in a self-determined way*. They are also in a position to control themselves and to orientate themselves on reasonable grounds. Adults are *experienced* and have a special position in the relationship within the generations. They are more advanced in dealing with culture and also bear the responsibility for passing on culture to the next generation. Furthermore, adults are *reflexive* and thus have the ability for biographical self-observation; this even comes with the expectation of the development of a reflected individuality. Finally, adults are *ageing*: ageing in this definition is not a one-off life phase transition, but a differential that becomes significant again and again in the course of life. The process of ageing is characterised by an increase of past and a decrease of future and thus oscillates between not yet and no longer (Dinkelaker, 2018).

These positions on adult learning can thus be understood as answers to the question of how growth, continuation and loss could be made observable in adulthood. Older people are thus above all *adults* and therefore accessible to the 'native concepts' (Nittel, 1999) of educational science. There is therefore no need for an independent category of age in the educational sciences, but rather for a more focussed perspective on older adults in order to better understand the special features of education[2] and learning in this phase of life – e. g. by reconstructing biographies.

When it comes to a special content of learning for older adults, namely the use of Information and Communications Technologies (ICT) much is already known about the learning of fit and 'young' old people. However, little is known about vulnerable target groups, especially those living in institutionalised forms, such as residential or long-term care for the elderly. But for these groups rapidly advancing digitisation and

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2   From here on when referring to education, it is done in the sense of the German concept of Bildung – meant in a Humboldtian sense of self-education and education being a result of self and world acquisition. Learning is used referring to different forms of learning as in German educational discourses the word Lernen.

dissemination of ICT could offer a lot of opportunities to support their lives, especially in the orchestration of continuation, growth and regulation of losses. However, older adults often do not have access to these new technologies or are unable to use them (Seifert & Cotten, 2022). As a result, they are at greater risk of feeling excluded from a digitally dominated society and feel obsolescence and less self-efficacy (Jokisch et al., 2022; Seifert et al., 2018). Not only do older adults have less competencies or risks in the use of ICT, older adults still have the least access to the internet compared to other age groups: While 81 % of Germans over the age of 60 years use the internet, only 51 % of those over 80 years do so (first stage of the digital divide). Many more do not have sufficient skills to cope with the demands of modern technologies (second stage of the digital divide; (Rathgeb et al., 2022). From this arises the responsibility to better understand the consequences of the digital divide for aging and how it can be reduced.

2 The DiBiWohn Project – Fostering Digitisation in Nursing Homes and Assisted Living Facilities

The interdisciplinary and multi-site[3] project "Digital educational processes for older adults in senior-specific forms of housing" (DiBiWohn; duration: 09/2020–08/2025, BMBF – Framework Program Empirical Educational Research) combines the fields of empirical education research, gerontology and media education. We investigate how digital education formats can be successfully implemented in assisted living and nursing homes. As part of DiBiWohn, both quantitative and qualitative data were collected in order to develop new educational programs and realise basic research. This specific and vulnerable target group of older people has so far been excluded from digital education efforts. Educational programs in general and, in particular, digital education processes in old age have hardly been investigated for a vulnerable target group in the fourth age[4] and, despite very lively efforts with regard to the third age (https://www.digital-kompass.de/, https://www.digitaler-engel.org/, etc.), little material had been available for this group of people in practice to date. A major part of the project consisted in developing and delivering education programs in a peer-to-peer approach with older volunteers in the nursing homes and assisted living facilities. In addition to that, a central research focus of the project is basic research regarding ICT-use and biographical analysis for this ageing group (see dibiwohn.org for our publications so far). The aim of this paper now is to combine the different analytical results from different work packages with theoretical aspects of educational research and gerontology.

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3 In addition to the Catholic University of Applied Sciences Freiburg, the Centre for General Scientific Continuing Education at the University of Ulm (ZAWiW), the Foundation MedienKompetenz Forum Südwest (MKFS) and the Evangelische Heimstiftung GmbH are involved in the project. Further information can be found on the website: https://dibiwohn.org/

4 In gerontology, Third and Fourth Age are social categories not for describing chronological age but with the intention to further differentiate old age in terms of a fit and flexible age ready to answer to physical and cognitive challenges (Third Age) and a rather vulnerable Fourth age with limits in adjusting to more probable losses and health concerns.

3   Research Question and Triangulation Matters

In order to present the results of this triangulating case study, it is first necessary to contextualise its development, as it was not initially planned in the course of the project. The project's data collection formats included both qualitative and quantitative methods (see also Table 2), in order to address very different questions. When discussing the data, it became apparent that some people took part in several data collection formats and that different, not necessarily overlapping information was collected about these people. This prompted us to ask the question: what additional knowledge can be gained in relation to the ICT use of vulnerable age groups if data and theory triangulation is performed? Finally, the aim was to analyse the results from different work packages and also from different working groups centered around one case and to combine this new analysis with theoretical aspects of educational research and gerontology via sensitising concepts.

3.1   Gerontology and Adult Education – Sensitising Concepts for Case Triangulation

In the introductory remarks contexts and positions in adult education have been opened (see 1.1). This chapter focuses on four sensitising concepts in particular which were applied to the data material for the triangulating perspective presented. These are illustrated in (Table 1) and briefly introduced below: three gerontological approaches and one educational science approach. All of them provide a good basis for epistemological interests in the field of education in later life grounded upon biographical descriptions (Himmelsbach, 2023). On their methodological function in the case study, see chapter 2.

Table 1: Theoretical concepts for case triangulation

Educational events **(Kade, 2023; Koller, 2012)**	• Humboldt – education as a change in self and world relations • Koller's idea of transformative education
Development **(Baltes & Baltes, 1990)**	Development goals in later adulthood: • Continuation • Growth • Regulation of losses
Coping **(Brandstädter & Renner, 1990;** **Heckhausen & Schulz, 1995)**	• Tenacious and Flexible Goal Pursuit • Thesis – Older people with increased flexible goal adjustment strategies are more satisfied (especially in the 4th LA)
Socioemotional selectivity theory **(Carstensen, 2006)**	• Analysis of social relationships • Quality before quantity • Perspective of finite time

In terms of educational science, Koller's theory of transformative education aims to promote profound change in people's self-comprehension through reflective processes by questioning existing thought patterns and developing new perspectives. It emphasises the importance of critical thinking and a dialogue between the individual and

their social world, which enables personal and societal transformation. For ageing, the theory opens up new perspectives by supporting the continuous educational process across the lifespan, which includes not only knowledge but also the ability to adapt and reorientate. Koller's theory is in line with Humboldt's ideal of education, which sees the individual as an active, self-determined actor who builds a deeper connection to itself and the world through education. Humboldt emphasises the need to develop in a dynamic engagement with the world, which is reflected in Koller's theory by emphasising the reflection and transformation of one's own understanding of the world. In this way, education becomes a lifelong process that promotes both personal maturation and the responsible shaping of society in old age (Koller, 2012). Koller's theory was chosen here for the case, because it fulfills what was demanded in Chapter 1 for an educational science approach connected to ageing or the full lifespan, namely possibility of complete reorientation, integration of losses and relativity in the discourse of growth.

In gerontological terms, subjective ageing can be described as the orchestration of growth, stagnation/continuation and loss. This is the achievement of the theory of selective optimisation with compensation (SOK) (Baltes & Baltes, 1990). The antecedent conditions with regard to the definition of human development are of crucial importance for embedding it in an educational science discourse: "Development is understood as a lifelong adaptive process characterised by a finite amount of available resources, by age-related changes in plasticity and by losses of internal and external resources." (Jopp, 2003, p. 29). This means that development can encompass processes of growth, stagnation and loss in equal measure: The strategies of selection, optimisation and compensation serve to adapt to limited resources as well as to their age-associated changes. This model characterises the individual's ability and performance to adapt to the ageing process and provides valuable information for expanding the concept of education beyond enhancement and progress (Göhlich & Zirfas, 2007). In addition, this approach provides an impetus to consistently describe learning processes in old age against the background of dealing with change. Another gerontological approach is that of primary and secondary control. Heckhausen and Schulz (1995) distinguish between these two mechanisms by which older people adapt their goals in a changing life situation. Primary control refers to the attempt to change external circumstances, while secondary control aims to modify one's own perception and acceptance of circumstances. Brandstädter and Renner (1990) extend this approach with their theory of flexible and tenacious goal pursuit, whereby flexible goal pursuit means that people adapt their goals to changing life circumstances, while tenacious goal pursuit describes perseverance and consistency in realising goals despite challenges. Both theories emphasise the importance of adaptability and perseverance for ageing.

With regard to social relationships, Carstensen (2006) states in the gerontological socio-emotional selectivity theory that the individual development process is characterised by shifts in motives. This is driven by the type of future perspective and not by chronological age. The more expansive the future perspective, the more the motive of seeking information comes to the fore and drives development. As a result, a variety of developmental paths are taken and life possibilities are actively explored in many diffe-

rent ways and loaded with information. However, if the future is perceived as limited, which is particularly the case in old age, target processes concentrate on the preservation of emotionally meaningful experiences, for example in the area of social relationships: Older people focus primarily on maintaining particularly significant social partners with a high level of attachment and reliability, while less important social relationships tend to be abandoned: in other words, it is about quality rather than quantity of social relationships. These motivational shifts have the potential to explain many of the educational experiences of older people, even if they are not purely age-related, but are rather triggered when the individual's future prospects are shortened, e. g. when moving house or becoming ill (Carstensen, 2006). The concepts elaborated under this section 1.4 serve as sensitising concepts within the following data analysis meaning that it is these specific concepts we tested against the background of the empirical material. That is, because we estimate that combining those concepts will help us to further understand and elaborate on ICT usage of older and vulnerable adults.

4   Methods

The presentation of the sensitising concepts already points to a form of triangulation that was used as a methodological basis: Triangulation is a central procedure for increasing validity in qualitative social research by combining different perspectives on an object of investigation. Denzin (1978) distinguishes between data, methodological and theoretical triangulation. Data triangulation refers to the use of different data sources, for example different points in time, locations or groups of people, in order to minimise bias. Method triangulation combines different research methods, such as interviews and observations, in order to obtain a more comprehensive picture of a phenomenon (Flick, 2011). Theoretical triangulation, on the other hand, uses different theoretical approaches to interpret the data in order to avoid a one-sided or biased analysis (Denzin, 1978). We focus in the following on data and theoretical triangulation. This means we combined data from different work packages of the project and create a case with all data existing from that case and no matter what the research question was (Table 2) and tried to see through with the lenses of the sensitising concepts introduced in 1.4. Thus, after having known the case very inductively, we chose those relevant background ideas that inform the overall research problem in order to inform it a deductive-inductive manner the theory debate on education and ageing and ICT usage of vulnerable persons (Bowen, 2006).

Regarding the forms of data collection and data analysis within the DiBiWohn project Table 2 provides an overview of the data used for the analysis presented. In the case of Ms. Franke all data presented in Table 2 is present, which is not the case for all subjects since data stem from different work packages with their own data collection procedures. Data collection formats consisted in interviews, narrative and problem-centered, as well as a social space map and quantitative results on ICT use, quality of life and subjective health. Since data stems from different work packages and thus dif-

ferent working groups within the project there had been different objectives that led the original data collection. All data in the case of Mrs. Franke was transcribed. The interviews were led in German and all citations presented in this paper were translated after analysis and were only translated for this paper (for this strategy see Haak et al., 2013).

Table 2: Overview of the triangulated materials

Work package/ Focus	Objectives	Data Collection Method	Analysing Method
Qual. Access 1 Biographical research	Learning/educational strategies over the life course, relevance of biography	Narr. Biogr. Interview with problem-centered Enquiry part	Reconstructive
Qual. Access 1 Biographical research	Time table		Case overview of self-reported elements
Qual. Access 2 Practice/partici-pation research	What typologies of Internet newcomers are there?	Problem-centered interview	Coding – content analysis
Qual. Access 3 Social space research	How are socio-spatial settings per-ceived? Settings perceived after moving? Are digital social spaces emerging?	Social space map	Coding, Grounded Theory
Qual. Access 3 Social space research	Social space map accompanying interview	Problem-centered interview	Coding, Grounded Theory
Quant. Access 1 Media geronto-logical research	Pre-survey on health, life satisfaction and ICT skills and benefits	Questionnaire	Descriptive, mean values
Quant. Access 2 Media geronto-logical research	Post-survey on health, life satisfaction and ICT skills and benefits	Questionnaire	Descriptive, mean values

The analysis for presenting the case of Ms. Franke was performed by triangulating results from different data packages. The starting point was to take the reconstructed narrative identity pattern analysed from her case (Lucius-Hoene & Deppermann, 2004). This was our classical form of working with the biographic interviews in Qual. Access 1 (see Table 2). Then we took the other interviews in a Grounded Theory approach manner – and put concepts and topics from other interviews in content comparisons within the case and applied the applying sensitising concepts (see 3.1). That we did in a con-cept driven alignment process of combining earlier inductive analyses with deductively driven application of the sensitising concepts. Thus, the procedure used here is at-tached to Grounded Theory approaches as of being an approach of constant compari-son and integration of sensitising concepts (Clarke, 2007).

5   Results

The results of our triangulation are presented in four thematic chapters. Within the case study, at first Ms. Franke is introduced along a time table resulting from the biographic interview and some comparison to the sample with some of her estimations regarding well-being and life satisfaction taken from the quantitative data (3.1). In 3.2 the starting point is the short analysis of a key sequence from the biographical interview showing her move to a nursing home and then back to assisted living and also referring to important topics in her life. This is followed by a chapter encompassing her lifelong appropriation processes and how they are connected to ICT use and the last topic in this paper (3.4) introduces the case with its patterns of permanently shaping social space. The discussion (4) then sums up relating the findings to the sensitising concepts and discussing further aspects.

5.1   Case Portrait Ms. Franke

Ms. Franke is – at the time of the interview – a 93-year-old woman who thus experienced the Second World War as a teenager. She married for the first time in 1949 and her sons, born in 1949 and 1952, are now older men themselves. Overall, she describes a life full of crises, but something is always wrested from the circumstances and fighting against the circumstances is a major motive in her life. With regard to her age, Ms. Franke describes a rather happy and fulfilled phase of a third age with many trips and a new partnership. However, crises also increasingly set in: her own breast cancer, her partner's lung cancer and finally the death of both men in her life. Further details of her life story are shown in the timeline (Table 3). Of interest, in her case is that she moved into a nursing home and then moved again to assisted living. This is the first sequence to begin with in this paper in order to a) introduce her via the biographical interview and b) because this fact, which is rather unusual in German settings, impressively represents the case heading we chose for her – 'As long as I can, I still do it'.

Table 3: Time table Ms. Franke

1929	Born in capital city
	One brother (seven years older)
about 1933	Death of grandmother
	Repeats first grade at primary school due to prolonged illness (angina, tonsillitis)
1939	Start of the Second World War (most of the teachers are drafted)
	Secondary school
1945	At the age of 15 she experiences the end of the war
	Father taken as prisoner of war (Siberia)
	Cleaning work jobs, then sewing room (sews underwear), Working from home (Heimarbeit) knitting and painting buttons

(Continuing Table 3)

	Meets her future husband at the neighbour's (from Western capital city)
	Moves to West capital city (together with her mother-in-law and sister-in-law, who harass her)
1949, 1952	Marriage and birth of sons
	Takes piano lessons
1956	Move to city in southern Germany
	Gymnastics/Yoga/French courses on TV
	Stay at a spa (getting to know her future new partner), Separation from husband (no divorce)
	One son lives in Germany (family and children), one son in Asia (children and grandchildren from first marriage, second marriage childless)
1983	New partnership (he buys the flat below hers)
	Many trips (Austria, America)
	Breast cancer (partner has lung cancer)
ca. 2003	Spatial separation due to partner's poor health (he moves into a nursing home)
ca. 2018	Death of husband and death of ex-partner (in nursing home)
	Move to a nursing home in X city (home of her son's grandchildren and great-grandchildren, who now lives in Asia)
	In-house move to assisted living (and the associated purchase of furniture, as she had given everything away)
	Going for walks, trips on the local bus, passing on knowledge to her neighbour via tablet; video calls with her son in Asia; granddaughter orders her pre-selected clothes online

In addition to the biographical data, Ms. Franke can also be compared to other participants of the peer-to-peer program by quantitative survey data. Thus, she is a person who does not ascribe any computer or smartphone skills to herself, but who characterises herself much better than our average respondent in terms of her knowledge of the internet and tablet. Her life satisfaction and subjective health is also better than the average of the people surveyed (Table 4).

Table 4: Selective Quantitative Data Mrs. Franke
Outputs from the quantitative survey on the topics of ICT skills, life satisfaction and subjective health – individually and in comparison, to the surveyed group, by using German school grades ranging from 1 = very good to 6 = very poor

Item/Scale	Measurement	N	Mean
ICT-capabilities: Computer/Laptop	Comparison	34	4,16
	Franke	1	6,00
ICT-capabilities: Smartphone	Comparison	37	4,00
	Franke	1	6,00
ICT-capabilities: Internet	Comparison	36	3,69
	Franke	1	1,00
ICT-capabilities: Tablet	Comparison	34	3,53
	Franke	1	2,00
Life Satisfaction	Comparison	40	2,73
	Franke	1	2,00
Subjective Health	Comparison	40	3,40
	Franke	1	3,00

In the qualitative interviews, she initially views ICT use quite sceptically, but then becomes an active user and even some limitations that old age brought to her or mark her as vulnerable are solved or addressed by ICT use. But this is what the rest of the results section is about where three thematic units are presented in which the sensitising concepts already appear and are woven into the material.

5.2 Move to a Nursing Home and Assisted Living as Key Sequence

The first sequences presented revolve around the special nature of her move from a nursing home back to assisted living. The sequences are taken from the problem-centered interview on the social space map and the narrative biographical interview. In a kind of summary, she describes the context in the social space interview – she has been in the facility for three or four years, seven months of which were spent in the care unit, and now she feels at home and also enjoys time with her neighbour.

> B: I think I've been living here in X-town for three, four years (1.0); I was first under care downstairs, (-) seven months; (-) then I moved up here (-) I've actually already got used to it here I **actually feel at home** yes and (3.0) yes and how = what can I say ((laughs)) (2.0) **we often go out for a walk with my neighbour (1.0) do our RUN daily (-) so we go out** (-) (Transcript Ms.Franke, 93; Social Space)

This short episode is significantly expanded in the biographical interview. After describing numerous losses in the transition to a more impaired fourth age, she describes key aspects that a) encouraged her to make the transition to the nursing home – because unlike in other situations, here she is taking an active path towards the care facility and b) central elements that are central to her biography and to her content life today:

> [DESCRIPTION LOSSES]
> B: and then I was ALONE again in X-city (-) in the flat; and I had once known people who walked their dog and I could keep in touch with them a bit in the afternoons (1.0) but it got worse and worse. (1.0) my arthritis got worse and worse, I could hardly move my hands and (2.0) and I didn't feel like it anymore, so I was really DOWN; I1: mhm
>
> B: And then we were always chatting among ourselves, yes, one of them had already registered at the OLD people's home there and asked if I already had a nursing care facility, no, or a nursing care level or something (-) Yes, I still have to call the health insurance company to find out what it's like; nursing level [...] then my SON had always got me documents from old people's homes I should take a look at and stuff (-) and then well then I thought so now you'll soon be NINETY, I have my grandchildren here in X-city [... SUPPORT FROM BOTH SONS] [...][ORGANISATION, FUNERAL ORATOR] yes, but was saying not too sad, since I've lived my life and it was good because of the TRAVELs and so on, I had come to terms with it and (2.0) yes and then I was down here for SEVEN months under care; no; down here (1.0) and then the directress said, well, I can't take responsibility for this any longer, you've recovered so well here, how about (.) an (-) apartment; (1.0).h and I already knew the others, Ms V and so on, . h (-) not and oh yes Ms Franke come up here and so on not and so .h yes (.) well (1.0) and yes then uh (1.0) I let myself be persuaded two years ago (1.0) but had sold or given away EVERYTHING (Transcript Ms. Franke, 93; Biography)

Thus, motives appear in the first narration that are also to be found later as central motives for ICT utilisation: Loneliness and social contacts. Due to the loss of the men in her life, she describes herself as being left alone, the still loose contact with acquaintances is reduced due to poorer health, which leads to her evaluation, 'I didn't feel like it anymore' and 'I was really DOWN'. The theme of sadness and tiredness of life are further escalated in this narrative towards a downward spiral approaching a nursing home and even already organising a funeral speaker (not printed here). The story is resolved by delaying over a retarding moment – 'SEVEN months down in care' paired with adjectives such as 'I've lived my life' and 'it was good'. Finally, she describes that she moved to assisted living at the request of the 'directress' (an authority). The external and trustful evaluation that it was no longer reasonable to leave her in a care situation strengthens her argument. The externalisation, but as well the emphasis on her recovery and her achievement, becomes clear again at the end of the description with the resolution: although she had already given everything away, another metaphor for having finished with life, we now see her lively, content and independent in an assisted living facility.

This sequence as a mixture of the presentation of central motives in Ms. Franke's life and her special achievement to turn life upside down to a better life, which was no

longer expected by her, shall serve as a key sequence. We already see her coping strategies (also when it comes to losses and the role of social contacts in her life to make a meaningful life.)

5.3 Lifelong Appropriation Processes and ICT Use

In Ms. Franke's life, education and learning are lifelong and multidirectional processes. On the one hand, she has a wide-ranging interest in various topics, but on the other hand, she has few formal educational qualifications.

But her understanding of education is almost all-encompassing, and very much interlinked with enabling/expanding and maintaining social interaction:

> Education is actually all. Everything [...] is already encompassed [from infancy]; as I said, you need a lot of contacts and I had little contacts as a child back then (Transcript Ms. Franke, 93; Biography)

She acquired smart devices late in life, but uses them almost daily in her everyday life. She also motivates her neighbour to take part in the DiBiWohn project and actively supports her in the use of ICT. In other words, she herself becomes a teacher in this area. In terms of her educational and learning behaviour, however, this is not surprising, when looking back in her biographies. As she describes taking part in a French course in the biographic interview – we can see her describing a prominent learning scheme which she just takes up when it comes to leaning in later life:

> F: LEARNING? (-) yes, I liked learning earlier, I also started learning French; (.) on TV there was a TV course; (.) yes, a = a great teacher with his assistant. I didn't have any DOCUMENTS then; (1.0) I just wrote; ((demonstrates how she writes)) and the French and so on; and I recorded, I had a recording device; (.) and then I had a button at the bottom, so I could operate the recording device with my foot, (-) and then afterwards, when the course was over, I listened to it, I could read what I had written. (Transcript Ms. Franke, 93; Biography)

Although using a different technique (TV course), it becomes very obvious that distance learning courses and forms of non-formal education, which require personal responsibility and expertise in acquiring – here knowledge – are important for her. Structurally, she describes these forms of self-referential acquisition as early as middle adulthood and characterises them as relevant.

This proximity to biographically acquired forms and motives for learning would hardly have been possible without comparing different interview formats, as will now be explained further: This is because for her the use of technology was initially unlikely:

> B: and now I've turned to the tablet, (-) at first I said I don't have a computer what's the point (-) with my mobile phone my grandchild had to set it up down here and oh well yes, (-) but then I thought (-) I think I've told you before; (-) thought (-) now you have to know what you're rejecting; (Transcript Ms. Franke, 93; Social Space)

And indeed, she had this scepticism – which was probably a) very significant or b) parallel to the narrative form of a retarding moment (like in a drama setting), which shows

again that the form of the description is an expression of the motto of life, to wrest something from the circumstances. This becomes obvious when comparing the motive 'rejection of digital technology' in the various interviews where it appears: Social Space, Practice/Participation Research Interview and Biographical Interview. This time, however, the most detailed narrative is not found in the biographical interview, but rather in the participatory interview with the question of uncovering a typology of Internet newcomers:

B: At first I said no. Then I thought to myself, no, you must know what you're rejecting. You just have to take a look. And then I slowly got into it and so on. At first I didn't have maps, because my other son lives in Japan. And only then did I look everywhere on the map, etc. But the videophone, that's even better. (I: That's great, I think so too).B: So my son went for a walk in the evening and it was still lunchtime for me and he took me with him to the rice fields with his dog. I was there and on the way back, we met the neighbor and she came out. And Hello, this is my mother, they speak English. And that's when I met the neighbor. Hello. I: That's nice. [...]B: Yes, really. My son is also amazed that I've managed to do so much in such a short time. Well, and today the sons will both be amazed when the photos arrive. Yes. And now when I was ill, we couldn't go out. I was always typing messages, yes. Wrote to me and so on, great. I was outside a bit. Yes, yes, you just have a bit of opportunity via the device.
(Transcript Ms. Franke, 93; Participation)

B: and now I've turned to the tablet, (-) at first I said I don't have a computer, what's the point with my cell phone
(Transcript Ms. Franke, 93; social space interview)

B: and now I think that [technology] is great (-) imagine, (-) my son had his cell phone with him, in asia (-) went for a walk with his dog and I was there.
(Transcript Ms. Franke, 93; Biography)

Figure 1: Ms. Franke ICT use – extracts from various interviews

It is only in the Participation interview where an entire narrative tells us how the scepticism of ICT-use has been broken. First, it was step by step, first exploring where the son lives on maps, but the climax resolves around 'videophone' and 'he took me to the rice fields with his dog' uncovering the pairing of the motive improving social contacts, loving to travel and the pride in learning success and ability to fight her way through.

In relation to the sensitising concepts (3.1), in contrary to what is generally assumed in gerontological theory for fourth age, we propose something like an expansion (to the idea of the Baltes model): The use of ICT in the context of the fourth age gives the potential to experience growth WITH loss regulation and it allows education in the sense of a transformation of the whole person. One could say that Ms. Franke can gain something from changing WORLD conditions through continuous self-reflection.

5.4　　Patterns of Permanent Adaptation Shape Social Space

Combining two short sequences that were already under discussion in this paper and adding them to the social map, allows us the hypothesis that her permanent adaptation processes and flexible goal adjustments also extend to her perceived social space.

> B: and then I was **ALONE** again in X town (-) .h in the **flat**; (1.0) and I once **had** a few **acquaintances who .h walked their dog** .h and (-) I was able to have a bit of contact with them in the afternoon (1.0) (Transcript Ms. Franke, 93; biography, before moving to nursing home)

> B: I think I've been living here in X-town for three four years (1.0); I was first under care downstairs, (-) seven months; (-) then I moved up here (-) I've actually already got used to it here I **actually feel at home** yes and (3.0) yes and how = what can I say ((laughs)) (2.0) **we often go out for a walk with my neighbour (1.0) do our RUN daily (-) so we go out** (-) (Transcript Ms Franke, 93; social space)
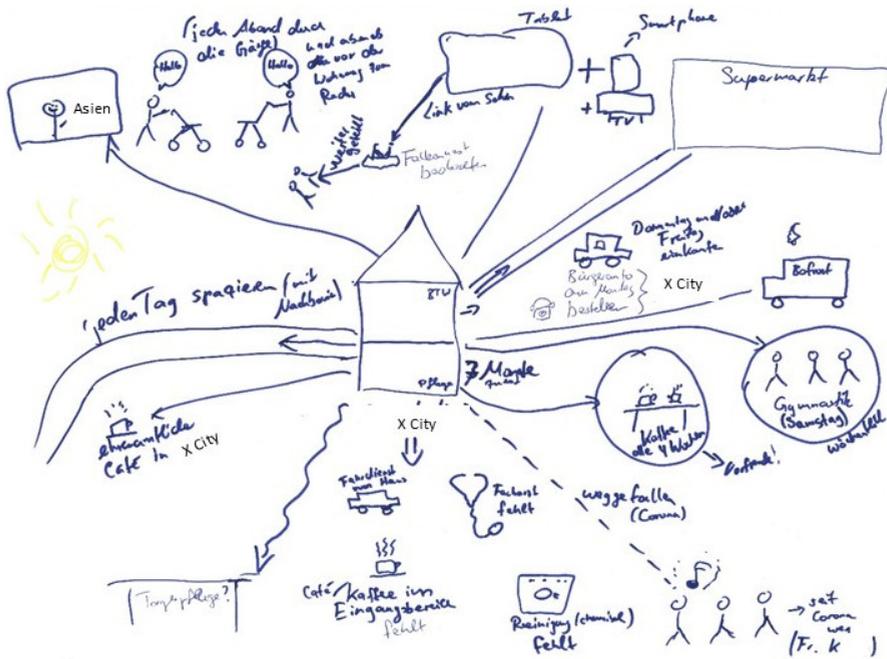
Figure 2: Social Map drawing from the Social Space Interview with Ms. Franke

What is described in her biography even before living in the nursing home – the habit of being out with the neighbours – is taken up in the nursing home as well – also drawn at the upper left section of the drawing (see figure 2) and also combined with the ICT use (Asia, incorporating the neighbour to the DiBiWohn project).

This can be interpreted as continuous organisation of social contacts, which is important to her throughout life. And – even more important – it is essential for the (re)appropriation of the social space or adaptation to the social space in the new setting of nursing home and assisted living. So, the fact of continually action out this strategy lets her cope with the move, even in fourth age. Thirdly, it is a confirmation of the educational understanding related to social contacts. Although this is an increasingly frequent topic in current debates about the opening of residential care facilities – also in organisational terms – our case study once again particularly represents the importance of this facet of life in old age – continuation of social contacts and not shutting them down.

6   Discussion – Results in the Light of Sensitising Concepts and Final Remarks

And finally, to answer the research question: what additional knowledge can be gained in relation to the ICT use of vulnerable age groups if data and theory triangulation is

performed? Related to the case Mrs. Franke the following can be stated contentwise: In terms of the sensitising concepts and starting out with the narrative identity reconstructed in the analysis of the biographical interview (Lucius-Hoene & Deppermann, 2004) 'As long as I still can, I'll keep on doing it' the addition of the use of further interview material and the use of sensitising concepts leads us to the following hypotheses and additions to the concepts presented in 3.1 (for an overview see Table 5):

Table 5: Overview of sensitising concepts in the case of Ms Franke

Concepts	Ms. Franke	Reference to ICT – Use – Hypotheses
Narrative identity	**'As long as I still can, I'll keep on doing it' – chasing the odds**	
Education Humboldt – Self/world relations Koller – Transformative as a comparison to coping	Making sense of the changing and persistent **world conditions**	Competence of 'wresting' as opportunity for learning process; If the world changes, she is capable of (reflective) change of the person
Development Development goals in later adulthood: Continuation Growth Retention/loss regulation	Maintenance in the present and regulating losses in the past in "difficult times" **Idea:** Expansion (towards growth)	Despite increasing losses, compensation mechanisms, which are also linked to individual growth/expansion, are utilised
Coping Tenacious and flexible Goal Pursuit Internal and external control	Assumption that **'flex'** helpful for dealing positively with age-related change **External** control helps with goal adjustment	'Defying' enables her to remain flexible in adjusting her goals and to remain satisfied despite massive losses
Socio-emotional selectivity theory Analysing social relationships Quality before quantity The perspective of finite time	Importance of development of social relationships in the ageing process	Reported importance of the quality of social relationships lets her take any means – including the (positive) use of ICT – in order to sustain qualitative relations (son, neighbour)

With regard to Humboldtian self and world conditions, Ms Franke succeeds repeatedly in gaining an advantage from changing but also persistent world conditions in critical situations throughout her life. This ability to 'defy' – to utilise opportunities even in adverse circumstances – is also helpful when learning to use ICT. When the world changes (in the sense of increasing digitalisation), she is also able to (reflectively) change as a person – and is therefore ready for transformation in Koller's sense. In terms of development in the psychological sense and according to gerontological assumptions from the Baltes & Baltes' SOK model, her case can be described as a form of continuation in the here and now, while forms of loss regulation were more necessary in the past. Despite increasing losses – turned towards ICT use – she activates compensation mechanisms that are even associated with individual enhancement/expansion. This leads us to the hypothesis that even in the fourth age – contrary to the usual interpretation – possibilities of enhancement can be assumed.

Coping with regard to flexible/tenacious goal pursuit and internal/external control, it is reasonable to assume that Ms Franke acts in the sense of 'flexible' goal adjustment and that this appears helpful for dealing positively with ageing processes. External control helps her to adjust her goals accordingly. Applied to the use of ICT, the rejection nevertheless enables her to remain flexible in her goal adjustment and to remain satisfied despite massive losses.

And as proposed in the last example, the importance given to the development of social relationships by her triggers learning and lets her take any means – including the (positive) use of ICT – in order to sustain those qualitatively high social contacts (son, neighbour). All this is also represented in the quantitative data. In relation to comparative individuals of our trial her measures in self-esteem, quality of live and well-being are considerably high.

Within the adult education discussion given at the beginning highlighting that a more focussed perspective on older adults can help us to better understand the special features of education and learning in this phase of life, we estimate that the reflection given in section 3.3 highlight that we have an added value in educational science by connecting biographical analyses, adult education and gerontological concepts which enriches understanding in both disciplines and also allows for opening up the concepts for new insights.

The evaluation of the triangulation (a), (b) the importance of these finding for the DiBiWohn project will form up this last paragraph of discussion

In a methodological sense (a) this form of a data driven and conceptual triangulation is valuable, since data triangulation enables a deeper understanding of the case, but on the other hand also expands the understanding of the biographical forms of learning and the motivations for working on the end device or only creates them through triangulation. Thirdly, it also allows to validate case-immanent hypotheses with the help various interviews.

With regard to the DiBiWohn Project our findings from triangulation also manifest the importance of individual – and not generational – experience and ICT utilisation. It is through biographical knowledge that we find the motives to overcome obsolescence and find the individual benefits of ICT that lead to its use for very old adults.

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**Part Two
Programs and Institutions**

Health Literacy and Digitalisation

An Urgent Field of Action for Adult Education

Kim Deutsch

Abstract

Health literacy, the ability to access, understand and apply health information, is increasingly important in the digital age (Bundesministerium für Gesundheit, 2022). With the introduction of digital tools in healthcare, such as tele-medicine and mobile health apps, adults need to be health and digitally literate to use these resources effectively (Bigga, 2022). The lack of such skills contributes to health inequalities, especially for those with low digital skills or limited access to technology (König et al., 2024). This underlines the need for adult education to teach skills in the use of digital health tools, informed decision-making and communication with healthcare providers.

To explore these dynamics, this article draws on qualitative interview data from a telemonitoring program implemented during the COVID-19 pandemic.

Keywords: Digital Health Literacy, Adult Education, Interview study

Zusammenfassung

Health Literacy, die Fähigkeit, Gesundheitsinformationen zu erfassen, zu verstehen und anzuwenden, ist im digitalen Zeitalter immer wichtiger (vgl. Bundesministerium für Gesundheit, 2022). Mit der Einführung digitaler Tools in der Gesundheitsversorgung, wie Telemedizin und mobilen Gesundheits-Apps, müssen Erwachsene gesundheits- und digital kompetent sein, um diese Ressourcen effektiv zu nutzen (vgl. Bigga, 2022). Der Mangel an solchen Kompetenzen trägt zu gesundheitlichen Ungleichheiten bei, insbesondere für Personen mit geringen digitalen Fähigkeiten oder begrenztem Zugang zu Technologie (vgl. König et al., 2024). Dies unterstreicht die Notwendigkeit, in der Erwachsenenbildung Fähigkeiten zur Nutzung digitaler Gesundheitstools, informierten Entscheidungen und Kommunikation mit Gesundheitsdienstleistern zu vermitteln.

Um diese Dynamik zu untersuchen, stützt sich dieser Artikel auf qualitative Interviewdaten aus einem Telemonitoring-Programm, das während der COVID-19-Pandemie durchgeführt wurde.

Schlüsselwörter: Digitale Gesundheitskompetenz, Erwachsenenbildung, Interviewstudie

1   Introduction

The ongoing digitalisation is transforming all areas of society, including the healthcare sector. Digital technologies offer new opportunities for health prevention and care but also requires individuals to develop specific competencies to effectively use, critically assess and integrate health-related information into their daily lives. The concept of Digital Health Literacy describes these abilities and has gained attention in scientific and policy discussions, particularly in light of the growing flood of information and the increasing digitalisation of healthcare services (BMG, 2023; König et al., 2024; WHO, 2024).

Both nationally and internationally, digital health literacy represents a significant challenge. The World Health Organization (WHO) emphasises the need for digital health education. There are still few coordinated strategies to promote digital health literacy at the population level. In Germany, as in many other countries, a gap exists between the widespread use of digital health tools and the actual competencies required to critically assess and apply health-related information. While 72 % of EU citizens use the internet to seek health information, up to 58 % report difficulties in accessing, understanding, evaluating, and applying such information (WHO, 2023).

In this context, adult education plays a crucial role. On the one hand, it serves as a key avenue for fostering digital health literacy; on the other hand, the topic remains underexplored within adult educational research.

This article aims to situate the concepts of health literacy and digital health literacy within the field of adult education and presents qualitative research findings conducted within a telemonitoring study as an example of the importance of digital health literacy in practice. The goal is to highlight the relevance of digital health education in adult learning and to outline perspectives for future research and educational approaches.

2   Health Literacy, Digital Health Literacy & Adult Education

2.1   Health Literacy

Health literacy has long been an important term in both national and international political discussions. It was first explicitly formulated in the context of the Ottawa Charter, initiated by the WHO, which aimed at creating health-promoting living environments to enable people to gain better control over their health (Bieker & Floerecke, 2011; Keupp, 2000, p. 34; WHO, 1986). Despite numerous current WHO programs and initiatives, the fundamental principles of the Ottawa Charter still serve as a reference framework for health policy and promotion today.

At the end of the 1990s, the Ottawa Charter was expanded to include aspects of social participation:

> "Health is a resource which permits people to lead an individually, socially and economically productive life. Health is a resource for everyday life, not the object of living. It is a positive concept emphasizing social and personal resources as well as physical capabilities" (WHO, 1998, p. 1).

Building on this, the commonly accepted WHO definition states:

> "Health literacy represents the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health" (Nutbeam, 2000, p. 264).

Recent studies highlight the strong connection between health literacy and socioeconomic status internationally. As Marmot and colleagues (Marmot, 2020) have pointed out for England, the health of the population is not only determined by the efficiency of health services but is closely linked to the conditions in which people are born, grow, live, work, and age, as well as the resulting inequities in power, money, and resources. Poor health is strongly associated with poverty, as individuals with lower socioeconomic status are less likely to live in good-quality housing, have time and money for leisure activities, feel secure at home or work, be employed, or afford healthy food (Bambra & Payne, 2020, p. 266). Therefore, although ill health may be perceived as a private trouble, it is embedded in broader social and political processes and should instead be viewed as a public issue (Mills, 1959).

On a national level, the Robert Koch Institute (RKI) published a current and comprehensive definition of health literacy in March of this year:

> "The ability to find, understand, evaluate, and apply health-related information is referred to as 'health literacy.' This encompasses not only reading and writing skills but also knowledge, motivation, and competencies that enable individuals to form opinions and make decisions regarding healthcare, disease prevention, and health promotion in everyday life, thereby maintaining or improving their quality of life over the course of their lifetime. General health literacy describes cross-topic and cross-context abilities in dealing with health-related information. Specific health literacies, on the other hand, refer to individual areas such as health behavior (e. g., nutrition or exercise), diseases (e. g., diabetes or cancer), or digitalization. The level of health literacy in the population is significantly influenced by the quality and availability of information provided, as well as by health literacy-promoting structures in organizations and institutions, including healthcare facilities, schools, and workplaces" (RKI, 2025).

In light of this comprehensive definition, it is now clearer than ever that health literacy represents a societal (educational) responsibility that cannot be reduced to individual accountability but is rather an integral part of basic education (Mania & Tröster, 2018). Additionally, health literacy comprises multiple competency levels, which are generally categorised as functional, interactive/relational, and critical health literacy (Nutbeam, 2000, p. 263). The link to digitalisation is also explicitly addressed, as the context in which health-related actions take place is becoming increasingly digital.

2.2   Digital Health Literacy

The increasingly digital everyday reality can be observed in the health-related context and is also addressed at the political level. The EU4Health program, launched by the European Commission, aims to strengthen healthcare systems by developing digital tools and services and driving the digital transformation of the healthcare sector (European Commission, 2025).

The WHO has defined digital health literacy as "the ability to search, find, understand and evaluate health information from electronic resources and to use the knowledge gained to solve health-related problems" (WHO, 2024). People already vary widely in their ability to manage their health and healthcare, as was shown above within the concept of health literacy. Digital health literacy introduces an additional dimension: the ability to navigate digital environments, which is increasingly required for accessing healthcare.

Health-related digital competencies are therefore becoming increasingly important for both patients and healthcare professionals (Palumbo et al., 2021). An adequate level of digital health literacy is essential to accomplish the digital transformation of healthcare (van Kolfschooten et al., 2024).

This demand stands in stark contrast to the mentioned WHO reports, which indicate that 72 % of EU citizens use the internet to search for health information. However, a significant portion of the population (up to 58 %) faces challenges in accessing, understanding, evaluating, and applying the information needed to navigate healthcare services (The HLS19 Consortium of the WHO Action Network M-POHL, 2021, p. 18). At the same time, the 2023 WHO Report on Digital Health in the European Region reveals that there is currently no coordinated EU-wide strategy to address digital health literacy (van Kolfschooten et al., 2024).

A comprehensive literature review conducted in 2021 gives a deeper understanding about how digital health literacy is discussed internationally (Palumbo et al., 2021).

Of particular interest is the breakdown of the results into the three competence levels already mentioned in the context of health literacy: functional, interactive/relational and critical digital health competencies.

The development of functional skills serves as the foundational step in equipping both users and providers with the necessary competencies to navigate the increasingly digitalised healthcare landscape. These skills encompass the ability to access, understand, and apply digital tools and health-related information effectively, ensuring individuals can make informed choices about their health (Patrício et al., 2020).
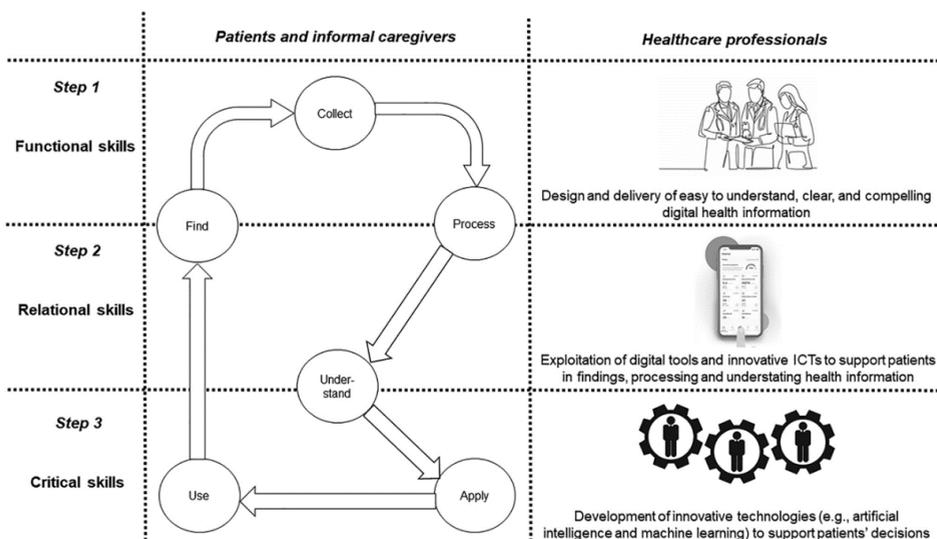
Figure 1: Digital Health Literacy Competencies (Source: Palumbo et al., 2021, p. 90)

Beyond this initial step, fostering relational skills is crucial, as these competencies empower patients, informal caregivers, and healthcare professionals to apply their functional abilities in meaningful ways that foster collaboration and engagement, which means to be able to actively participate in the co-production of health services, leveraging technological advancements to enhance patient care and improve overall health outcomes. Relational skills facilitate effective communication, mutual understanding, and trust-building, forming the foundation for co-creative partnerships in healthcare settings. Such relationships are essential for value co-creation, ensuring that digital health innovations are integrated into everyday practices in ways that are both user-friendly and effective (Barsom et al., 2021).

Finally, strengthening critical skills is vital in an era where health-related misinformation and an overwhelming volume of digital health content can easily lead to confusion and misinterpretation. Critical skills enable individuals to systematically evaluate the credibility, reliability, and accuracy of online health information, distinguishing between evidence-based sources and misleading or harmful content. Moreover, these skills support individuals in assessing the ethical implications of digital health tools, such as data privacy and informed consent. By cultivating a high level of digital health literacy, patients and caregivers can make more autonomous and well-informed decisions regarding health promotion, disease prevention, and treatment options, ultimately leading to better health outcomes and a more resilient healthcare system (Bickmore & Paasche-Orlow, 2012).

On the one hand, digital health literacy concerns the patients and informal caregivers' ability to use digital apps and resources to access, collect, understand and process available health information and to effectively interact with health-care providers in the cyber-physical domain (van der Vaart & Drossaert, 2017). The better the individ-

ual digital health literacy skills, the greater the patients and informal caregivers' ability to function in the digital environment, to exchange data through web-based artifacts with the providers of care and to actively participate in the co-design and co-delivery of health services (van der Vaart et al., 2019). On the other hand, digital health literacy entails the health-care providers' capability to accomplish a transition toward a digital-based and people-centered approach to the provision of health promotion and risk prevention services, which is based on the patients' needs and ensure a fair and not discriminated access to care (Smith & Magnani, 2019). Taken together, the development of functional, relational, and critical skills is key to ensuring that both healthcare professionals and the general population can fully benefit from digital health advancements. Addressing these competencies within healthcare education and training programs is crucial to bridging existing gaps and fostering an inclusive, digitally competent society.

2.3   Adult Education

After outlining the extent to which the development of (digital) health literacy represents a societal educational challenge, the discourse must now be anchored within the context of adult education. Digital health literacy – which includes the ability to find, understand, evaluate, and apply digital health-related information – is highly relevant to adult education, as it directly affects adults' ability to manage everyday health-related demands, navigate increasingly complex healthcare systems, and use digital technologies effectively.

In 2018, the National Action Plan for Health Literacy established a stronger policy foundation for this topic. It clearly states: "The institutions of the education and training system are of great importance for the promotion of health literacy. They accompany people throughout their lives and support the development of cognitive, social and emotional knowledge, skills and abilities that have an impact on health literacy" (Schaeffer et al., 2018, p. 31). This understanding aligns well with adult education's potential, which focuses not only on knowledge transfer but also on biographical learning processes, behavioural change, and empowerment through self-directed learning. As Haug (1991) formulates, "'education' in the context of health-related activities can then be understood as a lifelong process that is relevant for all ages and stages of development and in all areas of life in the sense of self-determined and 'reflective and educational learning' and is characterized by the moments of self-responsibility and self-determination." Education thus becomes a resource for individual and social maturity, particularly when oriented toward learners' real-life experiences and needs. König et al. (2024) recommend "target-specific digital health literacy interventions in the domains of information seeking and information appraisal for people with a low level of formal education, people with a low social status and the older part of the population," pointing to a clear need for differentiated educational strategies.

Despite this promising framing, there is currently no systematic overview of adult education course offerings related to (digital) health literacy. Nevertheless, various research and development projects offer relevant entry points. For instance, the JMIR study (König et al., 2024) addresses digital health literacy in adults with low literacy

levels, suggesting more interdisciplinary potential and relevance for foundational education contexts. MHLS-Germany (Kolpatzik et al., 2024) and HELICAP (Bitzer et al., 2021) explore the health literacy of specific populations such as parents or people with migration backgrounds, collecting valuable data on information behaviour and access barriers. Yet these initiatives rarely reference educational theories or adult learning principles.

The Erasmus+ project iHERE (2020–2022) presents a more education-oriented model. It "supports the vulnerable social groups in developing a set of health literacy and digital literacy skills. This set of complex skills includes the ability to analyse information from digital sources and apply the knowledge to personal health situations" (iHERE Digital, 2021). Similarly, the Robert Bosch Foundation's project "Promotion of digital health literacy among patients and citizens in Baden-Württemberg" emphasises practical access: mobile and stationary showrooms such as the "Digital Health Truck" allow individuals to experience healthcare technologies first-hand, aiming to reduce digital barriers and build everyday competencies (Bosch Health Campus, 2025).

From an adult education perspective, however, these initiatives often lack systematic integration of pedagogical design, didactic reflection, or research-based evaluation. The analysis reveals a clear and persistent need for development at the intersection of health literacy and adult education. Despite this relevance, the integration of health literacy into educational theory and didactic frameworks remains limited. Educational concepts such as transformative learning (Laros et al., 2017; Mezirow, 1991), learner-centred pedagogy (Schrader, 2023; Siebert & Gerl, 1975), and life-world-oriented didactics (von Felden, 2015; Arnold, 1989) have yet to be systematically connected to health literacy research or programmatic development. This disconnect indicates a significant theoretical and practical gap in the current discourse, including theoretically grounded models for conceptualising health literacy as a lifelong learning task; didactic frameworks for teaching health-related topics in formal, non-formal, and informal learning environments; empirical studies on the motivations, challenges, and strategies of adult learners in dealing with health information; and systematic evaluations of educational interventions and their outcomes in health contexts.

Addressing these gaps will require closer collaboration across disciplinary boundaries – particularly between medicine, public health and adult education – to ensure that digital health literacy is not only accessible but also relevant, sustainable, and empowering. The considerations presented so far will now be contextualised with empirical findings from the "COVID-19@home" study, which explores the management of health information during the pandemic and illustrates the concrete role of digital health literacy in everyday adult learning processes.[1]

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1 "COVID19@home" is a study conducted under the leadership of Prof. Dr. med. Sebastian Kuhn (Marburg University) and Prof. Dr. med. Beate Müller (University Hospital Cologne).

3　COVID19@home

From the outset, the COVID19@home study did not focus on adult education; rather, it was a medical implementation study. Nevertheless, the data corpus collected offers interesting clues for the connections between digital health literacy and adult education outlined so far, but it is important to recognise that the presented findings should be interpreted as illustrative rather than comprehensive.[2]

The prospective mixed-methods study "COVID-19@home" was conducted from January to December 2021 in Frankfurt/Main, Germany. In collaboration with eight family practices 51 patients were included in the study. Participants had a legal age (≥ 18 years), a positive polymerase chain reaction (PCR) test for SARS-CoV-2, and access to a smartphone.

Subsequently, the study team instructed the patients in the use of smartphone-based remote telemonitoring (SaniQ, Qurasoft) which combines a smartphone app with biosensors to monitor vital signs and COVID-19 symptoms remotely. By pairing the patient's app with the physician's telemonitoring software (SaniQ Praxis), the general practitioners could monitor the patients remotely. Patients measured and tracked their symptoms and vitals at least once a day for 28 days. If symptoms persisted, patients could extend their participation in the study and continue telemonitoring for a total of 12 weeks.

After the study period was over, all patients were invited to participate in a telephone interview to obtain in-depth feedback on the patients' experiences with telemonitoring. Overall, 34 semi-structured patient interviews were conducted. The interview guide was based on the Technology Acceptance Model (TAM) according to Gagnon et al. (2012) and our own previous work (Brünn et al., 2021; Kuhn et al., 2020; Söling et al., 2020). All interviews were conducted by phone, recorded and transcribed verbatim. Data were analysed using qualitative content analysis.

As this article focusses on digital health literacy in the context of adult education, the presented results refer primarily to the patients' statements that can be connected to this topic. Please note, that as mentioned above for this article there is no full analysis of all interviews rather than examples extracted from the interviews to illustrate aspects of digital health literacy relevant for adult education.

Overall, comments about reducing anxiety, increasing safety and the reassuring effect of continuously monitoring oneself characterised the interviews. In addition, when health improvement was visualised in the retrospective observation of measured values, it tended to have a positive effect on the patients' subjective well-being.

Additionally, some participants' remarks showed that an increase in information on their vital signs had a motivating effect and encouraged them to improve their overall health (e. g. by increasing their number of daily steps). This indicates a general sen-

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2　A systematic and comprehensive evaluation of the interview study focusing on patients' positive and negative experiences with remote patient monitoring and recommendations for further telemonitoring implementations is published in medical context, following the initial purpose of the study (Oftring et al., 2025).

sitisation towards health and an increase in health literacy, especially on the level of functional skills.

> "For me, it was very reassuring that I could monitor myself. And to be honest, that I didn't have to go to the hospital. That I was able to manage everything here on my own, so to speak. Also, where I then... I probably would have decided for myself: 'No, up to this point and no further, now I really have to go, or admit myself to the hospital.' I probably would have made that decision myself. But all these measurements actually contributed to the fact that I was able to make those decisions on my own or together with the doctor." (ID 011)

This interview excerpt highlights that the participant subjectively perceived the ability to collect their own health data as reassuring. Additionally, they felt empowered to make more independent decisions regarding their health. This sense of autonomy aligns with core goals of adult education, where learning is not only about acquiring knowledge but also about empowerment and gaining control over one's life.

Nevertheless, the doctor is still mentioned as the professional, who can interpret the data in cooperation with the participant. The relevance of cooperation with a healthcare professional is found in various other excerpts.

> "Yes, that you really/the GP perhaps already has this information. (I: Yes.) And if there is something like what I just mentioned, that he then says: "I'll give you a call, what's going on with you?", there are certainly people who might not even notice, yes, that there is suddenly such a high pulse rate. And I think that can also save lives under certain circumstances." (ID 006)

> "So I think it's good that you have a bit of an overview of your state of health yourself. (I: Yes.) So you can also classify for yourself what the data that a doctor collects actually means in some way. (I: Yes.) And can categorize it for yourself. And that you can simply give the doctor a greater overview. Because it's always possible that your blood pressure, you're nervous at the doctor's, your blood pressure isn't right or things like that. And with data like that you can show, okay, but it's actually, as a rule, normal. There are just situations where he falls out. And I think it simply gives a better overall impression of the state of health in each case." (ID 041)

These excerpts can be linked to the interactive/relational dimension of digital health literacy competence since the patient was able to facilitate effective communication – in this case, with his healthcare professionals – forming the foundation for co-creative partnerships. At the same time, the ability to discuss data with medical professionals reflects a form of communicative competence acquired through practice, dialogue, and reflection – all central to adult learning processes.

Regarding the exchange of data with the healthcare professionals, participants were disappointed when the data they collected and transferred were not regularly looked at.

> "We were told that we would get ... that the doctor would be able to access the results, right? That, for example, is something that I found out from experience or conversations with the doctors that they didn't do at all. What they did do was to say: "Please take part in the study", but my impression was that at the end of the day it didn't interest them at all." (ID 025)

Such disillusionment may also have a learning effect in itself. When expectations about digital collaboration are not met, it creates a **reflective space** in which individuals reconsider their role as data producers and consumers within the health system. This kind of reflection can indicate a form of **transformative learning**, in which adults revise their assumptions and begin to develop new understandings of institutional processes and their own agency.

Another important factor related to the guarantee of data protection, which was a precondition of data collection, and something that some patients asked about.

> "Yes, the disadvantage is of course data protection. You can never be 100 % sure with any app, whatever they may say, what is going to happen with the data, right?" (ID 010)

Concerns relating to data protection are directly linkable to the critical dimension of digital health literacy. In one case a participant even considered to not take part in the study because of data safety concerns. This shows a higher level of critical digital health literacy since the person decided after a thorough evaluation of the project and used health applications, that a participation is data safe (since all data collected is stored within Germany and is protected by DGSVO). Especially regarding sensitive data as health information, a critical position is crucial for protecting personal data – not in a way that excludes one from using digital health services but in a way that enables one to make informed decisions about what digital health services are truly a benefit.

This evaluative and critical stance also reflects key objectives in adult education, where the aim is not just knowledge acquisition but also capacity-building for independent judgement in complex sociotechnical environments (Kloubert, 2018). Through participation in the study and the associated reflection processes, patients developed not only health-specific skills but also broader digital and civic competences, which are crucial for navigating a digitalised society.

Even though the "COVID-19@home" study did not explicitly focus on increasing digital health literacy, it provided valuable insights into its significance in ensuring health-related self-determination in the context of a progressively digital healthcare environment as a field of action for adult education. The patients engaged in a form of **self-directed learning**, where they independently interpreted health-related data and made decisions accordingly. The process of collecting, understanding, and acting upon personal health data reflects **informal learning** in daily life, a central element in adult education theory. This self-directed and context-driven learning experience supports the acquisition of competences that are relevant far beyond the specific use case and may foster **lifelong learning attitudes**. The strong connection to life-world-oriented didactics and the clear importance of digital health literacy in adulthood highlights the need for a systematic approach from the perspective of adult education at the theoretical, programmatic, and research levels.

4   Discussion

The findings discussed in this article highlight the growing importance of integrating digital health literacy into adult education. As digitalisation continues to reshape healthcare systems, the ability to navigate, interpret, and apply digital health tools is becoming an essential competency – especially for adults managing chronic or long-term conditions. Participants' experiences illustrate key principles of adult learning, such as self-directed learning, empowerment, informal learning, and critical reflection. Digital tools were not only perceived as health-related instruments but also served as resources for learning and development. Through their use, individuals actively constructed knowledge by engaging with real-life health data, reflecting on their experiences, and communicating with healthcare professionals.

These learning processes point to the central role that adult education can play in strengthening digital health literacy. Educational initiatives should acknowledge and build upon adults' prior experiences, digital competencies, and learning needs. In this context, digital health literacy must be understood as more than a set of technical skills. It encompasses functional, interactive/relational, and critical competencies, all of which are central to lifelong learning and informed health decision-making.

The study findings emphasise particularly the importance of relational and critical digital health competencies. When participants felt that their self-tracked data was acknowledged and used by health professionals, they reported greater engagement and trust in digital health tools. Conversely, when their input was ignored, they felt disappointed and questioned the relevance of the technology. This highlights the educational potential of fostering co-creative and dialogical relationships between patients and providers. Strengthening critical competencies is equally vital, especially in a digital environment saturated with health misinformation. Adults need the skills to assess the reliability of online content, understand data protection issues, and evaluate the benefits and risks of digital applications. These critical skills enhance not only personal autonomy but also responsible engagement in health promotion and disease prevention.

Despite the growing relevance of digital health literacy, adult education has so far played only a marginal role in its dissemination – both in research and in practice. There is a pressing need for structured educational initiatives that embed digital health literacy at all three competence levels into broader adult education frameworks. By equipping individuals with the necessary tools to critically and confidently engage with digital health technologies, adult education can contribute to more equitable healthcare, support self-efficacy, and ultimately improve health outcomes on both national and international levels.

However, a limitation of this article lies in its specific analytical focus. As it concentrates on digital health literacy in the context of adult education, the findings presented refer primarily to statements from patients that are thematically connected to this perspective. A full analysis of all interviews was not conducted; instead, selected excerpts were used to illustrate relevant aspects of digital health literacy, such as self-

directed learning, empowerment, and patient-professional interaction. A study that is designed from the outset with a specific focus on digital health literacy and adult education could more systematically collect and analyse relevant dimensions. Future research would benefit from such an approach to more fully capture the complexity of patients' learning processes and needs in digital health contexts.

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Political Socialisation in Mediatised Adulthood

On the Importance of Political Media Education

Franziska Bellinger and Lisanne Heilmann

Abstract

The article examines the increasing interdependence of media use and political socialisation in mediatised societies. It is argued that social media, especially TikTok, have gained central importance for political learning and political opinion-forming of adults. Traditional boundaries between politics and media are becoming blurred, making political communication more dynamic and reciprocal. The analysis shows how right-wing populism in particular is spread on TikTok through platform-mechanisms, codes and emotionalising narratives. It argues in favour of an integration of media education and civic education, as these seem to be inextricably linked today. Based on Negt's understanding of democratic education, the necessary competences for critical-reflexive civic media literacy are discussed. Finally, recommendations for political media education are expressed that enable adults to recognise populist narratives and strengthen democratic values in digital spaces.

Keywords: political socialisation, political learning and opinion forming, informal learning, civic education, citizenship education, media education

Zusammenfassung

Der Artikel untersucht die zunehmende Verflechtung von Mediennutzung und politischer Sozialisation in mediatisierten Gesellschaften. Es wird argumentiert, dass soziale Medien, insbesondere TikTok, von zentraler Bedeutung für das politische Lernen und die politische Meinungsbildung von Erwachsenen avanciert sind. Traditionelle Grenzen zwischen Politik und Medien verschwimmen, sodass politische Kommunikation dynamischer und wechselseitiger wird. Die Analyse zeigt, wie besonders rechter Populismus durch plattformspezifische Mechanismen, Codes und emotionalisierende Narrative auf TikTok verbreitet wird. Es wird für eine Integration von Medienbildung und politischer Bildung argumentiert, da diese heute untrennbar miteinander verbunden scheinen. Basierend auf Negts Verständnis demokratischer Bildung werden notwendige Kompetenzen für eine kritische-reflexive politische Medienkompetenz diskutiert. Final werden Empfehlungen für die politische Medienbildung formuliert, die Erwachsene dazu befähigt, populistische Narrative zu erkennen und demokratische Werte in digitalen Räumen zu stärken.

Schlüsselwörter: politische Sozialisation, politisches Lernen und Meinungsbildung, informelles Lernen, politische Bildung, Medienbildung

1   Introduction

One of the multiple effects that modern media, especially social media, have, is that the boundaries between politics and media have become increasingly blurred. Political discourse is no longer confined to traditional (journalistic) media or locally connected communities. Instead, discussions are happening between larger groups of people, often across time zones and country borders. At the same time, political communication has become more dynamic and more reciprocal as political actors start presenting and interacting on social media while others get opportunities to speak their mind (Lipschultz, 2023). An increasingly complex entanglement of (social) media and politics requires us to look more closely on how we understand both and how conceptualise political and media-related socialisation and learning as a consequence.

While the process of political socialisation has always been influenced by media, currently, this influence has increased and become more intricate to recognise and understand. Traditional media have declined in importance, while platforms like Instagram and TikTok increasingly shape how adults learn about politics. Therefore, social media is where they encounter political discourse (Heilmann, 2024); they are able to express their own views and engage with others about them, and they gain and shape their understanding of democratic values and social justice. All the while, these discourses are often highly charged, societal power relations are reproduced (Boffone, 2022) and while democratic regulations are often missing, the platforms themselves show forms of regulations and even censorship (Ryan et al., 2020). This can be seen from the spread of right-wing populism to the manipulation of electoral processes, digital surveillance, but also to the rise of activist movements. Social media has made movements such as #MeToo and Fridays for Future possible, as they allowed for visibility and for community as well as community building, as they are not only mirroring current political topics but becoming relevant sites of political struggle.

Therefore, the objective of this article is to demonstrate that media learning and civic learning are not only independent of each other, but in a way entangled that they are mutually constitutive and that neither is possible nor sensible without the other: Media education without understanding and critically examining the political conditions and consequences of the consumed media neglects the risks for our democracies and people's freedoms. Citizenship education without media literacy cannot help individuals to guard themselves from disinformation and propaganda. Based on this fundamental conviction, we explore this interdependence from several angles. We will combine interdisciplinary findings from media socialisation and civic education and compare the thereby gained syntheses with knowledge about the mechanisms of TikTok. We refer to Negt's (2011) understanding of education for democracy (Zeuner, 2013), and follow Oberle's (2022) conviction that viewing media education as political is vital for the preservation and defence of democracy. We will demonstrate the importance of further developing and researching political learning in a mediatised society.

Although this theoretical based approach does not necessarily offer new empirical insights or knowledge of the way that right-wing populism on TikTok works or em-

pirically proven effects of the platform in general, the juxtaposition of these different theoretical and empirical perspectives allows us to shine a light on a relevant but often overlooked field of adult education research on digitalisation.

2 Political Socialisation, Civic Education and Media Learning

First, understanding civic education in today's society requires a closer look at how political identities and beliefs are formed through everyday (media)experiences. Therefore, the chapter examines political learning in mediatised societies through three interconnected dimensions: First, it explores how political socialisation has evolved in mediatised environments, emphasising the lifelong development of democratic competencies and identities. Second, it analyses the convergence of media socialisation and political media literacy as essential skills for navigating digitalised public spheres and democratic participation. Third, it investigates TikTok as a specific case of informal political learning, highlighting both the platform's potential for community building, identity forming, and knowledge sharing, as well as concerns about misinformation, attention spans, and populist influence.

2.1 Political Socialisation in a Mediatised Society

Political socialisation is a lifelong process in which individuals continuously learn and adapt to ways of thinking, discussing and acting on political topics, and overall crystallise political identities that remain largely consistent throughout life (Neundorf & Smets, 2015). While the process begins in early childhood, it continues throughout life, always influenced by a variety of factors, agents, and contexts like family and friends, peers, school and work life, religious institutions and media (Campos & Martins, 2024). For a long time, political socialisation was seen as a linear process of learning and adapting to surrounding norms and values, often closely linked to educational systems. However, a more recent understanding focusses on the dynamic and potentially lifelong developing systems of political identities, belief and understandings (Haegel, 2020). It further includes the way people learn how to navigate the political systems, learning their rights and ways to participate (Holecz et al., 2022). In their participation, they ideally gain political efficacy and an understanding of their self-efficacy (Oser et al., 2022). Studies have shown that social media influencers can potentially have a significant impact on shaping their followers' political efficacy (Harff & Schmuck, 2023). Moreover, a meta-analysis demonstrated that online political participation is strongly associated with feelings of political efficacy – comparable to those generated by offline participation (Oser et al., 2022).

This process of political socialisation is not only relevant for the individual's identity and development, but has a fundamental function for the society. Every society needs some kind of understanding on how to act and behave in it. But especially democratic societies depend on their citizens' understanding and willingness to continue, maintain and further improve democratic structures (Negt, 2010). This includes theo-

retical learning about structures and regulations, as well as their histories and reasoning. It also includes a practical approach to experiencing forms of democratic decision-making (Kessler, 2023, p. 241). This is important not only for understanding how to vote in national elections, but also for fostering a shared sense of how democracy works – its limits, its structure, and the individual's ability to engage and create change. Therefore, modern and global civic and citizenship education approaches focus on the "roles, responsibilities, and rights of individuals on a global scale" (Heggart, 2024, p. 65). Additionally, being socialised into a democratic society also means to learn its values and broader necessary skills to not only be able to vote but also to be an educated and emancipated citizen (Negt, 2010). These democratic values cannot be reduced to elections alone, but also include a commitment to human rights and the protection of marginalised groups as central aspects of a democratic disposition. Civic education needs to take social injustices and individual's realities of living into account (Bremer & Trumann, 2019).

Accordingly, Negt (2010) calls for six different skills that are needed for members of a democracy: (1) Individuals need to understand themselves and build their identities as democratic citizens. As such, they need to be able to handle the ever-changing challenges of a modern world including social and political transformations. Such an understanding of democratic values as central to one's identity offer a guideline and framework to differentiate between helpful and harmful technology (Negt, 2010, pp. 223–224). (2) They need to be able to look critically at technology and in today's time especially at digital media, as they often have opaque connections and consequences that heavily impact societies and individual's lives (Negt, 2010, pp. 223–225). (3) Citizens need to be able to see and understand injustices, they need to be able to reflect them and their own role in them, and they need to find ways to talk about and resist social injustices and inequalities. Furthermore, they need a deep understanding and valuation of their rights and learn to see when and how seemingly small moments in everyday life are connected to fundamental rights of our democracy (Negt, 2010, pp. 226–229). This is particularly important in capitalist societies where unequal power relations prevail, which can lead to members of society who feel like 'losers' losing confidence in democracy (Negt, 2010, p. 517). (4) An understanding of nature as a baseline of all life is further needed. Negt called this an ecological competence. He referred not only to a sensible and careful handling of natural resources in regards to the climate change, exploitation of nature, or clean environments, but also as a generally respectful, careful and nonviolent understanding of nature – including human and one's own nature. The aim is to understand these natures as ecological contexts in which we are built and are entangled in – often in complex ways (Negt, 2010, pp. 229–230). (5) Equally, an economical competence does, according to Negt, not mean to be economical or financially sound, but rather to understand the complexities with which our everyday life as well as our democratic system are entangled with economic mechanisms. In this context, being economically competent means to understand how a change made by the economy will influence the society as a whole or parts of the society (Negt, 2010, pp. 230–232). (6) The historical competence is probably the most refer-

enced of Negt's six competencies. It calls for a reflection and a critical understanding of one's personal history as well as our history as a society (Negt, 2010, p. 232–233).

Not only skills and competencies are challenged in a mediatised society. While some forms of community suffer with increased digitalisation, others – especially marginalised people – are able to build new forms of community via social media (Skinner, 2022). At the same time, there are increasing concerns about the pace of life being accelerated by digitalisation and about our capacity to experience resonance and empathy in community with others (Unay-Gailhard et al., 2023; Wienberg & Buddeberg, 2020).

2.2 Media Socialisation and Political Media Literacy

As shown, political socialisation is closely linked to the dynamics of mediatised societies. When looking at the influence of social media in that lifelong process, it seems inevitable to also put the process of media socialisation into perspective. The circumstance that media play a central role in the socialisation process of individuals is also recognised in adult education science (Schmidt-Hertha & Tippelt, 2020, pp. 97–100). Following Jörissen and Marotzki (2009), socialisation processes in modern times are deeply connected to and permeated by media structures (Jörissen & Marotzki, 2009, p. 239). Adults' media usage practices have changed over the years, which is linked to the transformation of media itself and particularly affects information and communication behaviour (Initiative D21 e. V., 2025). Traditional media (print, radio, TV) is in decline as adults increasingly turn to social media for news and political discussion. In the EU, 64 % of adults read online news and 18 % engage in digital civic or political participation; in the US, about half of adults regularly get news from social media platforms (OECD, 2024, p. 34).

From a theoretical point of view the understanding of media socialisation in this article is closely linked to interactionist perspective, which is presented in the theory of socialisation by Bauer and Hurrelmann (2021). In the sense of a "productive processing of reality" (Bauer & Hurrelmann, 2021, p. 10, author's translation), socialisation describes a lifelong process of personality development in an interrelationship with social living conditions, whereby the individual does not simply adapt to their environment or society, but – ideally – creates a productive fit between themselves and their environment. As media have developed into a key instance of socialisation due to their omnipresence in people's lives, media education focuses on the process of media socialisation. Based on the interactionist perspective, Aufenanger (2022) describes media socialisation as follows: "Media socialisation can thus be understood as the active engagement of people with media offerings in a media-influenced world, which can itself influence their thoughts and actions" (Aufenanger, 2022, p. 60, author's translation). Two perspectives on the process of media socialisation are addressed in media education: On the one hand, the influence of media on the process of personality development is of interest; on the other hand, the question of what competencies people need in order to be able to act appropriately in a mediatised world. Focussing on the second perspective, the acquisition of media literacy becomes relevant – especially for learning in a mediatised society over the lifespan.

The concept of media literacy is broadly discussed in adult education and it is hence understood as a necessary key competence (e. g. Hippel & Freide, 2018; United Nations, 2024). In this context, Hellriegel and Rohs (2023) argue that there is a need for programmes to promote media literacy in adult and continuing education that, rather than focussing on a functional qualification level, enable a critical examination of the consequences of the digital changes. The central role of media literacy is also emphasised by Oberle (2022) for the maintenance and further development of democratic societies in the digital age. Based on the digital structural change of the public sphere, Oberle argues that while new information and communication technologies can promote the participation of citizens, they also pose risks such as digital control, information overload, disinformation and social inequalities.

Considering these challenges, media literacy is becoming an indispensable skill: it includes the critical analysis of media content, an understanding of media processes and the ability to actively and reflectively use digital media. The author's particular focus is on political media literacy (Oberle, 2022, pp. 122–125), which she defines as the ability to critically analyse political content in digital media, to understand political communication processes and to actively and responsibly participate in them. This competence enables citizens to navigate the digitalised public sphere in an informed, reflective and democracy-promoting manner. Furthermore, Oberle highlights implications for civic and political media education and states that it must adapt to the changing conditions of the digital world. Consequently, this requires new didactic approaches that incorporate digital media and specifically promote the development of media literacy (Oberle, 2022, pp. 127–130). Oberle's statements show that media education is always civic education and vice versa. The promotion of political media competence as a goal thus provides the reference framework for civic education in adulthood in order to ensure a critical and reflexive political learning and engagement with political content in mediatised society.

2.3   Populism and Political Learning on TikTok

TikTok distinguished itself by synthesising three key features of consumer retention: It provides audio-visual content, it relies heavily on algorithmic recommendations, and – unlike YouTube, for example – it has a mobile-first interface (Guinaudeau et al., 2022). Videos on TikTok can last up to 10 minutes but are mostly between 30 seconds and 3 minutes long. They are predominantly shown on the so-called For You Page, which allows for endless scrolling and which is structured by a non-transparent and proprietary algorithm. First, TikTok was known as a platform for dance trends of younger generations but has quickly evolved into a space for all generations to share and engage in almost every topic and facet of life: Ranging from tips for knitting or cleaning and sharing experiences with specific symptoms or illnesses to discussing political issues (e. g. Allekotte, 2022; Schellewald, 2023). Additionally, mechanisms of society as a whole are also evident in these digital spaces and are being continuously reproduced. Hate speech and discriminatory narratives on platforms such as TikTok are by no means isolated cases, but rather an expression of more deeply rooted power relations. A cen-

tral issue in this context is the cultural and economic appropriation by white users and influencers, who profit from the creativity of Black people and People of Colour. This appropriation (e. g. of dances or sounds) often goes without recognition or financial compensation for the original creators (Davis, 2022; Sweeney-Romero, 2022). At the same time, TikTok has the potential to connect and empower marginalised communities in ways that would otherwise be impossible. Skinner (2022), for example, described the multiple ways in which young queer people can find a sense of community and belonging (Skinner, 2022). Similarly, neurodivergent (esp. ADHD) people have been able to find each other but also learn about themselves from each other after being connected by the TikTok algorithm (Leveille, 2024).

Overall, TikTok has become an increasingly important platform for people to find themselves and each other, and to socialise. Right-wing parties in various countries were among the first to understand this and to deduce the importance and the possibilities of TikTok for communicating political content to younger generations. In Germany, for example, the AfD (Alternative für Deutschland), a right-wing and in parts even extremist and unconstitutional party has been using the platform to gain followers and to spread their perspectives (Bösch, 2023). In the context of Sweden's 2022 elections, a wave of right-wing ideology on TikTok could be observed and the platform was expected to further play a role in the ways that political elites communicate (Widholm et al., 2024).

Looking at TikTok as a place of informal learning, people often worry about the effects of TikTok on our capabilities to learn and to concentrate. First studies are indicating, that spending time on TikTok indeed does seem to shorten our attention spans (Faradis & Reksiana, 2022) and our abilities to learn and to concentrate on learning (Alfatih et al., 2024). A small study among students in the USA indicates that especially young generations tend to use the platform even to explicitly search for information and they are increasingly getting their news from TikTok (Leppert & Matsa, 2024). While the platform has no form of democratic control, it is increasingly becoming a place where adults are not only learning but also a place they specifically visit to gain knowledge on specific issues: From mental health (McCashin & Murphy, 2023) to contraceptive information (Döring et al., 2023) to the negotiation of diversity (Heilmann, 2024), TikTok is a place where people inform themselves and learn (Wolf, 2021).

3 Platform Dynamics and Right-Wing Populist Discourse Strategies on TikTok

Having previously examined how political identities and competencies emerge in mediatised societies by analysing political socialisation, media literacy and informal learning as central dimensions of political learning using the example of TikTok, the platform dynamics of TikTok will now be focussed on. Codes, narratives and aesthetic design tools of populist actors as well as the conditions of the TikTok platform need to

be critically analysed in order to derive implications for research on civic and political media education and programmes for adults.

3.1   Platform Conditions and Mechanisms

Fundamentally, TikTok is a privately owned platform that has very little democratic oversight and regulation. In 2020, an extensive political report was published that revealed censorship and unsafe handling of personal data by the company ByteDance (Ryan et al., 2020). Among the demonstrably suppressed keywords were #acab ('all cops are bastards'), Russian-language criticism of Putin and nine hashtags expressing queer identities in different languages (Ryan et al., 2020, p. 5). This suppression takes place either through the direct blocking of videos (e. g. by blocking them with reference to the community guidelines) or through so-called shadowbanning[1] (Braun et al., 2023, p. 11). A spokesperson for the platform later apologised for the censorship of queer topics and creators, describing it as a mistake and announcing improvements (Bacchi, 2020). The extent to which these were actually implemented is unclear and is doubted by many users.

Concerns about censorship or shadowbanning are particularly prevalent for marginalised groups and lead to so-called algospeak (a combination of algorithm and speak) in many places (Steen et al., 2023). The aim of these linguistic adaptations is to bypass censored or suppressed formulations so that communities and topics can be and remain visible (Ungless et al., 2024). While there is no reliable information on the actual numbers of censorship by the platform itself, many communities are dominated by a strong perception of this. These experiences and concerns are thematised and thus, beyond the negative effects of censorship, lead to harmful effects on the psyche and cohesion of these groups (Ungless et al., 2024). This leads to the increased development of individual and new language patterns (Calhoun & Fawcett, 2023). This necessity alone disempowers marginalised groups and strengthens right-wing talking points on TikTok.

While this aspect can be attributed to the platform directly, the mechanism of the platform allows for multiple further effects that are or empower right-wing populism. New technological advances like deepfakes[2] allow actors to actively disseminate disinformation in a credible way and to it in strategic ways. By employing so-called 'bot farms'[3], large amounts of fake accounts can be continuously created and fake videos disseminated (Moore, 2023). Russia's use of this and its impact, for example, are so extensive that they can be described as hybrid warfare comparable to the Cold War (Virtosu & Goian, 2023). The deepfakes are particularly practical for this purpose, as even if they could be reliably identified, generalised doubts are being cast on video and audio material, thereby eroding the general public's trust in official media and ultimately fur-

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1   Shadowbanning is a process in which videos on TikTok are not blocked but their distribution via the algorithm is suppressed.
2   Deepfakes are AI-generated video or audio recordings that appear realistic. Often real material is used and adapted so the content seems authentic.
3   Fake accounts that are created by computers are often called 'bots'. Bot farms are multiples of those accounts that are often established with malicious intent. They are the successors of 'click farms', where real people were (often badly) paid to create as many fake clicks as possible for their clients.

ther damaging social cohesion (Verma, 2023). TikTok is more suitable for this than other platforms, as the algorithm works less via liking and following specific accounts or videos and instead initially plays new content at random.

This mechanism plays into the hands of another typical right-wing phenomenon: In times of post-capitalist societies, people increasingly struggle to live up to ideals, responsibilities and consequences are highly individualised, and this leads to fear, shame and insecurities – all of which bring with them a high potential for right-wing populism to transform these into anger, resentment against each other and identities that are closely connected to political parties (Salmela & von Scheve, 2017). These societal mechanisms are now connected to the way that TikTok functions, especially the shortness of the videos and the algorithm pushing videos that evoke strong emotions and therefore increase the traffic on the platform. Populist videos offer alternative interpretations to individualised ideas of success or failure and therefore alternative emotions to shame and inadequacy by evoking strong negative feelings towards minorities that are portrayed as scapegoats and offer more positive identities. Both are elements that increase the viewers' willingness to interact with the video (Salmela & von Scheve, 2017).

3.2 Codes and Narratives

Further strategies of right-wing populism include the use of multiple codes and narratives. While marginalised communities need to use the algospeak to protect themselves, right-wing groups use dog whistles to connect with each other and further spread their ideas. Dog whistles are words or phrases (but can also be non-verbal) in which most often racist ideology is hidden so that people who share it as well as those who are to be attacked do understand the real meaning, while everyone else tends to interpret the statement as inoffensive (Tillyris, 2024). When addressed, the speaker can always camouflage their real intentions behind the inoffensive alternative interpretation (Filimon & Ivănescu, 2024, p. 184). Again, this is a mechanism that further destabilises our democracies.

A prominent narrative that populist and right-wing actors adopt on TikTok is antifeminism. These positions are motivated by the belief in a 'natural gender order', which is particularly rooted in religious fundamentalist ideologies and is used in right-wing circles as an argument to legitimise acts of discrimination and violence against women (e. g. Kemper, 2024). Antifeminism not only threatens women's rights, but also democratic values (Herberth, 2024). Those narratives on TikTok use anti-women and anti-queer stereotypes in a derogatory manner and denigrate the physical characteristics and intellectual abilities of women and queer people (Rafael, 2023, p. 299). Therefore, antifeminism can be understood as a bridge ideology that enables the entry into other forms of group-focused enmity. Alongside party political actors (e. g. from the AfD or the GOP), antifeminist narratives are presented in the content of influencers of the so-called Manosphere. Jasser & Rothermel (2024) refer to various sub-groups of the manosphere, including Incels (short for involuntary celibate men), men's rights activists, pick-up artists and the 'Men Going Their Own Way' movement. Those sub-

groups share specific ideologies such as the Red Pill/Blue Pill thesis, according to which there are two ways of looking at the world: The illusion (Blue Pill) and the truth (Red Pill). The latter is the belief that men are the true victims of the system and are oppressed by feminism. Other perspectives are dismissed as an illusion (Blue Pill) and removed from the echo chamber. This representation favours a distorted perception, making it easy for those affected to find supposed evidence for their ideology (e. g. Kelly, 2021; Dignam & Rohlinger, 2019). Other influential creators that promote anti-feminist narratives are the so-called Tradwives. While a concept rooted in systemic misogyny and white supremacy underlies the 'traditional wife' concept, Proctor (2023, p. 21) argues that Tradwives cannot be solely attributed to antifeminism and white nationalism. They represent online personalities who propagate traditional gender roles and a traditional family life and see it as their task to have children and take care of the family's needs while men pursue gainful employment (Tebaldi & Baran, 2023). Nevertheless, this antifeminist narrative is favoured by nationalist actors on social media to spread populist positions. Following Zahay (2022, pp. 172–173), the representation of femininity is specifically used by actors of the Alt-Right movement in the USA to spread anti-feminist positions and discourse (e. g. on biological genders and traditions). This highlights the importance of female aesthetics in online communication on social media, which is also part of the right-wing populist discourse on social media in general and TikTok in particular (Bellinger & Kramer, 2024).

3.3   Playing with Emotions

Parties such as the German AfD have been shown to use provocation and emotionalisation to increase traffic on their accounts (Degen & Olgemöller, 2023). By evoking mostly negative emotions and by fear-mongering insecurities and anxieties, they are bypassing people's rational considerations and keeping people enraged and engaged (Decker & Lewandowsky, 2017). Classen et al. (2024) identify seven forms of "emotional and fear-inducing stylistic devices: Subjective Assessment, Building Scapegoats, Exaggeration, Sense of Community, Moral Adjectives, Portrayal of Threat Scenarios, Fear Mongering through Generalization" (cursive in original, Classen et al., 2024, p. 112). The aim with which these strategies are used is to present and normalise radical and inhumane solutions in order to increase approval. This form of normalising right-wing ideology happening in populist right-wing TikToks is further based on a de-demonisation. By not only invoking fear and negative emotions, but also combining them with portrayals of a caring, less threatening and more accepting in-group, radical ideas are stripped of their de-demonised character (Albertazzi & Bonansinga, 2024).

4   Conclusions for Political Media Education of Adults

Understanding the deep interconnectedness of media learning and political learning is essential in our current democracy. There is a need to establish a political media education as a distinct field and focus of adult educational research on digitalisation. Transferring Negt's six skills for democracy into today's world of platforms like TikTok and

rising right-wing populism, we can adapt them for political media education: A lack in democratic identities seem to be one of the main reasons that parties like the German AfD are succeeding in spreading their populist ideologies. A critical look at media education therefore must built on strengthening people's identification of democratic values online as well as offline. The second skill, to look critically at digital media, holds true as a key competence for political media education. Thirdly, to see and understand social injustices becomes equally easier and more difficult via TikTok. Wars and genocides are livestreamed and people have access to suffering and misery that extends far beyond their own private space. The term 'doom scrolling' describes a continuous viewing of negative news as an almost addictive practice. Learning to recognise when people are suffering and when social injustice is occurring remains a central competence. At the same time, the new technology also makes it more necessary than ever for us to learn not to remain trapped in this watching and to take a critical look at our own role. In order to do so, the fourth skill, the ecological competence, is needed. Understanding and reflecting our own nature, our needs and wants and how they relate to our media (and especially TikTok) consumption is an essential prerequisite to a critical usage of TikTok. Equally, the increasing complexities of the connections between global and social justice and platforms like TikTok often remain obscured. This is precisely where the economic competence becomes relevant as it focusses on recognising the connections between one's own media consumption and global structures. Questions on the impact on the climate by TikTok servers or what data TikTok can access can and should be raised in political media education. As well as: What happens to the data afterwards? Who benefits financially from my media consumption and what ideologies are being spread? With regard to political media education, this means that historical references (such as dog whistles) must be recognised and their further development must be continuously discussed. These interconnected skills form the foundation for a political media education that prepares citizens not only to consume digital content, but also to actively shape democratic discourse in mediatised societies.

Challenges like algorithmics polarisation, disinformation, right-wing populism, censorship on privately owned platforms, and digital capitalism cannot be adequately understood and addressed through either media education or civic education alone. What is needed is more research that explicitly investigates and conceptualises the competencies that are required to navigate, critique and change the political dimensions of our mediated lives. Our understanding of civic education is changing, but is still too often rooted in an understanding of political participation that does not include the affective, performative and fast-paced practices of digital participation. Especially (but by far not exclusively) young people are engaging in political expressions through memes, TikToks, hashtags, and digital communities. Political media education must take these expressions seriously as emerging forms of civic identity and engagement that require reflection and guidance. The dimension through which right-wing populist actors exert influence that have been included in this paper (see Chapter 3) are central to understanding the spread of anti-democratic ideologies. They are therefore funda-

mental to conceptualisations of civic education in a mediatised adulthood, the essential components of which are outlined below.

First, TikTok's algorithm-driven architecture, rapid pace, and focus on maximising user attention create an environment where populist content thrives. The platform itself is inherently undemocratic, which becomes even more problematic given its role in community building and learning. Political media education must not only cover the mechanisms behind such platforms but also equip citizens with the skills to navigate them. People need to understand how algorithms work, how virality can distort truth, and how to identify reliable sources of information. Institutions, on the other hand, must be trustworthy and demonstrate their credibility. This aligns with Negt and Oberle's call for critical media literacy as an essential component of civic education. However, this will not suffice. Modern civic education must also foster self-reflection, helping individuals to understand how their needs and identities intersect with large international corporations like ByteDance, TikTok's parent company. One way to help users gain more distance from TikTok's constant video stream could be by encouraging a slower pace, take a second look and critically reflect and talk about what they have seen. It seems essential to further explore how the everyday demands of continuous performance and speed play into TikTok's attractiveness.

Furthermore, right-wing populism on TikTok operates through opaque and interconnected codes and narratives. They are often highly dependent on context and deeply embedded in everyday pop-cultural content, which makes them especially potent and difficult to detect. While there is increasing research on multiple, specific codes and narratives of right-wing populism, there are still open questions of how political media education can better prepare adults to confront it. Returning to Negt, especially the idea of forming a stable identity as a democratic citizen, can be seen as elemental. Further, to be able to actively object and disagree with subtle presentations of populism, adults need to learn what that contains but also deeply internalise why their objection is important.

And lastly, playing with people's emotions is maybe one of the most impactful ways in which right-wing actors gain popularity. To resist this effect, we need a greater focus on emotional literacy. In political media education, a focus on emotional self-regulation and empathy seems necessary to be able to consume political content without falling for and critically question right-wing ideologies. In a society, where everything from health and appearance to success in labour and finding a partner is individualised, it seems necessary to understand these mechanisms and focus on the prevalent feelings of shame and inadequacy – not only to limit the spread of right-wing populism but also to improve and heal as a society. A strong alternative to populist suggestions is to focus on community: Individuals deep wish and need for community that welcomes and accepts them, needs to be further reflected. How can we feel safe with each other? Again, slowing down, giving us more time for empathy and not falling for the emotionally easiest option could be a helpful way to gain more control in our collective handling of platforms like TikTok – in addition to direly needed democratic regulations and limitations.

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Adapting to the Digital Transformation

Needs-based Design of Media-Supported Educational Formats in Organised Adult Education

Lisa Breitschwerdt

Abstract

In recent years, adult and continuing education (ACE) organisations have notably diversified their media-supported educational formats – ranging from on-site formats with integrated digital media to fully online and combined formats (hybrid or blended). This chapter investigates which media-supported formats are offered by ACE organisations and what needs and demands they address from organisational, professional, and participant perspectives. It combines a typology of media-supported educational formats with an exploratory review of studies from German-speaking countries and a case study. Findings highlight the importance of thoughtful didactic planning, transparent communication and learner support as well as challenges like limited resources and market dynamics. Educators require media education competencies and structured support, while participants seek flexible, individualised formats – placing greater responsibility on them as learners. Further research is needed on organisational conditions, format development in programme planning, staff professionalisation, and participants' decision-making processes.

Keywords: media-supported educational formats, digital media, organisations, participants, professionals, adult and continuing education

Zusammenfassung

In den letzten Jahren haben Organisationen der Erwachsenen- und Weiterbildung (EBWB) ihre mediengestützten Bildungsformate deutlich diversifiziert – von Präsenzformaten mit integrierten digitalen Medien bis hin zu vollständig onlinebasierten und kombinierten Formaten (hybriden oder blended). Dieses Kapitel untersucht, welche mediengestützten Formate von EBWB-Organisationen angeboten werden und welche Bedarfe und Anforderungen sie aus Perspektive der Organisationen, Professionellen und Teilnehmenden adressieren. Es verbindet eine Typologie mediengestützter Bildungsformate mit einem explorativen Review von Studien aus dem deutschsprachigen Raum sowie einer Fallstudie. Die Ergebnisse unterstreichen die Bedeutung durchdachter didaktischer Planung, transparenter Kommunikation und Lernendenunterstützung sowie Herausforderungen wie Ressourcenengpässe und Marktdynamiken. Pädagogisches Personal benötigt medienpädagogische Kompetenzen und struktu-

rierte Unterstützung, während Teilnehmende flexible, individualisierte Formate erwarten – was ihnen zugleich mehr Verantwortung im Lernprozess überträgt. Weitere Forschung ist erforderlich zu organisationsspezifischen Rahmenbedingungen, zur Formatentwicklung in der Programmplanung, zur Professionalisierung des Personals sowie zu Entscheidungsprozessen von Teilnehmenden.

Keywords: mediengestützte Bildungsformate, digitale Medien, Organisationen, Teilnehmende, Professionelle, Erwachsenen- und Weiterbildung

1   Introduction

Media-supported formats that deliberately incorporate digital media and technologies for didactic purposes have become increasingly important in organised adult and continuing education (ACE). They range from on-site formats with integrated digital media to fully online and combined (hybrid or blended) formats. In recent years, we can observe not only a growth but also a diversification of media-based formats within ACE organisations (Poopalapillai & Buchs, 2023). In particular, the experiences of the COVID-19 pandemic highlighted the advantages and possibilities of using digital media to deliver educational programmes. Until 2020, purely online formats were mainly offered by specialised providers; however, following the first lockdown they became the predominant educational format due to hygiene regulations and physical distancing requirements (Koscheck et al., 2022). Recent studies indicate that the "digitalisation boost" (Schmidt-Hertha, 2021, p. 20, transl. LB) since 2020 has changed social needs and the participants demand patterns, shifting toward more diverse and flexible educational formats. In response, organisations are increasingly developing and offering combined (hybrid and blended) as well as modularised formats (Koscheck et al., 2022; Poopalapillai & Buchs, 2023; Zechner, 2022).

The digitalisation transformations of recent years have undeniably altered society's perception of the possibilities and limitations of digital media in ACE programmes. Following the exploratory phase during the COVID-19 pandemic, attention is now turning to the long-term effects and strategic adoption of these changes by ACE organisations (Meier & Seufert, 2022; Schmidt-Hertha, 2021). Initial research shows that ACE organisations are adapting both content and format design to meet individualised learning needs (Buchs et al., 2023), address growing digital skill requirements (Altenrath et al., 2021), and respond to evolving policy agendas (Altenrath et al., 2020). The diversification of educational formats not only introduces new challenges for implementation but also increases complexity and reshapes requirements for planning (Haberzeth & Dernbach-Stolz, 2022). This underscores the need for a focussed discussion on the (re)evolving terms and modalities of media-supported educational formats in ACE. To date, there is little clarity on how ACE organisations are shaping their post-pandemic programmes, especially when it comes to media-supported formats. This article therefore asks: Which media-supported formats do adult education organisations offer, and what needs and demands do they address from different perspectives?

To explore this questions, media-supported educational formats are first conceptualised and systematised in the context of ACE and didactic considerations in their design to address needs and demands (Chapter 2). An exploratory, literature-based analysis then examines the development of such formats in German-speaking countries (Germany, Austria, Switzerland) in organised adult education from multiple perspectives (organisations, professionals, participants) (Chapter 3). A case study follows, analysing the design and evolution of a combined format from 2019 to 2021, with a focus on changing needs (Chapter 4). The final chapter discusses implications for didactic design, staff professionalisation, and organisational development, and outlines directions for further research (Chapter 5).

2 Media-Supported Educational Formats in Organised Adult Education

2.1 Systematisation of Media-Supported Educational Formats

Media-supported educational formats are defined as offerings provided within formalised structures by ACE organisations that deliberately incorporate digital media and technologies for didactic purposes. Digital media are understood not merely as technical devices, but as socially embedded mediators based on information and communication technologies. They shape communication and are influenced by the socio-cultural contexts of their production and distribution, always conveying specific content in a particular form (Tulodziecki et al., 2021; Winkler, 2008). In the context of media-supported educational formats in ACE, digital media play a particularly important role in supporting learning ("learning with media") (von Hippel & Freide, 2018, p. 973, transl. LB). In addition to tangible digital media (e. g., computers, tablets), this also include digital tools (e. g., software, learning platforms), didactically structured media (e. g., videos, VR), and data repositories (e. g., digital libraries) (Breitschwerdt et al., 2022; Tulodziecki et al., 2021).

The wide variety of digital media and technologies, along with the increasing flexibility of learning locations and times, allows for virtually limitless combinations in the development of educational formats. This diversity of media-supported formats in ACE programmes has led to a lack of clarity regarding terminology in both academic discourse (e. g., Grotlüschen, 2023; Nørgård, 2021) and practical implementation (e. g., Haberzeth & Dernbach-Stolz, 2022). Therefore, a theoretical categorisation is essential for a more precise investigation of these formats.

Media-supported formats in ACE can generally be categorised into three types (Egetenmeyer et al., 2021; Rohs, 2023):

1. **On-site formats with media support**
   Formats that take place at a physical location (e. g., in the organisation) and at a fixed time, supported by the use of digital media (e. g., digital whiteboards, digital tools). The use of digital media serves to "enrich" (Bremer, 2019, p. 79, transl. LB)

the on-site teaching and learning setting in a didactically well-considered manner.

2. **Pure online formats**

   Formats conducted entirely in virtual environments using digital media. While these formats are generally location-independent, the time structures can vary widely – ranging from fixed schedules using video conferencing software to asynchronous, structured distance education formats (e. g., Simonson et al., 2009), and even completely open modules such as Massive Open Online Courses (MOOCs) (e. g., Rohs & Ganz, 2015), which provide learning content and didactically structured media online, allowing participants to control their own learning processes.

3. **Combined formats**

   Formats that use digital media to enable a wide range of combinations across different temporal and spatial dimensions. Traditionally, the term *blended learning formats* has described the integration of face-to-face and online components (e. g., flipped classroom), characterised by the intentional integration of online phases into the overall didactical design (Bremer, 2019). Since the COVID-19 pandemic, there has been an increased focus on *hybrid formats*[1], which in both academic and practice-oriented discourse refers to formats allowing for simultaneous participation both online and on-site, typically at a fixed time. Such hybrid formats can differ in the extent to which they enable interaction between online and in person participants (Hümmer et al., 2025).

This typology makes clear that media-supported formats, through the integration of digital media and technologies, contribute to the dissolution of fixed temporal and spatial conditions – to varying degrees, depending on the specific format. The result is an open field of potential configurations, spanning a spectrum between synchronous and asynchronous (temporal) and on-site and online (spatial) formats (Figure 1).

The boundaries between the formal learning contexts considered here and self-directed or informal learning contexts – where learners engage independently with digital media, for example via social media or online platforms – are becoming increasingly blurred. Growing reflection on dimensions of time and space also gives rise to new scenarios in which self-directed learning with digital media may take place within the physical premises of educational organisations (see Figure 1, top left).

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1   Terminology varies depending on context. In some cases, terms are used interchangeably – for example, *hybrid* and *blended* (O'Byrne & Pytash, 2015) – or grouped into a single category, such as *online* and *blended learning* (Blieck et al., 2019). Usage may also shift, as with *blended* and *hybrid* during the COVID-19 pandemic, particularly in German-speaking contexts (e. g., Reinmann, 2022). It is therefore essential to consider the specific structure and composition of each format.
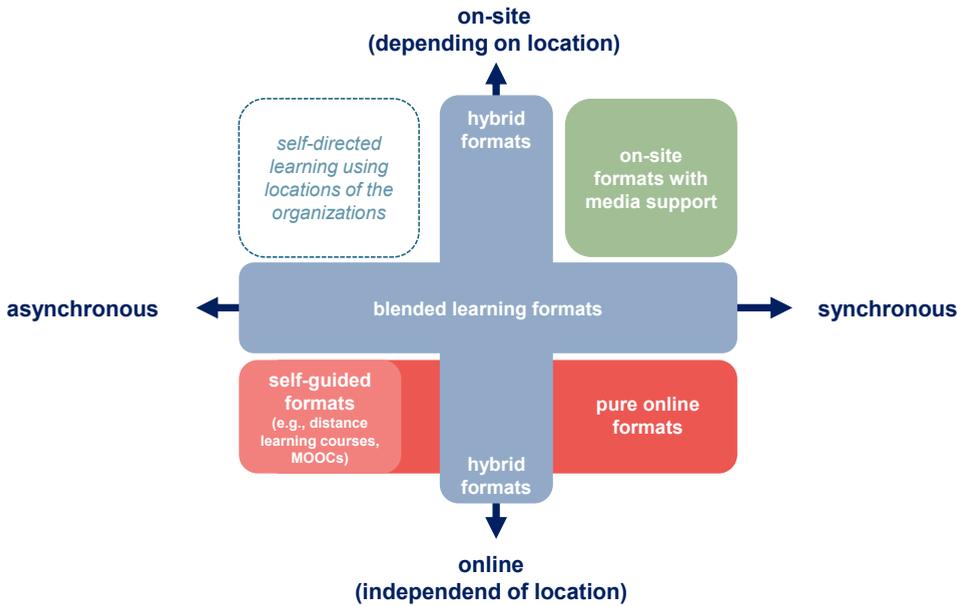
Figure 1: Media-supported educational formats in the spectrum of temporal and spatial possibilities (Author's own illustration, adapted from Reinmann (2022))

The typology of media-supported educational formats is not exhaustive but serves as a heuristic to simplify analysis. Since 2020, various terms have emerged in academic and practice-oriented discourse, often with different meanings. Terms like *remote education* and *emergency remote teaching* were coined to describe pandemic-related formats, but they deviated from earlier research-based and pedagogically grounded discussions (Hodges et al., 2020). Concepts like *distance education*[2], *online education, e-learning, mobile learning,* and *digital learning* had already been defined much earlier, particularly in the context of higher education (e. g., Schmidt & Tang, 2020).

While combined formats such as blended learning (e. g., Allan, 2007) and, more recently, hybrid formats (Gudoniene et al., 2025) have been widely discussed in higher education, debates within ACE remain more selective (Blieck et al., 2019; Chen et al., 2021; Lippmann et al., 2023). Due to ACE-specific conditions – such as shorter programme durations, predominantly voluntary participation, freelance instructors, and the diverse needs of adult learners – planning and implementing combined formats likely requires approaches distinct from those in other educational sectors.

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2 Various terms – such as *education, learning, teaching, instruction* – are often used in relation to different format types. *Education* often serves as an overarching concept, encompassing both individual learning processes (*learning*) and intentionally designed teaching activities (*teaching, instruction, design*) (Hodges et al., 2020).

2.2 Needs-Based Design of Media-Supported Educational Settings from a Multi-Level Didactic Perspective

The design of media-supported educational settings in ACE is based on didactic considerations at multiple levels: the macro didactic level of organisational framework, the meso didactic level of programme planning, and the micro didactic level of specific teaching and learning settings (Robak & Fleige, 2022). In German-speaking contexts, the term *Didaktik* refers to considerations regarding the facilitation and systematic planning, implementation, and reflection of learning and educational opportunities – particularly those that are formally and non-formally organised. It draws on various theoretical and normative assumptions from the (adult) educational field, such as ideas about learning and education (von Hippel et al., 2022).

Given ACE's heterogeneous structures and flexible, short-term learning demands, programme planning on the meso didactic level as the "professional-pedagogical interpretation of educational needs" (von Hippel, 2023, p. 349, transl. LB) is a defining characteristic of the field. It links macro didactic, strategic considerations within the organisations (e. g., programme areas) with micro didactic implementation of specific offerings (Robak & Fleige, 2022). Planning takes place in a complex field of interests and demands, shaped by various stakeholders at the individual, collective, and societal levels (Gieseke, 2022). It is embedded in power dynamics (Cervero & Wilson, 1994) that influence both the actions of individual planners (Arbeiter, 2023) and the development of organisational "planning cultures" (Dollhausen, 2008).

Social transformations such as globalisation, digitalisation, and changes in the world of work have further increased the complexity of programme planning in ACE (Sork, 2020). Societal demands and more individual needs (e. g., of learners) arise quickly and can change rapidly, as they are embedded in broader societal, political, and economic developments (Gieseke, 2022). ACE organisations respond to these observable demands and trends in their offerings. While digitalisation expands access to new (supra-regional) target groups, it also raises concerns about losing traditional participants (Rohs, 2020). As a result, needs analysis and programme planning are becoming more differentiated and complex (Grotlüschen & Weis, 2021; Haberzeth & Dernbach-Stolz, 2022). Insights from studies or surveys, peer exchange, competitor analysis, and the exploration of latent or still unconscious needs (e. g., through outreach or pilot projects) are becoming increasingly important for shaping future media-supported educational formats (Gieseke, 2022; Sava, 2023).

When planning media-supported educational formats it is essential to consider factors operating at multiple levels (Belete & Robak, 2018; Hellriegel, 2022):

1. **Societal level** (e. g., trends, media, research, political or labour market developments)
2. **Organisational and institutional level** (e. g., educational mission and goals, financial and human resources, association and funding structures, regional context, education market, companies, other ACE organisations)

3. **Professional level** (e. g., educational managers, planners, instructors – their attitudes towards media-supported learning and their media competencies)
4. **Participant level** (e. g., socioeconomic status, educational background, attitude towards media-supported learning, learning behaviour and motivation, interests, concerns, and hesitations).

These levels are not exhaustive but provide an initial orientation for understanding the complexity of needs and demands to be considered at the meso didactic level of programme planning. Based on this, more detailed analyses can be conducted to explore the micro didactic design of media-supported formats in relation to contextual factors across levels. Models that address micro didactic design aspects – such as content, methods, media configuration, group dynamics, or educational roles (e. g., Breitschwerdt et al., 2024; Goodyear 2020) – can then be examined in greater depth in light of the findings presented below regarding needs in specific organised adult education settings.

3 Research on Media-Supported Educational Formats in Organised ACE

The following sections provide an overview of the perspectives of organisations, professionals, and participants on developments and requirements related to media-supported educational formats, based on research focused on the German-speaking context (Germany, Austria, Switzerland). This includes both cross-cutting and targeted studies, as well as annual reports and trend analyses.

3.1 Perspective of the ACE Providers

Before March 2020, face-to-face formats dominated adult education offerings in Germany (80 %) and Switzerland (51 %), while combined (23 %; 7 %) and purely online formats (18 %; 1 %) played a minor role (Christ et al., 2020; Poopalapillai et al., 2021). With the onset of the COVID-19 pandemic, online formats rose sharply and became dominant in Switzerland (in 2020) and Germany (until 2021) (Koscheck et al., 2022; Poopalapillai & Sgier, 2022). Combined formats also increased and have remained notable, especially in Switzerland (26 %) (Cacho & Gollob, 2024; Echarti et al., 2023). Similar developments, for example in continuing vocational training, can also be observed for Austria (Ziegler & Wöhl, 2024). A survey of managers from Catholic adult education organisations in Austria (n = 44) showed a tripling of online offerings in the first six months of the pandemic. The same period also saw the emergence of a wide variety of new formats, including a significant increase in webinars and hybrid events (Lackner, 2021). Since 2022, there has been a clear return to face-to-face formats with media support, a trend evident in Switzerland and Austria and anticipated for Germany (Bildungsnetzwerk Steiermark, 2023; Cacho & Gollob, 2024; Echarti et al., 2023, Ziegler & Wöhl, 2024).

A closer look at the data reveals consistent differences in the use of media-supported formats across organisation types. In Germany, private commercial providers, (technical) universities, and academies report higher adoption, whereas denominational, political, union-affiliated, and public institutions show lower levels (Echarti et al., 2023; Koscheck et al., 2022; Scheidig, 2024; Schmid et al., 2017; Widany et al., 2022). In Switzerland, disparities are more closely linked to organisational size and the resources needed for implementing more complex media-supported formats – reflected in the range of offerings, staffing levels, and cancellation rates (Poopalapillai & Buchs, 2023; Poopalapillai et al., 2021; Poopalapillai & Sgier, 2022).

Findings from the organisational perspective show that the recent push toward digitalisation has influenced social needs, participant behaviour, and organisational strategies. Educational formats are gaining importance in the market-oriented planning of organisations (Echarti et al., 2023). The trend is toward more diverse, flexible, and modular offerings – often hybrid or blended – tailored more specifically to target groups (Gollob, 2022; Koscheck et al., 2022; Poopalapillai & Buchs, 2023; Poopalapillai & Sgier, 2022). These developments require both financial and human resources, as well as rapid and adaptive didactic planning to ensure flexibility (Cacho & Gollob, 2024; Egetenmeyer et al., 2021). At the same time, competition from new online providers is increasing (Cacho & Gollob, 2024; Echarti et al., 2023).

3.2   Perspective of Professionals in Adult Education

A non-representative study of 260 adult education instructors (Schmid et al., 2017) found that only a small proportion were familiar with online (22 %) or blended formats (19 %) before the pandemic. The study also showed that teachers in private-commercial organisations and freelancers were significantly more active in implementing these formats than their counterparts in publicly funded adult education centres. This suggests that online and blended formats have been more central for commercial providers, in part due to their greater emphasis on vocational training. However, this also emphasises that, across organisations, the development of digital skills has largely remained the responsibility of individual instructors (Breitschwerdt & Egetenmeyer, 2021; Schmid et al., 2017). Since then, familiarity with digital media has increased, and teachers are now encountering new roles in media-supported formats (Breitschwerdt et al., 2022). An analysis of access statistics from an information portal with a self-study area for adult educators shows significantly increased traffic during the first 2020 lockdowns compared to the previous year, with particular interest in resources related to digital teaching and learning design (Kilian & Biel, 2022). There is a clear overarching need for professionalisation in the use of digital media for the professionals (Poopalapillai & Buchs, 2023; Ziegler & Wöhl, 2024).

In 2017, 58 percent of organisational leaders (n = 224) in Germany reported little to no systematic use of digital learning media in their organisations (Schmid et al., 2017). A 2022 survey of Austrian adult educators (n = 342) similarly showed that more than half (53 %) had used digital media only sporadically or in specific courses before the start of the COVID-19 pandemic (Gugitscher & Schlögl, 2022).The first lockdown in

March 2020 posed major challenges, with planning often based on peer exchange and trial-and-error rather than systematic needs assessment. Although the benefits of blended formats became apparent, not all content proved suited for digital delivery. Future planning is expected to be more flexible and responsive, yet still grounded in pedagogical principles (Grotlüschen & Weis, 2021). Experts (n = 10) in Austria predicted the growing establishment of blended learning, with the specific mix of online and face-to-face elements determined by the instructional content. Online settings have been seen as effective for content delivery and document collaboration, while face-to-face phases remain important for interaction, reflection, and hands-on activities that are difficult to digitise (Egger-Subotitsch & Liebeswar, 2020).

The perspective of programme planners in Switzerland (Haberzeth & Dernbach-Stolz, 2022) showed that programme planning has become more complex and differentiated. Planners must now reflect, decide, and act on new format categories such as "online formats", especially when designing combined formats that respond to diverse and evolving target group needs. Clearer terminology (e. g., distinguishing "blended" from "hybrid") is also needed to establish a shared understanding. The ongoing diversification of formats remains a challenge. Planners must support participants in choosing suitable options, consider learning locations, and address the digital divide (Haberzeth & Dernbach-Stolz, 2022). They must strike an appropriate balance between online and in-person instruction while aligning their own preferences with those of the target groups (Poopalapillai & Sgier, 2022).

3.3 Perspective of (Potential) Participants

Empirical data on participants' interest in media-supported adult education remains limited, though some studies offer indirect insights. In 2018, adult learners in Germany showed growing interest in online and blended formats, though traditional in-person courses remained the preferred option. Preferences varied by gender (more men participated in combined formats), age (older adults preferred on-site learning), and employment status (full-time employees and the unemployed both favoured combined formats). Participation in digital learning was lower among older adults, individuals with lower educational levels, lower occupational status, and those with a migration background. Reported barriers included limited technical skills, lack of equipment, and insufficient competencies (Bundesministerium für Bildung und Forschung [BMBF], 2020).

The 2024 "EU Survey on the Use of ICT in Households and by Individuals" shows that 33 percent of respondents engaged in online learning – up 3 percent from the previous year. In Germany, however, the figure stands at just 25 percent, significantly below the European average (Eurostat, 2025). The Adult Education Survey (AES) in Germany confirms continued growth, especially in formal adult education digital learning formats, a trend accelerated by the pandemic (Bundesministerium für Bildung und Forschung, 2024). A DESI-based analysis from 2022 (Karger et al., 2024), covering four countries including Germany, highlights differences in platform use not only across national contexts but also between formal and non-formal education. While

some results overlap with general participation trends (e. g., lower use with increasing age), the study found no strong correlation between digital learning participation and educational attainment – contrasting with earlier findings. In Germany, a 2022 survey show strong demand for face-to-face formats (78 %) and moderate demand for online formats (51 %), with differences by provider type (Echarti et al., 2023). In Switzerland, rising interest in hybrid learning has been observed, along with changing booking patterns and expectations (Poopalapillai & Buchs, 2023). A 2020 survey in Styria, Austria (Zechner, 2022), found that learners appreciated online formats for their flexibility, compatibility with work-life balance, and suitability for specific topics (e. g., lectures). However, they were generally less willing to pay for these courses. Perceived quality was linked to teaching quality and methodology (e. g., shorter units, interactivity), platform usability, and course logistics (e. g., online registration and payment).

4   Case Study of a Combined Media-Supported Format in One ACE Organisation

The case study draws on data from the project "Digitalisation in Adult and Continuing Education,[3]" which includes semi-structured, guideline-based (group) interviews with permanent staff and temporary instructors from various adult education organisations in Germany. The project adopts a longitudinal perspective, with data gathered in 2019 and 2021 to examine digitalisation developments at six levels: societal context, umbrella organisation, organisation, programmes and offerings, employees, instructors and contributors, and participants (Egetenmeyer et al., in prep.)[4].

4.1   Sample and Procedure of the Case Study Analysis

One combined media-supported educational format from one organisation (H) was selected from this data for secondary analysis, due to the format's well-documented structure and development across both survey periods. This enables an exploratory, multi-perspective analysis of its implementation and adoption from 2019 to 2021, which also allows for a more nuanced examination of how it evolved in response to changing organisational needs and external conditions. Organisation H is a chamber of industry and commerce under public law with a state mandate in continuing vocational training, embedded in a nationwide network of umbrella organisations, but operating in one specific region with 450 permanent employees and many freelance instructors. The selected format is part of the organisation's core offering of formal education pro-

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3 The project "Digitalisation in Adult and Continuing Education" was funded by the Federal Ministry of Education and Research from 2019–2022 as part of the funding line "Digitalisation in the Education Sector – Fundamental Issues and Conditions for Success" (Funding code: 01JD1805). Further information about the project and its outcomes is available at go.uniwue.de/digieb.

4 Questions in the guidelines included: "In what way are digital elements integrated into the courses?", "Which digital media are used in your educational offers?", "Who are your digital offers aimed at?", "Who do you reach with which digital educational offers?"; "What wishes regarding digital elements do you encounter from the participants?". In the short interviews in 2021, questions were asked about changes in the six areas.

grams, which span one to two years and lead to nationally recognised qualifications. In addition, the organisation also offers non-formal formats like short seminars, workshops, consulting services.

For the case study, interview data was selected from the organisation's dataset (Egetenmeyer et al., in prep.). This sample comprises 1) one group interview with the management team in August 2019, 2) eight guideline-based individual interviews with permanent staff and freelance instructors in November 2019, 3) one discussion group with the management team in November 2020 and 4) eight guideline-based short interviews with the same permanent staff and freelance instructors in April 2021 (see table 1).

Table 1: Sample overview

Interviewee(s)	Time(s)	Acronyms	Type of interview
Management team	August 2019	H_GD	Group interview with three persons
Instructors	November 2019	H_I1, H_I3, H_I5	Individual interviews
	April 2021	H_I1a[5], H_I3a, H_I5a	Individual (short) interviews
Permanent staff (management & programme planners)	November 2019	H_I6, H_I7; H_I8	Individual interviews
	April 2021	H_I6a, H_I7a; H_I8a	Individual (short) interviews
Dual function: permanent staff (programme planners) & instructor	November 2019	H_I2, H_I4	Individual interviews
	April 2021	H_I2a, H_I4a	Individual (short) interviews
Management team	November 2020	H_FG	Discussion group with three persons

To analyse the needs and demands relevant to the format's design, an exploratory qualitative content analysis of the interview material[6] was conducted (Kuckartz & Rädiker, 2023), structured around the three analytical levels: 1) organisation, 2) professionals and 3) participants. Interviews with the management and permanent staff were particularly used to capture organisational-level aspects, while participant perspectives were derived indirectly from all interviews. The data analysis proceeded in several steps. First, interview segments about the format were identified and categorised by level. Second, an exploratory analysis was carried out at each level to discover which needs and demands were considered in the design and implementation of the format over the period from 2019 to 2020.

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5   For the 2021 interviews, the same identifiers were used for the same individuals, with the addition of an "a" suffix, e. g., H_I1 (2019) became H_I1a (2021).
6   The data is available in German. For this article, the selected passages were translated into English by the author with the help of deepL.com.

4.2   Perspectives on the Format in 2019

The following section begins with a description of the format in 2019 and presents the results on the design and implementation of the format in 2019 along the three levels of analysis: organisation, professionals, and participants.

Description of the format: Since 2019, the organisation has offered advanced continuing vocational training in a combined learning format that integrates synchronous in-person sessions with asynchronous online self-learning. Learners receive structured support during the asynchronous phases. The training programme, which enables skilled workers to qualify for leadership roles or advance their careers, leads to a formal qualification and is aligned with national curriculum and examination standards. The total duration of the training is 600 to 1,000 hours, depending on the subject. The format combines synchronous and asynchronous elements, structured by the organisation into "learning weeks" based on the curriculum and aligned with fixed examination dates (Figure 2). Participants receive prepared content (e. g., instructional videos) and complete assignments independently within that weekly framework. A learning management system is used to facilitate communication, content delivery, assignment distribution, and submission of completed tasks. Instructors moderate both the synchronous in-person and virtual sessions, as well as the asynchronous phases, by assigning tasks and providing feedback.
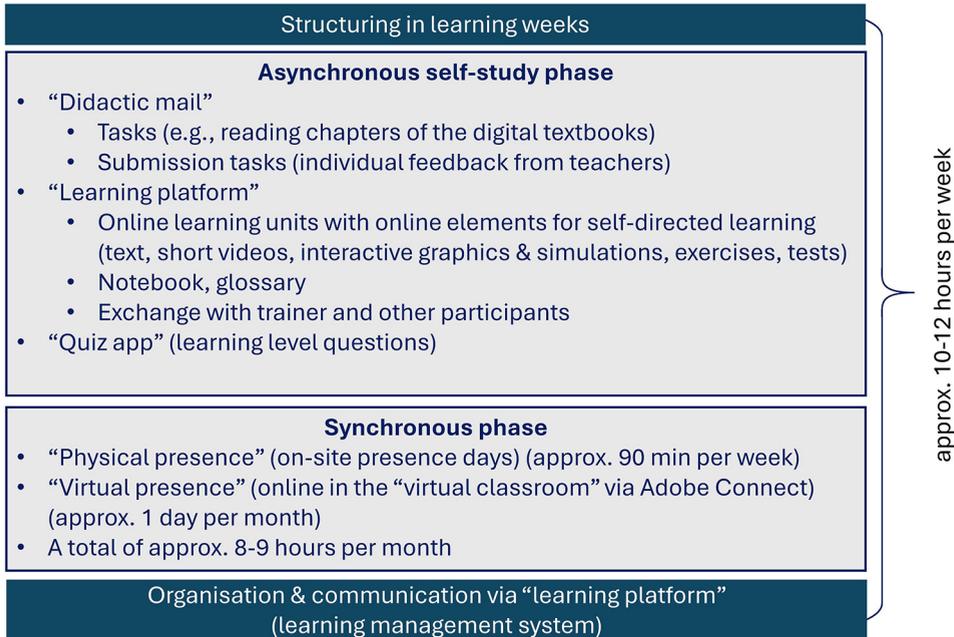

Figure 2: Structure of the combined format in organisation H in 2019 (Author's own illustration)

Organisation: For the organisation, the format served as a niche alternative to on-site courses, designed to meet growing demand for flexible, well-supported learning opportunities (H_I6: 5). Despite market pressure for shorter formats, the organisation prioritised depth of content and intensive learner support (H_GD: 171). Its strategy focused on reaching broader target groups by offering three parallel approaches in their advanced training programmes: 1) enriching face-to-face courses with digital elements, 2) implementing combined formats with reduced in-person attendance, and 3) offering distance learning emphasising self-directed study. The goal was to offer each participant a suitable format – whether they preferred interactive settings, self-guided learning, or remote access due to geographic constraints (H_I7: 123). Media-supported formats were gradually introduced into formal programmes based on models provided by the umbrella organisation. However, these were less developed in non-formal offerings (H_GD: 25). Although the licensed combined format reduced in-house development efforts, it also restricted experimentation and flexibility (H_GD: 26), and its design was constrained by legal regulations – such as funding limited to synchronous participation (H_GD: 70–71; H_I6: 13).

Professionals: The format placed increased demands on staff, requiring additional personnel, advanced media skills for both instructional implementation and technical handling, and enhanced participant support due to limited in-person contact (H_I4: 9). Permanent staff also supported the integration of freelance instructors by introducing them to both the technological and pedagogical aspects of the format (H_GD: 170). Instructors had to adapt their existing training materials to fit the new format (H_GD: 154).

Participants: The format worked well for specific topics and target groups (H_I4: 46; H_GD: 108–109; H_I6: 7). The management team observed that openness to the format among certain groups was linked to their professional contexts, which allowed for more flexible work arrangements (H_GD: 72–75). While the participant base was largely similar to that of traditional face-to-face courses, though those with a higher affinity for digital and self-directed learning were more likely to enrol. These participants expected reliable infrastructure, including stable bandwidth and software functionality (H_GD: 212; H_I4: 24).

4.3 Perspectives on the Format in 2021

The following section begins with a description of the changes to the format since the start of the Covid-19 pandemic and presents the results on the changes in the design and implementation of the format in 2021 along the three levels of analysis: organisation, professionals, and participants.

Adjustment of the format: What had initially been a marginal alternative to fully on-site courses became widely integrated into the organisation's formal education offerings by 2021, showing notable growth: "[W]e now offer different course formats. [...] Our blended learning courses used to go well two years ago, and now they are totally BOOMING." (H_I8a: 20). The format, originally chosen for its flexibility, was expanded to include hybrid synchronous sessions (on-site and online) in response to distancing

regulations, ensuring continuity for participants (H_I8a: 41; H_I4a: 32). A self-study option was also developed as a preparatory course, accessible asynchronously via the learning management system (H_I6a: 6). However, legal regulations tied state funding to participant presence, complicating fully self-guided learning (H_I8a: 11). Despite these challenges, the structure of synchronous and asynchronous components remained unchanged. Instructors were required to enhance their media skills to adapt flexibly to a variety of evolving delivery models (H_FG: 44). Infrastructure upgrades – including improved software, hardware (e. g., bandwidth, hybrid media technology), and IT support – were gradually implemented to support the expanded format (H_I4a: 64–65; H_I6a: 73–75)

Organisation: The format became widely established as an alternative to both fully on-site and online formats in the formal education programme area, helping reach new target groups (H_FG: 13; H_I8a: 25). The organisation continued its strategy of offering multiple formats to accommodate diverse learning preferences. However, planners noted that the need for participant guidance – especially during asynchronous phases – had increased significantly (H_I2a: 45). Although conditions were communicated in advance (e. g., through information events) (H_I8a: 42), the workload related to individual support grew steadily. While the combined format proved effective in structured formal education programmes, its adaptation to non-formal short courses – especially those lacking a framework – saw limited uptake. This was attributed to the content unsuitability (e. g., rhetoric training) and limited willingness or financial capacity of customers (e. g., companies) to book such offerings at the time (H_I7a: 29; H_I8a: 21–23). The organisation also faced delays in updating digital components (e. g., digital textbooks) due to dependency on the umbrella organisation for purchasing educational content (H_I8a: 32). While other organisations expanded their media-supported offerings, this was not seen as a threat due to the organisation's strong regional focus and mandate to serve local industry (H_I6a: 58; H_I7a: 34). Nevertheless, this mission shaped both external perceptions of the organisation and its evolving role within the broader association – highlighting the need to further develop in-house expertise in digital education moving forward (H_I7a: 35).

Professionals: Instructors showed strong willingness to pursue further training in digitalisation, particularly regarding combined formats – resulting in a growing pool of instructors capable of delivering media-supported offerings (H_I6a: 22). As the format matured, its implementation became more didactically informed, with instructors better able to utilise digital elements and guide participants through asynchronous phases (H_I4a: 21–22; H_I6a: 25; H_I8a: 49). However, planners reported increased workloads related to additional course management, teacher training, and individual participant support (H_I8a: 28). Instructors expressed the need for flexible working arrangements, as many juggled multiple jobs or worked freelance (H_I1a: 11–12; H_I2a: 31). They also required access to digital tools, which they often had to procure at their own expense, and called for the organisation to provide key resources such as collaboration software (H_I3a: 55). Additionally, they sought more consistent pedagogical and technical support during teaching – not just training in digital tool usage (H_I5a: 16–18).

Participants: Demand for the combined format increased notably, drawing participants from various occupational areas (H_I8a: 25). The format gained broad acceptance, with the pandemic contributing to greater openness toward digital learning (H_I2a: 18–19; H_I4a: 22; H_I8a: 4). It was increasingly viewed as equivalent in value to on-site formats (H_I6a: 58). Participants especially appreciated the flexibility in terms of time and location, which allowed them to balance their commitments (H_I6a: 33), avoiding commuting (H_I8a: 19), or restructure full-day sessions into more manageable segments across the week (H_I7a: 18). Planners noted that participants expected structured support during self-study phases (H_I6a: 34), reliable technology, and up-to-date, well-designed, visually appealing materials. (H_I6a: 43; H_I8a: 32, 46).

The case study shows how between 2019 and 2021, a niche offering became a strategic core element of the organisations' programme. The original structure was retained but flexibly expanded with new (a-)synchronous elements to meet diverse learner needs. Despite legal and licensing restrictions limiting innovation, the format proved effective due to alignment with standardised curricula and its long-term implementation. Professionals faced increased demands. While instructors had to revise existing materials and provide more intensive support during self-directed learning phases, planners mentioned greater responsibilities in course management and instructors training. Nevertheless, staff showed strong willingness to upskill in digital teaching. Participants responded positively to the accelerating adoption of blended formats during the pandemic, valuing their flexibility while expecting reliable infrastructure, appealing instructional materials, and structured support.

5   Implications and Further Research for the Needs-Based Design of Media-Supported Educational Formats

Designing and planning media-supported educational formats, places high demands on all actors involved, particularly planners in ACE organisations. It requires balancing organisational conditions, institutional contexts, connections to associations, and the interests and competencies of planners, instructors, and participants. The initial findings from this exploratory analysis offer insights into key aspects of format design and implementation, as well as the needs and demands these formats are intended to meet at different levels.

Design Implications

The design of media-supported formats requires a nuanced consideration of learning locations and time structures. Content, interaction needs, self-directed learning phases, and the use of (digital) learning environments must be carefully coordinated. Didactic decisions about synchronous versus asynchronous components, and location-bound versus location-independent elements, are becoming increasingly important. Fully online and asynchronous formats place considerable demands on learners' self-regulation, underscoring the need for continuous support (Bremer, 2019). This re-

quires clear and transparent communication regarding the format's structure and (technical) requirements, enabling participants to make informed decisions (Blieck et al., 2019). In the future, AI-based applications like learning analytics or AI-driven learner support could contribute to the individualised design of educational formats – provided that data protection regulations are observed and appropriately trained personnel are available (Dreisiebner & Lipp, 2022; Scheidig, 2022). At the same time, clearer conceptual distinctions and terminology are necessary – for instance, differentiating between physical and social presence in virtual or blended learning environments (Goeman et al., 2020). Implementing these offerings requires a broad range of resources: qualified personnel, robust technical infrastructure, digitised administrative processes, secure funding, legal clarity, and sustainable didactic decisions.

Implications at the Organisational Level

ACE organisations increasingly use digital media strategically to reach broader target groups and meet individual learning needs. However, the development and maintenance of media-supported formats require considerable financial and human resources, posing challenges especially for smaller providers. Organisational size and type both play a critical role. Participant structures also differ – commercial providers often respond to more market-driven, career-oriented demands, while non-profit organisations prioritise social participation and educational access. Going forward, organisations must balance strategic positioning in a more commercialised, supra-regional education market with their local educational mission, which includes addressing local learning needs. Emerging trends suggest growing differentiation in the use of combined media-supported formats between formal and non-formal education – where success appears to depend less on content and more on the integration of interactive components. Insights from formal education – where media-supported formats function effectively within structured curricula – may inform the design of shorter, non-formal offerings within organisations.

Implications at the Professional Level

Designing and implementing media-supported educational formats requires advanced media-education skills among planners and instructors. Beyond technical skills, a deep understanding of format-specific didactic structures and demands is essential. This calls for comprehensive, structured professional development programmes (Bellinger, 2024) that extend beyond the current emphasis on individual responsibility. When involving external instructors in organisation-specific formats, both a solid onboarding process and ongoing pedagogical and technical support are crucial – balancing top-down guidance and bottom-up involvement – helps foster a sense of autonomy and encourages the sustainable adoption of media-supported teaching practices (van Twembeke & Goeman, 2018). This support can be facilitated by dedicated staff or specialised units with expertise in adult and media education, which can guide format development and offer didactic guidance during implementation. The growing variety of formats increases the need for personalised learner support, which in turn requires

additional staffing. In light of current personnel shortages, AI-based tools – such as chatbots – may offer initial assistance, for instance in helping participants select appropriate formats (mmb Institut, 2024). New compensation models for instructors could also be considered to account for the additional workload associated with digital teaching (Bremer, 2019).

Implications at the Participant Level

As learners become increasingly familiar with digital learning environments, their expectations are shifting toward more individualised and flexible educational opportunities. This shift is accompanied by a greater degree of personal responsibility – particularly when it comes to making informed decisions and following through with commitments to media-supported formats. At the same time, as the case study shows, they also expect a reliable infrastructure, appealing teaching materials and structured support. Overall, there is still a lack of differentiated insight into how various adult learner groups use media for learning and what their specific preferences are. It remains unclear which participants are being reached – or excluded – by more or less complex formats, and which design elements matter most for particular target audiences (e. g., Buschle & König, 2018).

Limitations and Future Research Perspectives

The exploratory insights from the synthesis of the research and the case study reveal several limitations. The literature on media-supported educational formats in ACE is highly fragmented. From the multi-level perspective, studies offer only partial and selective insights. Organisational studies rarely address experiences of professionals or participants directly; those studies focusing on the latter often rely on small samples and yield only limited and indirect insights into the dimensions examined in this study. Still, this perspective helps identify research gaps. The single-case study limits generalisability but reveals design-relevant aspects especially from a development perspective within organisations, which may inform future analyses and methodological frameworks. The descriptive content-analytical approach offers an initial explorative step and should be expanded by other methodological approaches by focussing on design-specific characteristics within organisations.

Future research should include organisation-specific (case) studies to examine the conditions, opportunities, and constraints involved in implementing media-supported learning formats – especially within nonprofit and general adult education settings. This includes examining how different levels (actors, organisations, society) interact to shape organisational learning processes in format development (Dörner & Rundel, 2021), potentially following established organisational typologies (von Hippel & Stimm, 2020). In addition, international comparisons could reveal how education policy and funding shape the development and delivery of formats across countries. Domain- and content-specific studies could explore where complex media-supported formats make sense in non-formal education and how social interaction can be meaningfully combined with synchronous and asynchronous elements (e. g., in language courses).

The question of content suitability for online or combined formats remains a relevant cross-cutting issue. Programme planning under the conditions of digital transformation and shifting learner needs deserves closer attention. Research could examine how planning practices, decision-making processes, and the relationship between macro, meso and micro level didactics are evolving (Breitschwerdt et al., 2022), especially in relation to the professionalisation of programme planners (von Hippel, 2024). Further areas of inquiry include the analysis of marketing strategies (e. g., how formats are presented and communicated), and the systematic collection or use of existing data (e. g., AES) to better understand media use, learning behavior, and participation patterns across target groups. Finally, more research is needed on the complex process of participation decisions (Boeren, 2023), as well as on theory-based analysis of learner needs within specific formats (Diep et al., 2019).

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Platform-Based Business Models in Adult and Continuing Education

Navigating Public Responsibility and Market-Oriented Platform Logic

Nora Leben

Abstract

Platforms are emerging from providers in continuing education as well as the EdTech sector. While the global visibility of continuing education on platforms can potentially expand target audiences, locally embedded providers remain subject to regional regulations. Drawing on platform studies, this article examines how platform operators in adult und continuing education adapt their models to regulatory and funding conditions. Based on document analysis and semi-structured interviews from a case study on German public adult education centres and a research project on a booking platform for university continuing education, the article identifies incentive structures enhancing platform attractiveness – a key aspect of platform logic due to network effects. Rather than functioning as profit-oriented marketplaces like commercialised platforms, the empirical findings show how publicly funded platforms emerge as digital public infrastructures that prioritise transparency and access over profit.

Keywords: Digital platforms, adult and continuing education, business models

Zusammenfassung

Plattformen werden sowohl von Weiterbildungsanbietern selbst als auch aus dem Ed-Tech-Sektor entwickelt. Durch die globale Sichtbarkeit von Weiterbildungsangeboten auf Plattformen können sich potenziell Zielgruppen erweitern, gleichzeitig unterliegen Anbieter in ihrer lokalen Einbettung regionalspezifischen Regulierungen. Anknüpfend an Plattformforschung untersucht der Beitrag, wie Plattformbetreiber in der Erwachsenen- und Weiterbildung ihre Modelle an regulatorische und finanzielle Rahmenbedingungen anpassen. Auf Grundlage von Dokumentenanalysen und leitfadengestützten Interviews aus einer Fallstudie zu Volkshochschulen und einem Forschungsprojekt zu einer Buchungsplattform für wissenschaftliche Weiterbildung identifiziert der Artikel Anreizstrukturen, die die Attraktivität der Plattform steigern – ein zentraler Aspekt plattformlogischer Dynamiken aufgrund von Netzwerkeffekten. Anders als kommerzielle Plattformen, die als gewinnorientierte Marktplätze fungieren, zeigen die empirischen Ergebnisse, dass öffentlich finanzierte Plattformen sich

als digitale öffentliche Infrastrukturen etablieren, bei denen Transparenz und Zugang gegenüber Profit priorisiert werden.

Keywords: Digitale Plattformen, Erwachsenen- und Weiterbildung, Geschäftsmodelle

1   Introduction

As a societal phenomenon of digitalisation, platforms are increasingly becoming an integral part of everyday life, work, and the (digital) economy (Van Dijck et al., 2018). This also applies to continuing education, where platform-based business models are being developed both within the EdTech sector and by established providers of continuing education themselves (Grotlüschen, 2018; Karger & Kalenda, 2024). The establishment of the necessary platform architectures is not only initiated and financially supported by education policy but is also implemented by providers and associations to position themselves in the continuing education market with platforms tailored to their needs (Alke et al., 2025). In this context, the global visibility of educational offerings on such digital booking platforms can potentially expand reach and target groups, while offerings and organisations remain subject to region-specific regulations in their local context (Rohs & Lacher, 2023). Furthermore, educational marketing and participant acquisition are no longer exclusively location-dependent; providers are now placed in novel competitive relationships due to the supraregional visibility of their offerings (Alke, 2022).

Tensions emerging in this context are particularly apparent in the areas of adult and continuing education situated at the intersection of market dynamics and public responsibility. This applies to public adult education, which is shaped by both public funding and competitive pressures, and to university continuing education, which, although typically not publicly funded and largely reliant on participant fees, remains embedded within higher education institutions and thereby subject to their regulatory frameworks and overarching educational mandate. University continuing education, which occupies a hybrid position linking both the higher education system and the continuing education market (Seitter, 2017), is characterised by a high percentage (49 % in Germany) of digital course offerings, providing a location-independent format (Echarti et al., 2023). This requires an appropriate digital infrastructure for content delivery. In the adult education sector, German public adult education centres[1] are a prominent example of public organisations partially governed by market dynamics. These are much more focussed on face-to face formats (14 % of the offerings in digital form, Echarti et al., 2023), where the community-based educational mandate plays a significant role. Nevertheless, to meet the challenges posed by digital transformation, adult education centres increasingly need to re-orient themselves beyond the demands and needs of their region (Klemm & Repka, 2021). Efforts towards (cooperative) plat-

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1   In German: *Volkshochschule* (VHS)

form development with booking functions are observable, some of which are initiated at the association level (Klemm & Repka, 2021).

The aim of this article is to analyse the observed platform phenomena and associated business models and to place them in context based on empirical findings from interviews and document analysis in the field of adult and continuing education. It examines how platform operators reconcile public mandates with platform logic and identifies how, in contrast to commercialised platforms oriented toward monetisation, publicly funded platforms emerge more as digital public infrastructures shaped by various stakeholders, funding, and regulatory conditions. The paper first outlines theoretical perspectives on platforms and adult and continuing education (Chapter 2), followed by contextual background (Chapter 3) and research design (Chapter 4). Empirical findings on platform-based business models are presented (Chapter 5), introducing two models that illustrate different approaches to managing conflicting demands in platform management, contextualised within the field of adult and continuing education. The article concludes with a critical discussion and highlights opportunities for future research (Chapter 6).

2 Conceptual Framework

The rise of digital platforms signifies a fundamental shift in the way society organises economic and social interactions (Van Dijck et al., 2018). With reference to the term 'platform economy', questions arise on how datafication and the application of novel algorithms are profoundly changing the nature and structure of work and society (Kenney & Zysman, 2016). This phenomenon of digital transformation, referred to as 'platformisation', highlights the growing presence of digital companies and the gradual incorporation of infrastructural and regulatory platform components into internet ecosystems (Poell et al., 2019). The next section presents theoretical approaches to digital platforms, followed by an analysis of their role in adult and continuing education.

2.1 Platform Theoretical Considerations

Digital platforms function as interactive network and interface structures that enable the exchange of information, products, or services (Seemann, 2021). They are driven by a range of regulatory mechanisms, such as network effects, which relate the attractiveness of the platform to the number and interaction of active users, both providers and participants (Haselhoff & Harwardt, 2022). Platforms serve as intermediaries, fulfilling key mediating roles by facilitating interactions between different user groups (Pongratz, 2022). Drawing upon organisational and technological sociological approaches, the following terminology illustrates the different aspects of platforms. To begin, *platform architecture* consists of a platform organisation as a *controlling core* for strategic decision-making and a *digital platform* as a social space for action, forming "a second level within this hybrid configuration that is more or less closely coupled to the platform companies as organizing cores" (Dolata & Schrape, 2023, p. 9). Located in the

core, *platform management* includes a variety of activities aimed at structuring, regulating, and controlling the platform (Dolata & Schrape, 2023). However, these tasks are not neutral; they involve the active establishment of rules and norms that govern the behaviour of users and providers on the platform, with the aim of valorisation of data and behavioural traces (Dolata & Schrape, 2023). From a business administration perspective, the platform and its development are closely linked to the development of the business model, as the platform assumes an intermediary role and thus forms an essential component of value creation (Harwardt & Haselhoff, 2022). While analog models operate without digitalisation, *platform-based business models* facilitate value creation by digitally connecting providers and users and have a triangular basic structure (see Figure 1): The value-creating platform company typically acts solely as the operator of the platform, while the offered services are provided by suppliers/producers, which are then booked or purchased by users (Harwardt & Haselhoff, 2022).
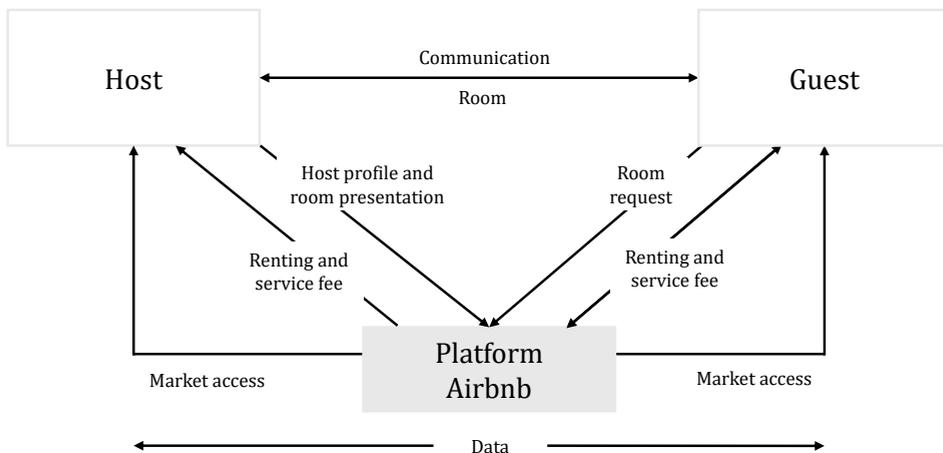

Figure 1: Platform-based business model using the example of Airbnb (based on Jaekel, 2017, p. 141)

The platform-based business model can be scaled cost-effectively by the operators. Rapid growth of the platform is crucial for profit-oriented platform companies, as the size and reach of the platform play a decisive role in securing market shares in competition with other providers, due to network effects (Gutting, 2020). However, as presented in the following section on the introduction of digital platforms in adult and continuing education, this logic is challenged when considering platform contexts with a public orientation for the common good (Schreyer & Schrape, 2021; Staab & Piétron, 2021).

2.2 The Role of Digital Platforms in Adult and Continuing Education

The spread of digital educational platforms accelerated after the outbreak of the COVID-19 pandemic (Williamson et al., 2020) and has been discussed (critically) across the entire educational sector (Decuypere et al., 2021; Williamson, 2021). Not only have

higher education and school become the subject of "platform pedagogies [...] bringing logics of datafication, automation, surveillance, and interoperability" (Perotta et al., 2021, p. 97) into classrooms, but also adult and continuing education have seen digital platforms play an increasingly important role. In this context, marketing and booking platforms as well as digital platforms for information, collaboration and learning purposes are emerging. Such platforms are present in both formal and non-formal continuing education contexts, as analysed and compared in a study by Karger et al. (2024), which examined platform usage in adult education across four countries (Czech Republic, Germany, Sweden, and the United Kingdom). While national usage patterns vary, the authors conclude that "platformization [is] well underway in formal adult education, even if [the] majority of it is still taking place through face-to-face interaction" (p. 11).

In addition to public funding initiatives and the development of own digital infrastructures by established providers, actors from the digital economy are pushing into the market and establishing themselves with commercial platform-based business models (Franken & Fischer, 2018; Grotlüschen, 2018; Karger & Kalenda, 2024). The specific market logic of the continuing education sector favours the establishment of digital platforms: Due to the strong demand and market orientation of adult and continuing education, digital platforms have become relevant, not only for learning and collaborating, but particularly in the marketing and booking of courses (Alke et al., 2025). Against this background, it is interesting to examine how platformisation unfolds in adult and continuing education, where different institutional and regulative logics apply (see Chapter 3). Digital booking platforms developed and operated in the public sector reveal unique tensions between economic and public-interest objectives, while navigating platform logic and market dynamics simultaneously. Whereas both commercial platform providers and platform operators in adult and continuing education are focused on visibility and scalability to broaden their target groups, adult and continuing education platform operators are not as concerned with economic success as commercial platform providers.

Thus, the growing importance of platform-based business models in adult and continuing education raises questions regarding their long-term economic viability, regulation, and institutional integration. Moreover, the use of data for personalised marketing and the algorithmic control of educational offerings are aspects that are to be (critically) considered (Franken & Fischer, 2018). These developments of platformisation point to an ongoing shift that raises concerns about platform governance and the role of digital infrastructures in reshaping the adult and continuing education landscape. The following section builds on these considerations and provides insights into platform financing structures in adult and continuing education.

3   Contextual Background

The development of platform-based business models in continuing education occurs within complex institutional, financial, and regulatory frameworks shaped by varying degrees of state versus market involvement in provider structures (Desjardins, 2017). In publicly administered adult education in particular, state involvement is especially relevant, as educational offerings in the public interest are primarily publicly funded (Ioannidou & Lattke, 2021). Regional frameworks play a central role in regulating and providing public adult and continuing education under market and state influences as shown in exemplary case studies from England and Spain (Bernhardt & Kaufmann-Kuchta, 2023). These financial and regulatory frameworks embody the principle of public responsibility in adult education – understood as the normative and institutional mandate of adult education providers to ensure access to educational opportunities in the public interest, such as those that promote democratic values, civic engagement and responsiveness to regional needs (Nuissl, 2023). At the same time, public funding for adult and continuing education has steadily declined (EAEA, 2023; OECD, 2019; Widany et al., 2021), prompting critical debates about whether societal educational needs are being adequately recognised and met (Nuissl, 2023). Against the backdrop of the gradual withdrawal of the state from direct public responsibility and the emergence of new governance mechanisms, questions of public responsibility and funding arise with renewed urgency, particularly in relation to how adult and continuing education providers sustain themselves. As Schrader (2010) argues in his model of reproduction contexts, providers must continuously secure both resources and legitimacy by aligning with different institutional logics, such as those of the state, firms, market, or (interest or value) communities as well as differing interests in public or private matters. As such, the realisation of public responsibility in adult and continuing education is shaped not only by normative commitments, but also by the structural conditions and contexts under which providers operate.

As digital platforms increase the visibility and accessibility of continuing education offerings, their reach extends beyond local contexts. Meanwhile, the offerings themselves remain embedded in regional regulations and local funding structures (Klemm & Repka, 2021; Rohs & Lacher, 2023; Schöll, 2021). Using Germany as an example, the following section examines funding structures in publicly responsible education as well as current policy initiatives related to digital platforms.

3.1   Financing Structures in Adult and Continuing Education

In publicly responsible continuing education, a tension arises between the regional subsidisation of the educational institution (and the associated regional educational policy interests) and the supraregional availability of the courses. These dynamics influence the development and implementation of platform-based business models, as both economic viability and public-interest objectives must be considered. The following sections examine the financing structures of publicly responsible adult and continuing education, focusing on the examples of adult education centres and university continuing education.

3.1.1 Adult Education Centres and the Territorial Principle

As historically developed municipal providers of public adult education in Germany, adult education centres have traditionally a strong connection to their region, operating independently of political and religious affiliations (Frieling & Rex, 2023). As non-profit institutions, the programs of the approximately 850 centres in Germany include a wide range of courses – from language and vocational courses to cultural and political events – and address a broad target audience. The offerings are grouped into overarching program areas[2], creating a degree of uniformity in the courses under the common umbrella brand 'VHS'. This uniformity is due to strong association-based structures: At the federal state level, the centres are organised in associations, which mediate between the regional providers and the federal state's education policy. In addition, the associations take on further tasks, such as organising training for staff as well as taking care of public relations. The federal state associations are also united in the 'German Adult Education Association' which coordinates the strategic direction of the centres' work and, for example, develops principles and guidelines (Süssmuth & Eisfeld, 2018). Based on the so-called *territorial principle*, which legally regulates the jurisdiction of the centres as a continuing education provider in a specific region (Rohs & Lacher, 2023), the centres receive financial support from the states and municipalities in the German federal system to provide demand-oriented and cost-effective offerings. About one-third of the revenue comes from subsidies through public funding from the respective region.[3] Accordingly, regional interests are tied to these funds, which leads to a stronger orientation towards local public adult education needs.

3.1.2 University Continuing Education and Cost Covering Fees

University continuing education operates in an even more pronounced tension between the public educational mandate and market dynamics: The provision of university continuing education, namely a wide range of mostly highly specialised continuing education courses with the possibility of acquiring academic degrees and certificates, is a core task of the universities in Germany as defined by law (HRG, 1999). However, it is – unlike undergraduate studies in Germany – generally not financed through the basic funding of universities, but rather through the collection of cost-covering participation fees (Lermen & Vogt, 2020). This results in a service-oriented approach directed towards paying customers, which contrasts sharply with the state-subsidised offering logic of universities (Lengler & Seitter, 2023). Due to their hybrid positioning between the higher education system and the functional logics of the continuing education market, different understandings of the function, role interpretations, and objectives of university continuing education emerge (Seitter, 2017). Beyond having very heterogeneous provider structures, the field is also characterised by plural organisational and governance forms and differently structured business models (Dollhausen & Lattke, 2020; Knust, 2006; Lermen & Vogt, 2020).

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2   The centres' program areas include basic education, work and career, politics, society and the environment, health, culture and design as well as language and integration (Frieling & Rex, 2023).
3   Adult education centres are funded by a mixture of subsidies from municipal and state funds, participation fees and third-party funds (Süssmuth & Eisfeld, 2018).

3.2   Digital Platforms Policy Initiatives

A distinctive feature of public adult and continuing education in Germany is the support of various policy initiatives for the development of digital platforms as central infrastructures. While this includes platforms for marketing and booking continuing education offerings – which will be the primary focus here – it is important to note that other types of digital platforms have also been developed and politically supported. An example is the *vhs.cloud*, a learning and collaboration platform within the context of the public adult education centres. Marketing and booking platforms, though, are the platforms bringing together regional course offerings, facilitating participation beyond traditional territorial boundaries. As continuing education providers see their role as regional educational service providers being questioned, administrative processes must be adapted to the new digital structures, and the long-term financing of the platforms becomes relevant.

3.2.1   Booking Platforms for Online Adult Education Centre Courses

With the aim of consolidating the online course offerings of the adult education centres, several regional state associations of the centres have developed digital platforms (e. g. Klemm & Repka, 2021). These platforms serve as a centralised booking and marketing infrastructure for the digital course offerings, operating on a state-based level (see Chapter 3.1.1). The platform exclusively aggregates digital course offerings from multiple centres, allowing potential participants to access not only offerings from their local provider, but also those from other regions. At the same time, the centres hope that the platform's broad outreach to potential participants will reduce course cancellations due to insufficient enrolment. By consolidating offerings on a central platform, the participating centres can position themselves as competitive actors in comparison to other providers of digital educational offerings, aiming to target new audiences. However, the supraregional visibility of the offerings also leads to new dilemmas, as the centres must account for their role as regional public service providers to local stakeholders once individuals from outside the regional boundaries of the offering centre participate in the courses.

3.2.2   Booking Platforms for University Continuing Education Courses

Various platform initiatives can also be observed in the field of university continuing education at the state level. Similarly to the initiatives of the adult education centres and their associations, platforms with booking, information, and marketing functions are being developed with the aim of providing a comprehensive overview of continuing education offerings at universities (e. g. südwissen, bayernweit, WIBKO©). However, these platforms do not exclusively feature digital, but also hybrid or in-person courses. The university continuing education offerings stand out due to their heterogeneity. They are not as easily scalable as, for example, language courses at the public adult education centres, due to their very specific target group. This places demands on scientifically oriented continuing education in relation to their flexible organisation in terms of time and location (Lobe, 2020). Furthermore, due to the principle of full cost

recovery, these offerings can be very expensive (Lermen & Vogt, 2020). This often leads to longer decision-making processes on the part of participants, which at first seems to contradict the 'one-click buying' logic of the platform (Alke et al., 2024).

Initiatives in both areas highlight the potential of digital platforms to expand access to adult and continuing education offerings but also present challenges, particularly regarding the preservation of regional educational opportunities and the sustainable financing of these digital infrastructures.

4 Research Design

Despite the growing importance of digital platforms in adult and continuing education, empirical studies on this topic are still lacking. To systematically analyse how business models are currently structured in this field and how actors handle emerging tensions, four semi-structured, open interviews (Helfferich, 2019) were conducted with experts for platform development and implementation. Additionally, a document analysis (Hoffmann, 2018) of 25 supporting documents related to the platform and business model development process was carried out, including press releases and planning documents. The selection of three platform cases was based on current platform initiatives at the association and provider level. For the study of university continuing education, one booking platform from an ongoing accompanying research project of the "Hochschulweiterbildung@BW" project, funded by the Ministry of Science, Research, and the Arts of Baden-Württemberg from 2021–2024, was used (overview: Alke et al., 2024). Furthermore, two booking platforms from associations of public adult education centres were selected, providing insights into the context of adult education. The analysis was based on a qualitative content-analytical procedure according to Kuckartz and Rädiker (2024) with deductive-inductive category development (see Table 1, which provides an overview of the main categories). Following the categorisation, an interpretative analysis was used based on the theoretical concepts in Chapter 2.1 to identify central themes, which are presented in Chapter 5.

Table 1: Category system

Business model	Platform	Platform development
Platform operator Providers Users Value creation process Financing Infrastructure	Definition Function Target group Platform management Effects on the continuing education landscape	Development process Strategy Actors involved
Deductive categories, based on Dolata and Schrape (2023), Franken and Fischer (2018) as well as Harwardt and Haselhoff (2022).	Inductive categories, linkable to Ametowobla and Kirchner (2023), Dolata and Schrape (2023) as well as Kirchner (2022).	

5   Results

Building on the theoretical-conceptual and contextual framework, the following section presents key findings regarding platform-based business models in adult and continuing education. Due to the structural, financial, and institutional conditions that differ from those of privately operated platforms, there is a contrast between the (commercialised) platform logic and the public educational mandate and associated funding. The implementation of platform-based business models thus shows a specific contextualisation, the details of which will be elaborated upon in the following section.

5.1   Conflicting Demands on Platform Management

A central challenge in implementing platform-based models in the adult and continuing education sector is balancing the various, sometimes contradictory, demands placed on platform operators and platform management: On the one hand, the platforms must be attractive to providers and users; on the other hand, they also must also comply with the existing regulatory framework. This results in three central areas of tension, which are outlined below.

Table 2: Areas of tension for platform-based business models in the adult and continuing education context

1. **Increasing the attractiveness of the platform** Creation of network effects through accompanying marketing measures	vs.	**Limited scaling** Regional limitation due to funding structure and finiteness of providers
2. **Platform as a reason for cooperation** Cooperation as the basis for potential benefits for all providers	vs.	**New forms of competition due to supraregional visibility** Varying willingness of providers to participate (depending on course heterogeneity/homogeneity)
3. **Limited funding and legitimisation of resources** Restrictions on financial support due to temporal constraints or alternative use of funds	vs.	**Need for long-term strategy development and financing** Ensuring competitiveness (also regarding other platforms)

5.1.1   Platform Attractiveness and Regional Limitations

To create value and enhance the reputation of the platform, platform operators in the adult and continuing education sector aim to achieve high user retention. Comparisons of the platforms to well-known digital companies like 'Amazon' address the intermediary function of the platform between providers and customers in the sense of a multi-sided market (Haselhoff & Harwardt, 2022). The interpretation of the booking platform as a marketplace assumes its attractiveness depends on the number of users: "The more offers there are on this platform, the less I have to go through [all providers]" (I1, Pos. 58, translated from German). Such network effects (Haselhoff & Harwardt, 2022) result from a politically initiated cooperation agreement between providers and their associated self-commitment to list their courses on the platform, as it was the case in the examined booking platform for university continuing education. Regarding platform attractiveness, the material also shows an incremental approach with

testing and feedback loops in platform development: New functions such as booking options extend the platform purpose beyond a mere directory and increase its appeal for users. Scaling the number of providers expands the reach: What started as a locally limited solution in the cases examined is evolving into a supraregional platform, which, through a growing array of continuing education courses, addresses a broader target group. Furthermore, supplementary marketing activities increase visibility and promote the platform and specific target groups (e. g. younger people or working adults are addressed). The platform is also linked with additional marketing formats (e. g. promotion via social media). Behavioural traces of users on the platform can be measured and utilised (see Kirchner, 2022), and, for example, used for a targeted approach toward specific groups. Through cooperative marketing and joint branding, the market-oriented structure of the continuing education sector makes platforms increasingly relevant for (regional) organisational identity (Alke et al., 2024). At the same time, platform operators face challenges regarding scalability: Regional limitations imposed by financing structures mean that platforms are politically bound to providers from specific areas and cannot expand indefinitely. Following platform logic, this restriction diminishes the ability to generate a critical mass of users, which is essential for reinforcing network effects.

5.1.2   Relations of Cooperation and Competition

As overarching infrastructures for the visibility and marketing of services, platforms offer an opportunity for collaboration in the sense of Dollhausen and Mickler (2012). This is achieved by bringing together actors who contribute specific resources or expertise to create added value for all parties involved. In the cases examined, collaborations have been established in which there has not only been active exchange for the development of the platform but also collective implementation. This has led to complex structures that expand the classic understanding of a platform operator (Dolata & Schrape, 2023): Instead of anchoring platform management exclusively in the central core of platform architecture, various actors are involved in the platform's development and governance. This emphasises the importance of the platform operator's role and relationship to providers. What becomes evident in the material is that platform development involves continuous strategy work and coordination, especially when platform processes are implemented through association structures. In this context, collaboration among all involved actors becomes crucial, as it serves as the foundation for realising potential benefits for all providers (Pongratz, 2022). At the same time, supraregional visibility leads to new competitive dynamics: Regional providers suddenly find themselves facing greater competition due to the platform's broader reach. A key factor here is the nature of the offerings. As explained above, courses of adult education centres are much more homogeneous in design than the highly specialised offerings of university continuing education (Christmann, 2020). If only digital courses are offered on the platform, as is the case in the examined platform models of public adult education centres, smaller organisations fear being overshadowed by larger providers.

5.1.3   Resource Constraints and Long-Term Strategy

Another area of tension in the context of the sustainable financing of digital adult and continuing education platforms concerns the legitimacy of the resources used and the long-term assurance of financial support. In the cases examined, public funding at the state level served as the initial impulse for platform development and implementation. While public funding at the state level can act as an initial catalyst for the creation and operation of platforms, the challenge arises in continuously legitimising and maintaining these resources. Platforms must not only remain competitive against other providers in the adult and continuing education market but also fulfill the interests of public funds, which often have clear guidelines regarding use and expected outcomes. However, these subsidies are often temporary or subject to regulations that limit sustainable financing. This becomes particularly challenging when the regulations (e.g. success criteria, key performance indicators) are not clearly defined. This lack of clarity highlights the challenge of establishing resource legitimacy, measured through indicators like booking numbers or course variety, for example. Unclear success criteria and the challenge of aligning public funding with platform operators' goals lead to the question of how digital adult and continuing education platforms adapt their business models in such an environment. Platform operators must create value for users and providers while also developing models that meet public funding requirements and address the competitive conditions of the continuing education market. The following section examines how business models are adapted to the specific conditions of adult and continuing education.

5.2   Contextualising Platform-Based Business Models

Based on the triangular structure between providers, potential participants, and platform operators, the business model represents the value-creating process of interaction between supply and demand (Harwardt & Haselhoff, 2022). In contrast to platform-based business models from the EdTech sector (e.g. Coursera, Franken & Fischer, 2018), which operate for profit and on a global scale, the examined cases illustrate context-specific adaptations of business models within the field of regionally oriented adult and continuing education. These adaptations reflect differing institutional frameworks and funding conditions, which will be discussed in detail below. To address the tensions outlined in the previous chapter, various incentive structures can be identified that platform operators implement to (1) generate network effects and increase platform attractiveness despite regional (self-)limitations, (2) enhance providers' willingness to participate, and (3) implement approaches for sustainable financing. The following section differentiates between incentive structures of solidary cost coverage (model 1) and subsidised marketing services (model 2).

5.2.1   Solidary Cost Coverage

This model focusses on platform approaches in the context of public adult education centres, where only digital courses are offered. A solidarity-based billing system, overseen by the state association as the platform operator, establishes an incentive structure for providers to address the regional responsibility of adult education in the context of

public funding. This is achieved through the supraregional visibility of further education offers on digital platforms (see Figure 2): When a person books a digital course on the platform, only a part of the participation fee goes to the provider organising the course (1), while the rest goes to covering the operating costs of the platform (2) as well as financing the supplier from whose regional area the participant comes (3). Thanks to this system, even providers who do not offer courses on the platform can also benefit from the platform solution developed:

> This is a solidarity measure, which is also intended to respect the territorial principle [...], i. e. we are not taking participants away from each other. And [providers] who have fewer online offerings or no online offerings can also be favored and do not simply fall aside." (I2, Pos. 32, translated from German)

The triangular actor configuration of the booking platform (providers, users, platform) is thus extended by a value-creating relationship between providers and the regional affiliation of the users. However, this expansion is only possible if the corresponding participant data is analysed and used for value creation (datafication, Kirchner, 2022). In this way, providers who are not part of the platform's provider portfolio also benefit. The platform also makes it possible to connect smaller providers with a larger target group and thus expand their reach and market potential.
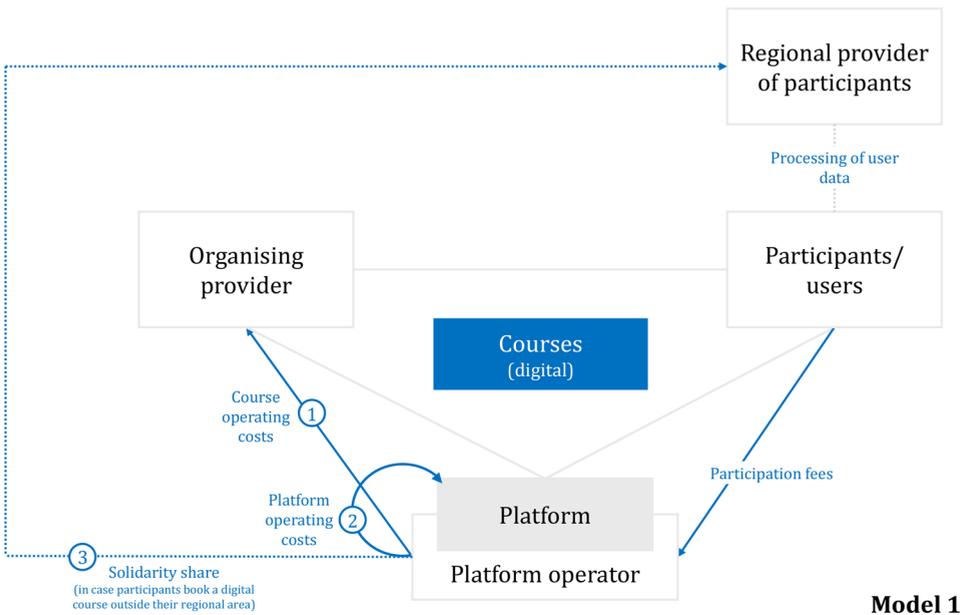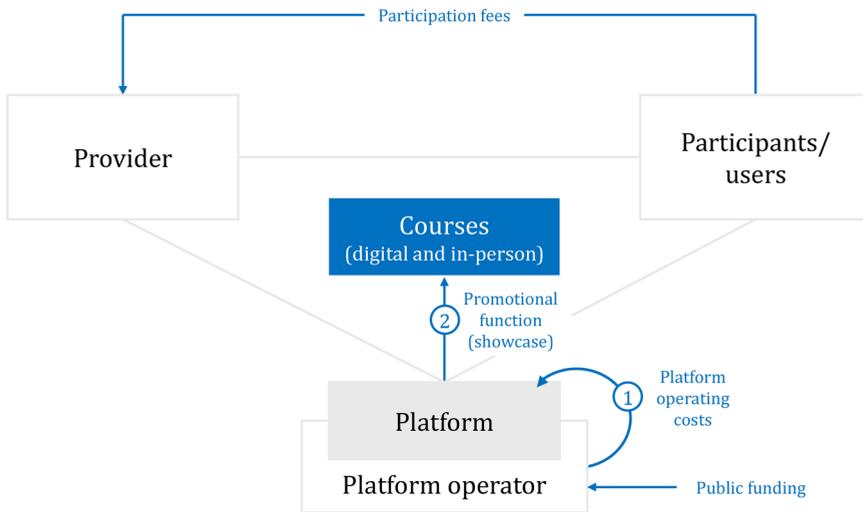

Figure 2: Incentive structure of solidary cost coverage

5.2.2 Subsidised Marketing Services

In the subsidised marketing service approach (see Figure 3), which can be found both in the context of public adult education centres and university continuing education,

the digital booking platform is financed by public funds to cover costs (1) and thus offers continuing education providers a showcase (2). This showcase supports providers in listing their offerings (digital, hybrid and in-person courses) to increase visibility and reach. Since the costs of operating the platform are covered, providers can be listed free of charge. In the case of public adult education centres, these subsidies are provided by association structures, with the association acting as the platform operator, while in the context of university continuing education, funding is provided at the federal state level. These differences in the funding structure are relevant for understanding the subsidised marketing services: A funding system established through association structures can strengthen the long-term perspective of the platform, enabling stable and continuous development of the platform based on the possibility of long-term financial support from the association. In contrast, the federal state funding for platforms is project-based, limited in time and subject to meeting regulations, which challenges the long-term planning and sustainability of the platform. While long-term perspectives through association structures allow for more stable planning, platforms that rely on time-limited funding face the challenge of using marketing as a central strategy for legitimisation and sustainable financing. Particularly in the context of university continuing education, marketing plays a crucial role in legitimising the existence and promotion of the booking platform. Here, the platform operator considers marketing to be essential for the provider's reputation and existence, given the heterogeneous structure of providers and the diverse target groups they serve (Lobe, 2020). Therefore, in addition to tracking booking figures, marketing measures – both for and by the platform – serve as key methods of legitimisation, helping to justify the platform's ongoing financing to funding providers (the state).

Participation fees

Provider

Participants/ users

Courses
(digital and in-person)

2   Promotional function (showcase)

Platform

Platform operator

1   Platform operating costs

Public funding

Model 2

Figure 3: Incentive structure of subsidised marketing services

6   Conclusion and Future Perspectives

The previous analysis demonstrates that platform-based business models in adult and continuing education present specific areas of tension that require nuanced consideration. These tensions arise from the need to balance economic viability with the fulfillment of a public education mandate. To navigate these challenges as publicly oriented platform operators, different incentive structures were identified in the empirical material.

In the solidary cost coverage model (see Figure 2), found in the context of public adult education centres, the association structure not only funds but also operates the platform, which gives the association a dual role as financier and coordinator. This positioning allows for more stable and continuous development, as the association can act strategically over a longer time horizon. However, coordination takes place in negotiation with the interests and capacities of member organisations, which limits the association's ability to act unilaterally as a steering core. The subsidised marketing service model (see Figure 3), by contrast, is found both in the context of public adult education centres and university continuing education. Here, the organising core is fragmented: Successful organisation depends on the cooperation of temporary project teams and external service providers, as well as the requirements of funding bodies. This results in a more layered and potentially fragile form, where platform development is shaped by the procedural logic of project implementation and reporting requirements. Due to the fragmented structure, governance becomes a precarious matter for the core organisation, as strategic control is limited and decision-making relies on external actors and project-based frameworks. In this setting, marketing emerges as a central mechanism for both outreach and legitimation as seen in the empirical findings. Booking metrics are not just tools to attract users but serve as key indicators used to justify the platform's continued funding. The observation that divergent platform strategies are pursued in the same context (e. g. Models 1 and 2 are both found in the context of public adult education centres) further underscores the need to understand these platforms as products of organisational decision-making and political negotiation. These differences raise questions about how platforms act as intermediaries (Decuypere et al., 2021), positioning themselves strategically in response to political and institutional demands.

Across both platform-based business models discussed, the role of the platform operator is expanding and it tends to be understood less as a centralised authority and more as a mediator of interests among a diverse set of stakeholders, including associations, public funding bodies, and educational providers. This raises questions about control mechanisms and platform governance (Alke, 2022), as well as about the role of platform operators with a public orientation for the common good: They can control access and set clearly defined criteria for the provision of services (e. g. standardised entry forms for adult and continuing education courses). The distribution of roles between platform operators, providers and users appears to also be decisive for the acceptance and legitimacy of the platform-based business model.

As platforms themselves are not neutral technical objects (Dolata & Schrape, 2023) and data provided by these platforms is also the result of predefined digital infrastructure (see also "'Raw Data' Is an Oxymoron", Gitelman, 2013), platform operators mediate educational decisions and potentially reconfigure institutional responsibilities, thus potentially shaping educational policy (Gädeke, 2025; Karger & Kalenda, 2024). Furthermore, platforms can also influence the presentation and arrangement of offerings through algorithmic recommendations or curated content. These dynamics present governance challenges for publicly oriented platform operators which highlight the need for transparent, accountable structures that allow for stakeholder participation and alignment within the public educational mandate, rather than focusing solely on operational performance indicators. Thus, platform management in public contexts also means navigating and negotiating between state mandates, regional responsibilities, and the heterogeneous expectations of users and providers.

In particular, the relationship between platform operators and providers, as well as strategic developments (e.g. in association structures), merit further exploration from the perspective of adult and continuing education research. While publicly funded platforms in adult and continuing education can adapt to market mechanisms to some extent, their development and management are typically constrained by political and administrative guidelines, limiting the full applicability of platform logic (Dolata & Schrape, 2023). This raises the question of whether subsidised platforms are platform-based business models or rather digital referral structures that are oriented towards the common good and largely circumvent platform logic – particularly because no commission is charged. In contrast to commercial platforms that generate revenue through transaction fees or commissions for each successful booking, publicly operated booking platforms in adult and continuing education do not monetise the matching between supply and demand: Platform operators do not earn profit from the digital infrastructure they provide, nor from the additional services they offer, such as the curation of course information or marketing support. These services are publicly funded and framed as part of a broader mandate to ensure access, transparency, and administrative relief for providers. As a result, these platforms could be discussed less as profit-generating marketplaces and more as public digital infrastructures, designed to coordinate educational offerings in line with public responsibility and regional cooperation, rather than competition (Bonnes, 2023). This conceptual ambiguity – between platform logic and public service infrastructure – needs to be further discussed in future research, particularly regarding the long-term sustainability and governance of such hybrid models.

Taken together, the findings suggest that further conceptual work may be necessary, particularly to better understand platform operators as well as the long-term sustainability and legitimacy of public digital platforms in adult and continuing education. These observations point toward a need to rethink the notion of a singular organising core in the context of publicly subsidised platforms. What emerges instead are multipolar governance arrangements of coordination involving public institutions, associations, and providers. Future research should critically examine the theoretical adequacy

of existing platform models in explaining such hybrid, politically embedded constellations, and could benefit from expanding existing concepts to capture these constellations more precisely. This includes raising questions about how to examine fragmented cores and the politicisation of platform infrastructure in adult and continuing education.

The specific contextualisation of platform-based business models in Germany offers valuable insights into how publicly funded, regulated systems shape the development of educational platforms, here exemplified by public adult education centres and university continuing education. These findings also provide a useful reference point for comparative research by highlighting how governance structures, funding models, and regulatory frameworks shape the design and operation of educational platforms across different contexts of continuing education. In doing so, the study underscores the importance of examining platform development not as a uniform process, but as one mediated by policy environments, institutional histories, and regional objectives. For international discourse in continuing education research, the analysis sheds light on the diversity of platform configurations beyond commercially driven models, enabling a broader understanding of how different national and/or regional contexts negotiate the intersection of digital infrastructures and public responsibility in adult and continuing education.

In conclusion, it should be noted that the marketing and positioning of continuing education courses, especially in platforms as market and service spaces (Alke et al., 2025), does follow a business logic. However, it needs to be considered that managing an educational platform requires pedagogical considerations (Grotlüschen, 2018, p. 113). These include aspects such as program planning, positioning of offerings and engagement with platform business models and market dynamics. This requires a thorough understanding of platform dynamics to ensure strategic platform development and coordination. The dual nature of platform-based business models – combining both market-driven logic and educational goals – underscores the importance of developing appropriate further training programs for those involved. Future research could contribute valuable insights into the dynamics of platform-based models in adult and continuing education, especially regarding their governance and regulatory challenges.

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Navigating Digitalisation in Adult and Continuing Education

Governance and Policy Perspectives

Julia Koller and Ulrike Krein

Abstract

Adult and continuing education (ACE) are situated within a dynamic system defined by diverse educational institutions, organisations, and political frameworks. The digital transformation poses significant challenges in both strategic planning and practical implementation. There are indications that the process of digitalisation has led to an increased necessity for the coordination among relevant actors, facilitated by a multitude of exchange formats. These stakeholders exert influence through their legal position, political mandate, or role in public discourse. It is reasonable to posit that this will be particularly evident in the field of adult education, given the structural plurality and diversity that characterises this area. Nevertheless, the existing literature on the governance and policy related topics surrounding the digital transformation in adult education remains limited. The contribution aims to provide an international overview of research on policies and governance of the digitalisation of the system of continuing education, based on a international systematic literature review focusing on relevant actors.

Keywords: Digital Transformation, Educational Governance, Adult and Continuing Education Policy, Systematic Literature Review

Zusammenfassung

Die Erwachsenen- und Weiterbildung bildet ein dynamisches System, das durch unterschiedliche Bildungseinrichtungen, Organisationen und politische Rahmenbedingungen geprägt ist. Die digitale Transformation birgt dabei große Herausforderungen, sowohl in Bezug auf die strategische Planung als auch die praktische Umsetzung. Es gibt Hinweise darauf, dass der Prozess der Digitalisierung zu einem erhöhten Abstimmungsbedarf der relevanten Stakeholder führt, der durch eine Vielzahl von Austauschformaten erleichtert wird. Die Digitalisierung des Bildungssektors wird von einer Vielzahl von Stakeholdern geprägt, die durch ihre rechtliche Stellung, ihr politisches Mandat oder ihre Rolle im öffentlichen Diskurs Einfluss nehmen. Im Bereich der Erwachsenenbildung ist aufgrund der strukturellen Pluralität und Vielfalt eine besondere Sichtbarkeit dieser Stakeholder/Einflussnahme zu erwarten. Gleichwohl ist die vorhandene Literatur zu den Governance- und Policy-Themen im Kontext von digitaler Transformation in der Erwachsenenbildung noch begrenzt.

Ziel dieses Beitrags ist es, basierend auf einem systematischen Literaturreview einen internationalen Überblick über die Forschung zu Politik und Governance der Digitalisierung des Weiterbildungssystems mit Fokus auf relevante Akteure zu geben.

Schlüsselwörter: Digitale Transformation, Educational Governance, Erwachsenen- und Weiterbildungspolitik, Systematic Literature Review

1   Introduction

Adult and Continuing Education (ACE) is part of a dynamic system that is shaped by numerous educational institutions, organisations and political framework conditions. The digital transformation poses significant challenges in this regard for both strategic planning and practical implementation (Schrape, 2021; Bonnes, 2023). The extant literature offers only limited insight into the actors and coordination within the institutional environment, at national and supranational levels (Bonnes, 2024; Schrape, 2021). However, it is evident that these actors have a significant influence on the opportunities and limitations of adult learning. The financial framework conditions for the implementation of technical infrastructure and the legal framework conditions for software, for example, are particularly relevant here. Equally important are horizontal and vertical cooperation relationships between continuing education institutions, as well as the role of umbrella organisations and central interface actors in the continuing education landscape.

These aspects have not yet been systematically and comprehensively analysed for ACE. The purpose of this contribution is therefore to seek an exploratory approach via an international systematic literature review (SLR). Its objective is to provide an overview of research on the policy and governance of the digitalisation of the continuing education system. The central research question is: Which governance constellations and policy instruments are addressed in the international research literature on the digital transformation of adult and continuing education, and how do governance and coordination practices vary across national contexts?

In this article, *digital transformation* refers to structural and procedural changes in adult and continuing education (ACE) institutions driven by technological developments, particularly digital infrastructures, platforms, and data-related practices (Schrape, 2021). *Educational policy* is understood as a set of formal strategies, instruments, and regulatory frameworks that guide educational development on national or supranational levels. *Governance*, in line with Altrichter et al. (2007), denotes the coordination of actions and interdependencies between state and non-state actors across multiple levels of the education system.

First, the initial situation and research focus are outlined, with particular attention given to the data economy and platform capitalism in the education sector. The theoretical perspectives are then presented, with educational governance serving as a theoretical point of reference (Altrichter et al., 2007; Kussau & Brüsemeister, 2007; Maag Merki et al., 2014; Schemmann, 2013). This is followed by a description of the SLR methodology. The central results of the analysis are presented in the following section, struc-

tured according to the subjects of digital transformation discussed, (supra-)national education policy instruments and initiatives, and relevant actors. The article concludes with a summary of the key findings and an outlook.

2   Background and Theoretical Perspective

The digital transformation (Schrape, 2021) has led to changes in the education system in various areas of life. These changes do not manifest themselves exclusively in technological developments. Substantial changes in communication and social interaction also permeate organised adult and continuing education (ACE) (Kerres & Buntins, 2020) and have the potential to transform the ACE landscape by expanding or disrupting existing knowledge bases and competences. Furthermore, technological advancements have the capacity to influence extant structures within research and development, production, sales and markets, exerting pressure on established actors to adapt, encourage the emergence of new participants and challenge the entire sectoral configuration. In addition, these phenomena foster novel forms of cooperation and competition, necessitating institutional adjustments, including the establishment of legal and regulatory frameworks, as well as modifications to sectoral guiding principles (Dolata, 2021). Beyond the discourse surrounding the use of digital media in teaching and learning processes, there has been growing attention to the institutionalisation of digitalisation in educational organisations. While this issue has been addressed to some extent in the ACE (Bernhard-Skala, 2019; Bonnes, 2024; Koschorreck & Gundermann, 2021), the perspective of changes in the institutional landscape and administration or policy has received comparatively little attention (Bernhard-Skala et al., 2021).

When considering the institutionalised learning of adults as a multi-level system (Schrader, 2011), factors beyond the specific teaching-learning opportunities must also be taken into account. Schrader's multi-level system distinguishes four levels:

1. the system level, which focuses on the overall social framework and political structures at national and supranational level (e. g. European Union/EU) that influence continuing education (e. g. legal regulations, funding systems and national education strategies),
2. the institutional environment, which is characterised by cooperation, competition, and diverse constellations of actors,
3. the organisational level (e. g. organisational culture, professionalisation) and
4. the teaching-learning interaction level of direct interactions between teachers and learners.

The model provides a framework for comprehending the multifarious constellations of actors and forms of coordination that are instrumental in the context of ACE, by demonstrating the emergence and evolution of social orders and services. However, knowledge about these actors and coordination at the institutional, national and supranational levels in the context of digital transformation is scarce, despite their influence on adult learning.

In this context, the perspective of educational governance offers a valuable lens for understanding and elucidating these processes. It provides a systematic analysis of the processes by which social orders and services are produced in education systems (Kussau & Brüsemeister, 2007). A notable strength of this perspective is its emphasis on the coordination of a multitude of interdependent actors, who collectively influence the performance of continuing education organisations (Kussau & Brüsemeister, 2007). The focus is on the coordination of action (Altrichter et al., 2007), whereby the management of interdependencies of collective and individual actors is considered. The term 'policy' is used here to describe phenomena of educational transformation and governance.

While governance research in ACE is still emerging, school research already provides critical studies. In the context of school research, there is already a number of works that critically examine the political dimensions of digital transformation and the growing influence of multinational corporations in the education sector (Dander, 2018; Dander et al., 2024; Förschler, 2018). Recurring themes in these discourses pertain to digital capitalism, data economics and platform capitalism. The term 'data economy in education' refers to the collection, analysis and use of data to optimise educational processes and create personalised learning opportunities (Dander et al., 2024). This encompasses the utilisation of learning management systems, digital platforms and AI-powered tools that collect large amounts of data about learners and their interactions. Data capitalism is seen as an economic system in which data is regarded as a commodity and capital, with monetisation through advertising and opacity posing a specific risk to particularly marginalised groups (Friedewald et al., 2024). Platform capitalism, as a distinct production model, describes the dominance of large technology companies that operate educational platforms and pursue economic interests in doing so. These platforms offer learning content, as well as analysis and management tools based on the data collected. Consequently, the control over educational content and processes is being handed over to a small number of large companies (Urban, 2022).

An expansion of the private sector in the field of education is noticeable. However it should not be interpreted as a takeover of state tasks by private actors, according to economisation research in education. Instead, the state actively promotes the penetration of non-economic areas through economic discourses and practices, facilitated by networks, public-private partnerships, and cooperative endeavours within the scope of projects or initiatives (Höhne, 2022). A study on governance in the digital transformation of schools by Förschler (2018) shows that the expansion of networked policy modes can be observed, in which sectoral boundaries are crossed and complex interdependencies between non-state actors and state actors arise. These non-state actors, including EdTech providers, management consultants, and industry associations, have the capacity to influence the establishment of political agendas and the implementation of governance processes across various levels.

The extent to which these developments are evident in ACE remains an open question, given the paucity of comprehensive network analysis studies to date. Given the mid-level systemisation, the political principle of subsidiarity, the complexity of the

multi-level system and the contexts between market and community, it can be assumed that there are at least gradually different developments. Despite the evidence of cooperation and coordination of action in the ACE being network-based and community-based (Bickeböller, 2022; Koller et al., 2021), it can be hypothesised that market-based cooperation is evident, along with a reduced political control over cooperative relationships. Preliminary studies in the field of ACE have indicated the challenging organisational structure principle of platforms and coordination of action amongst the relevant actors involved (Alke, 2022).

Educational governance and policy logics are embedded within broader national institutional configurations. Welfare state theory, particularly as discussed by Esping-Andersen (1998), distinguishes between liberal, conservative and social-democratic models, each associated with distinct patterns of state intervention, market reliance, and the role of civil society.

These regime types influence not only funding structures and regulatory frameworks in adult and continuing education (ACE) (Knauber, 2017), but also shape expectations towards digitalisation, public-private partnerships, and modes of actor coordination. For example, liberal regimes may prioritise employability and digital skills through market-oriented strategies, while conservative systems may display fragmented, corporatist governance. Social-democratic regimes may support universal access through integrated policy instruments.

So far, however, the findings and frameworks presented have been drawn from research in German contexts. The extent to which similar changes and frameworks can also be found in other countries has not yet been systematically compiled. Therefore, a systematic literature review was carried out. The subsequent empirical section will focus on the international systematic literature review, the objective of which is to provide more knowledge about studies, references and connections between digital transformation and governance and policy in ACE, to clarify the desiderata highlighted above.

3   Method

The methodological approach of this article is consistent with the standards set out in the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) by Moher et al. (2015) and the guidelines for conducting systematic reviews by Newman and Gough (2020). The following provides a transparent overview of the search strategy used to develop the data corpus, followed by a description of the coding process and data analysis.

The search for relevant academic publications was conducted between October and November 2024 using the following databases: FIS Education (including ERIC and BASE), Google Scholar and Web of Science. The search was conducted using predefined search terms in German and English reflecting the key research interests. The search terms were categorised into three main groups. The Boolean operator 'OR' was used to link terms within each category, while 'AND' was used to link terms from diffe-

rent categories. The construction of the search strings involved the development of different search queries for English and German terms, which were then customised to the specific requirements of each database. While the search strategy was designed to capture both English and German literature, we acknowledge a bias towards German-language publications. This stems from the current state of research in which many relevant studies, particularly on governance in ACE, are published in German or within the German speaking region. A limited number of search results for an English-only search string were identified, which subsequently resulted in the integration of a German search string. Although efforts were made to include international literature, language barriers have contributed to the underrepresentation of certain regions. We consider this a limitation, yet also a reflection of an empirical gap in the international research landscape.

> TOPIC(Erwachsenenbildung OR Weiterbildung OR Fortbildung OR "further education" OR "adult education" OR "continuing education") AND TOPIC(policy OR governance OR "politische Steuerung") AND TOPIC(digital*)

The search results can be found in the search results tree (Fig. 1):
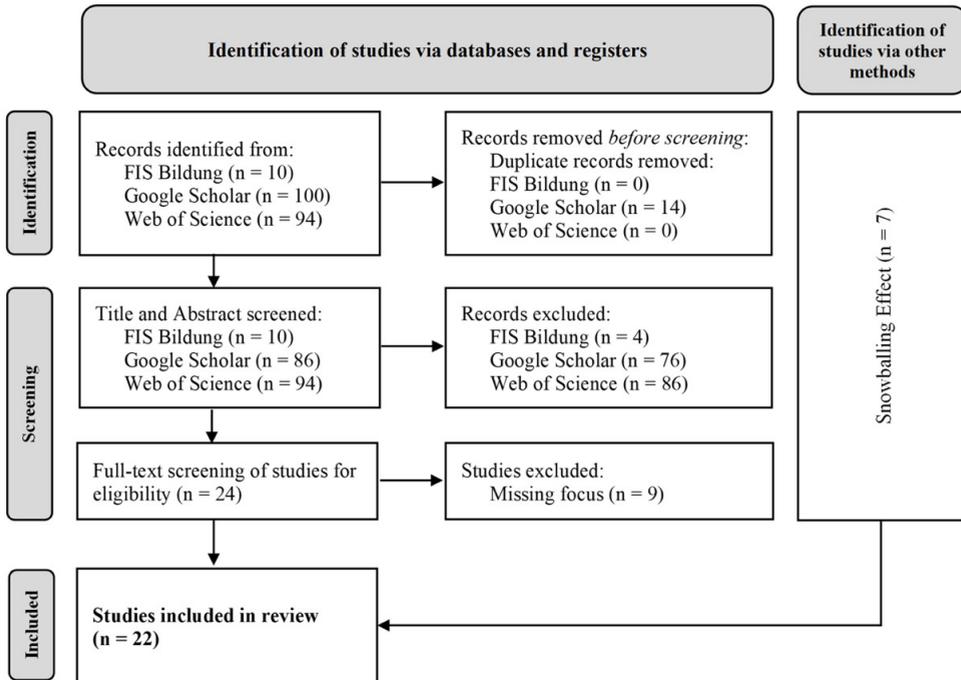

Figure 1: Search results tree

An inductive, systematic coding method was selected for the analysis of the publications included (see, for example, Newman and Gough 2020). Consequently, a thematic coding book was developed, encompassing content codes such as actors, instruments, and objects of digitalisation. While categories emerged inductively from the material, the coding process was theoretically sensitised by key concepts from educational governance research, such as coordination mechanisms and actor constellations. The coding book was subjected to a preliminary evaluation on a sample of works, after which it was refined, expanded and inductively adapted. The final version of the coding book was then utilised to code all included publications with MAXDQA.

Following the coding process, the coded units were analysed for themes, similarities and differences across the papers to synthesise key findings. The results of these analyses are presented below.

4   Results

The corpus is predominantly composed of journal articles (18), with one dissertation and five book chapters. The nations represented are Australia (1), the UK (4), Portugal (2), Germany (13), the USA (1) and Singapore (1). The earliest contribution dates to 2011, and only four contributions were published before 2020. This composition is indicative of the German perspective inherent in our search string, the preponderance of German research in this field, and the dearth of international comparative studies on governance and digitalisation in ACE.

The following section will first provide an overview of the thematic focus and phenomena discussed in the publications in relation to digital transformation. This is complemented by the presentation of respective national and supranational levels, including the connection with relevant education policy and instruments. Finally, an overview of the actors and actor constellations that influence digitalisation-related ACE processes is presented.

4.1   Thematic Focus Areas in the Literature

Digitalisation has an orienting effect on a variety of educational objects or phenomena. Among the recurring themes in the literature is the necessity of digital literacy as a pedagogical programme (Epstein et al., 2011; Eynon, 2021; Helsper & van Deursen, 2015; Lim et al., 2024; Smythe, 2018; Wallis & Buckingham, 2019). Some publications adopt an organisational pedagogical perspective, addressing the conditions of the organisational environment and educational policy (Alke, 2022; Bernhard-Skala, 2019; Bonnes, 2023; Bonnes, 2024a; Koschorreck & Gundermann, 2021; Rohs & Lacher, 2023). There is also a focus on specific technical objects, in particular platforms and e-learning programmes (Alke, 2022; Bonnes, 2023; Lim et al., 2024). The governance and policy aspect is also central to some publications (Alke, 2022; Bonnes, 2024; Castanheira, 2023; Engec, 2022; Lim et al., 2024; Rathmann et al., 2023). Furthermore, special governance-related issues play a role – such as policy advice through the measurement of digital

literacy (Gerhards, 2022; Marshall et al., 2024). These themes recur across countries but are prioritised differently depending on institutional logics and policy orientations, which will be discussed later on.

4.2   (Supra)national Education Policy and Instruments

It is evident that education policy actors are driving the transformation of the legal and regulatory framework around digital transformation.

While the actor constellations vary in composition and influence, a recurring pattern is the increasing importance of cross-sectoral governance involving public and private actors. These constellations mirror the governance logic of the respective welfare regime, with market-led models prevailing in liberal systems and more coordinated public frameworks in conservative or social-democratic settings. Although the reviewed literature does not systematically classify countries by welfare regime types, certain governance patterns observed in the material may tentatively reflect underlying welfare state traditions. This interpretative lens allows for a cautious contextualisation of differences in digital policy and coordination structures.

Germany, for example, is characterised by fragmented governance structures and the principle of subsidiarity, which shape the implementation of digital strategies in ACE Germany, often referred to as operating under a "territorial principle"[1] (Bonnes, 2024; Rathmann et al., 2023; Rohs and Lacher 2023). In contrast, publications from the UK and USA indicate a stronger market orientation and higher involvement of private actors in shaping digital skill agendas (Eynon, 2021; Epstein et al., 2011). Portugal and Singapore show more centralised approaches, with policy initiatives led by state authorities and aimed at digital inclusion or vocational upskilling (Castanheira, 2023; Lim et al., 2024). These findings suggest that while the corpus does not allow for a systematic typological comparison, some country-specific tendencies in governance and policy may align with broader institutional logics.

The instruments and the specific national discussions and mechanisms that can be identified in the review texts are outlined below. While the education policy itself must also be considered as an actor (among others) from the perspective of educational governance, this section is presented before other actors, primarily because of the interest in a coherent presentation of (supra)national education policy.

4.2.1   EU

The European Union has defined digital skills as key competences for lifelong learning. The Digital Education Action Plan (2018–2020) sought to enhance the utilisation of educational technology and advocate for the cultivation of digital competencies. The updated plan (2021–2027) places greater emphasis on developing an effective digital education system and improving digital skills. A European Digital Education Centre has been established to support implementation and promote cooperation (Rathmann

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1   The "territorial principle" refers to the federal governance and funding structure in Germany, where adult and continuing education is primarily regulated and financed at the level of the Länder (federal states) or municipalities. This often results in highly decentralised responsibilities and diverse regional practices within the broader national policy framework.

et al., 2023). This Digital Agenda for Europe (DAE) is regarded as the most important framework (Helsper & van Deursen, 2015, p. 137). The authors observe that existing policies have predominantly concentrated on the supply side of the equation, neglecting the demand side. Consequently, there is a necessity to emphasise user-driven and participatory designs, particularly for marginalised individuals within the context of digital literacy. The integration of digital media within educational frameworks is accompanied by three dimensions of expectation, articulated within international and national educational policy documents. At EU level, strategies such as the Digital Education Action Plan 2021–2027 have been developed to build an effective digital education ecosystem.

4.2.2 Australia

In Australia, the government is collaborating with a research group to develop a digital skills assessment tool. The researchers emphasise that policy makers who create benchmarks for digital skills will be more successful if they take into account authentic learning and skills development processes (Marshall et al., 2024). Collaborations with academia and relevant stakeholders in adult education on empirically informed digitalisation policy are therefore recommended: "Overall, we argue that authentic digital skills policy and programme development must account for the contexts in which digital technologies are used" (Marshall et al., 2024, p. 2).

4.2.3 UK

The authors Eynon (2021) as well as Wallis and Buckingham (2019) engage in a critical discussion of some aspects of the UK digitalisation policy in the context of the UK Digital Strategy of the Department for Culture, Media and Sport (DCMS), the Department for Education (DfE), and the Department for Business, Innovation and Skills (BIS). These are responsible for digital skills: Digitalisation policy in England is strongly aligned with the needs of business and has a narrow, instrumental focus on digital skills (Eynon, 2021, p. 149). There is a strong involvement of commercial actors in the design and implementation of digitalisation initiatives, which leads to a prioritisation of commercial objectives (Eynon, 2021, pp. 149, 156). Conversely, a more comprehensive, emancipatory and democratic educational approach to digitalisation is conspicuously absent. Instead, the focus is on teaching operational skills (Eynon, 2021, p. 159). Wallis and Buckingham (2019) draw attention to the fact that no clear definition prevailed in the development of media literacy in the UK, therefore diversity took over and digital literacy became a flexible instrument – also in terms of economic interests.

4.2.4 USA

As Epstein et al. (2011) emphasise that the digital divide is not only a technological problem, but also has significant social and economic dimensions. The authors contend that the digitalisation policy in the education sector of the United States is predominantly oriented towards access to technological resources. In their analysis, they observe a relative paucity of emphasis on cultivations of digital competencies and provi-

sions of support to disadvantaged demographics. This has resulted in an inequitable distribution of benefits, with policies favouring business interests and the advancement of technology, thereby reinforcing existing social inequalities. The authors advocate for a more comprehensive policy that prioritises both access to technology and the cultivation of digital competencies. It is important to note that the text was written in 2011 and does not reflect current American education policy. Nevertheless, it is worth mentioning that clarity of concept is crucial for education policy and the actors involved.

4.2.5   Germany

Germany has a variety of legal regulations in different contexts, but these are not explicitly related to the digital transformation of adult education (Bonnes, 2024). Bernhard-Skala (2019) shows that German education policy needs to adapt to the demands of digital transformation. This necessitates the formulation of novel strategies and the adaptation of extant structures to facilitate the integration of digital media (Bernhard-Skala, 2019). Rathmann et al. (2023) provide an instructive summary of German education policy: In June 2021, the German federal government published the updated Strategy paper Digitalization, which sets out a joint strategic implementation of digital measures with the dual objective of increasing the opportunities of digitalisation for the country's prosperity and assessing the associated risks. The strategy encompasses a range of areas, including digital skills, infrastructure, equipment, and societal aspects of the digital transformation. According to Rathmann et al. (2023) Germany's education policy aims to invest in digital skills, infrastructure and teaching plus learning materials, with the objectives to enable citizens to shape the digital transformation in a self-determined way and to deal with risks responsibly. A range of initiatives designed to foster the development of digital capabilities are to be made available, with the education system itself being recalibrated to place greater emphasis on the digitalised life, the digital workplace and economic sphere, and the digital knowledge society. This focus aligns with the objectives of the EU Digital Education Action Plan, underscoring the EU's strategic influence in this domain (Rathmann et al., 2023).

Rohs and Lacher (2023) draw attention to the principle of spatial structures of ACE through federal education legislation and state regulations. These regulations exert a significant influence on the programming, organisation, financing and quality assurance of continuing education. It is relevant to note that ACE – which is oriented towards the common good – is funded to the approximate extent of 35 % from municipal, district or state sources. However, this principle is being challenged by digital transformation, as programmes are now being offered online and therefore have an impact across regions.

Bonnes' (2024a) analysis demonstrates the pivotal role of political actors in shaping legal and regulatory frameworks concerning data protection. In doing so, these stakeholders establish parameters for the utilisation of specific technologies within educational programmes or formally approve their employment.

4.2.6   Portugal

In April 2020, the Plano de Ação para a Transição Digital was initiated in accordance with the national e.2030 initiative for digital skills. The Capacitar i4.0 programme is instrumental in promoting the development of in-house and inter-company training measures in this area. The Plano de Ação para a Transição Digital is comprised of three principal domains (Rathmann et al., 2023, p. 117): The first area focuses on the digital inclusion of people through adult and continuing education (ACE); the second area targets the digital transformation of companies; and the third area concerns the digitalisation of government services. The first area, which aims at the digital inclusion of people, includes strategies such as digital education and training activities funded through various programmes, including INCoDe.2030. The government's strategy to support the digital transition is intended to create a knowledge-based economy and society in which productivity growth is fuelled by innovation and highly skilled people. The Ministry of Education, the National Agency for Qualification and Professional Education (ANQEP) and the Instituto do Emprego e Formação Profissional (IEFP) are the primary entities responsible for the provision of guidelines and tools related to guidance services (Castanheira, 2023; Rathmann et al., 2023)

4.2.7   Singapore

In Singapore, the government has initiated the SkillsFuture programme. This programme is an initiative to promote lifelong learning and skills development for adults (Lim et al., 2024). In contrast to earlier schemes in which the responsibility for employee training lay with employers, SkillsFuture promotes employee self-improvement, making them more appealing to employers. Additionally, SkillsFuture plays a pivotal role in the transition of the Singaporean economy from a capital-intensive to a knowledge-intensive economy by emphasising key competencies for Industry 4.0. Digitalisation-related skills and e-learning are inextricably interwoven in this context. Singapore's commitment to lifelong learning – with a particular emphasis on digitalisation-related vocational training and in-company training – positions it as a leading proponent of innovative educational models (Lim et. al., 2024).

5   Actors and Actor Constellations

A close examination of the extant literature reveals that digitalisation has given rise to a new constellation of actors in the field of adult education. To facilitate digital transformation in this sector, it is imperative to establish a wide network of relevant actors. Alongside conventional educational institutions (adult education centres and providers) technology companies, platform operators and education technology companies (EdTech) have now entered this field (Alke, 2022; Bonnes, 2023; Schmid, 2021). These actors bring new opportunities for collaboration, but also challenges in terms of competition and market position, and also require careful coordination (Alke, 2022; Bonnes, 2023; Echarti et al., 2023). These actors are involved in steering digital agendas

either through formal policymaking, resource provision, or indirect influence (e.g. agenda-setting, lobbying). While associations and umbrella organisations of ACE play a central role, technology providers with a profit-motive pursue their business interests, which are not always in alignment with the goals of continuing education for the common good (Eynon, 2021). Digitalisation necessitates strategic management of ACE organisations to ensure that the opportunities offered by new collaborations are exploited while minimising the risks posed by new competitors (Bernhard-Skala et al., 2021; Bonnes, 2024).

5.1   ACE Organisations

In consideration of the conditions in digital transformation from the vantage point of ACE organisations within the institutional environment, Bonnes (2024) expounds that digital transformation engenders social interactions with a diverse array of actors within the organisational milieu. These include addressees of adult education, ACE associations, external service providers, freelance course instructors, managers of other adult education organisations, and political actors. These actors can act in an advisory and reflective capacity to initiate or drive changes in organisational programmes, structures, and digital media repertoire. A particular focus in managing these transformations should be on the leadership of ACE organisations (Bonnes, 2024, p. 331). Bernhard-Skala (2019) asserts that this necessitates a comprehensive and meticulously devised strategy that encompasses both the technical and pedagogical dimensions of digital transformation. A significant challenge pertains to the investment in the requisite IT infrastructure and the necessity for qualified personnel, who must be appropriately remunerated – a factor that presents difficulties for numerous institutions (Bernhard-Skala, 2019). Digitalisation alters both internal workflows and external cooperation patterns, often requiring new governance capacities.

In the context of the increasing expansion of platforms, Alke (2022) notes that both the organisational fields in continuing education and the organisational form itself will change in the medium and long term.

As demonstrated by Rohs and Lacher (2023), digitalisation has had a significant impact on territorial principles. Digital learning platforms and online courses enable ACE providers to disseminate their programmes over greater geographical distances, overcoming traditional spatial boundaries. Empirical evidence indicates that the territorial principle currently serves as a guiding principle. However, current developments – such as platforms – are dynamic. This necessitates ongoing adjustments to the prevailing framework conditions, including financial support and reliance on local authorities. Eynon (2021) proposes: "formal educational initiatives that encourage community-focused approaches to learning about technology is one way this more democratic form of education, that goes beyond skills training, could be achieved" (p. 158).

5.2   Umbrella Organisations

Umbrella organisations and trade unions play a pivotal role in shaping the content and form of digital ACE, and implementation of digital platforms in ACE centres. It is evi-

dent that this facilitates benefits, especially for small, resource-constrained institutions. The vhs.cloud serves as the primary reference point for current developments and discussions within the community of ACE centres, having been introduced in 2018 as a 'digital home port' (Alke, 2022, p. 25). In Singapore, the Continuing Education Authority (SSG) and the Institute of Adult Learning (IAL) as an umbrella organisation launched the initiative iN.LEARN 2.0 in 2022 to promote blended learning and the use of online tools in continuing vocational education and training (Lim et al., 2024a, p. 9).

In Germany, guiding principles for digital transformation have been established at the level of umbrella associations: In a position paper, various objectives in relation to the digital transformation are articulated. These include the expansion of networking between adult education institutions and other stakeholders, the development of new social communication and learning spaces, the orientation towards relevant European competence models, the improvement of the organisational digital media repertoire and the development of new sources of funding (Bonnes, 2024, p. 329). The umbrella organisations support the transformation of organisational structures in the area of marketing through guidelines for digital corporate design and offer individual institutions digital platforms for course designs and inter- plus intra-organisational exchange (Bonnes, 2024, p. 331).

Their role reflects both centralised coordination and decentralised service provision, varying by context.

5.3   Private Actors

The publications indicate that the constellation of actors and control dynamics have expanded and evolved in consequence of digital platforms assuming greater importance (Alke, 2022; Bonnes, 2023). New actors – such as platform operators, educational technology companies or agencies – now either support or replace training providers. In Singapore, this shift is visible in the SkillsFuture initiative, which links education closely to employment. The state has also embarked on collaborative endeavours with commercial entities: Companies and start-ups in the 'EdTech sector' in particular are developing education platforms (Schmid, 2021) as products of an international organisational field in which these players coordinate in a market-like manner (Alke, 2022). The result is that they can expand the scope of action of ACE organisations, for example by delocalising ACE marketing (Bonnes, 2023, p. 51).

Digital platforms are typically characterised by profit-driven enterprises. These companies are setting the rules and thus shape users' activities. This power imbalance has drawn criticism, especially in connection with critical emancipatory educational work on digital literacy (Eynon, 2021). There is a "need to reconsider the role of the commercial sector in the development, implementation and evaluation of digital skills policies" (Eynon, 2021, p. 13). It is evident that the "framing" in which subjects of digitalisation are articulated exerts a significant influence on the extent to which political decisions favour the commercial sector or the financing of measures oriented towards the public good (Epstein et al., 2011).

According to German ACE provider statistics, 22 % of providers perceive online continuing education providers as strong competition (Echarti et al., 2023, p. 35). Globally, the potential of edtech start-ups is emphasised, and the fact that European education technology companies are in the minority is problematised (Schmid, 2021).

EdTech firms, platform operators and consultants are increasingly relevant. Their logic is primarily commercial, sometimes conflicting with public education goals (Eynon, 2021; Schmid, 2021). They act as informal governors through technological standards, licensing models, and interoperability control.

5.4 Employers

The policy of digital transformation in Singapore is closely linked to employers and is primarily realised as workplace education (Lim et al., 2024). In this regard, collaboration with governments, educational institutions, private institutions and employers is crucial for the development of effective upskilling and reskilling programmes (Lim et al., 2024b).

5.5 Participants

Participants must be considered as central actors in a digital ACE landscape. As paying actors, they are crucial in the development of programmes (Lim et al., 2024a) and they exert an influence on the continued existence of ACE institutions and digital platforms through assessment and evaluation systems (Alke, 2022). In this context, instruments and programmes to promote digital skills should aim to establish a democratic relationship between individuals, educational institutions and the state, in which all stakeholders jointly determine what is valued by society (Eynon, 2021, p. 156). Learners influence ACE systems by shaping demand and platform usage. Some policies aim at their empowerment (Lim et al., 2024), while others risk excluding disadvantaged groups (Epstein et al., 2011).

These findings suggest that governance in ACE is becoming more polycentric, involving public, private and civic actors in shifting constellations. The coordination of these actors reflects broader regime logics and levels of public sector control.

6 Conclusion

The international SLR revealed various aspects that are relevant for answering our research question: First, the digital transformation in ACE necessitates a comprehensive network of stakeholders and is giving rise to new market actors, which in turn enable and/or require new forms of cooperation. Nevertheless, such cooperation should be critically examined, as the potential partners may also be regarded as competitors, thereby influencing the structure and the orientation of educational programmes.

Second, the findings indicate that the digital transformation is endorsed by a range of education policy instruments and programmes at national and supranational

levels. These aim to foster digital skills, to enhance technical infrastructures and to adapt legal frameworks.

Regarding the discussion on data capitalism and the platform economy, the results reveal that digital platforms act as central structural principles of digitalisation. While offering opportunities, they also have the capacity to precipitate market transformations and an orientation towards economic interests. This underscores the need for a critical examination of the role of commercial entities in this context. Furthermore, the findings support an educational governance perspective, which emphasises the coordination and interdependencies between different actors in the education system. Thus the digital transformation requires cooperation and new networks between diverse actors to develop and implement effective governance mechanisms. The findings indicate that digital transformation in ACE is driven by a wide range of actors and that governance configurations differ significantly across countries. These differences become more interpretable when situated within the broader context of welfare state regimes. Some of these differences may tentatively reflect broader institutional logics such as decentralisation, market orientation, or state-led coordination.

In the German cases, the subsidiarity principle and federal structure appear to complicate coordinated digital strategies. In contrast, studies from countries like the UK or USA suggest a stronger reliance on market actors and economic imperatives, whereas Portugal and Singapore seem to implement more centralised, government-led approaches. These observations should be understood as illustrative rather than representative, as the corpus is limited in scope and regional balance. The role of public and private actors, the framing of digital literacy, and the structure of policy instruments appear to mirror existing educational and political infrastructures.

Although this international review provides an initial exploratory approach, a more profound understanding of the intricate interconnections, the scope of influence, and the modes of cooperation among these diverse actors requires an in-depth and nuanced analysis of networks (Kussau & Brüsemeister, 2007). Future research should examine more systematically whether and how welfare state regimes, governance traditions, and policy paradigms influence digital strategies in ACE. This would require broader empirical sampling and comparative analytical designs.

The international SLR highlights the growing complexity of actor constellations and governance mechanisms in the context of digitalisation in ACE. It also reveals significant gaps in the current state of research. Most notably, the reviewed studies are predominantly grounded in the German context, with limited representation of other regions. This reflects both a methodological limitation and a broader research gap. In this context, it is important to bear in mind that despite the structured and comprehensive synthesis of existing research, certain limitations of the SLR must be considered, since they are susceptible to publication bias. The heterogeneity of the included studies and the variability in the quality of these studies often limit the comparability and reliability of the results. The development of a search string for this unexplored field was also a challenge, which we met by multidimensional development of search terms and a snowball search. The scarcity of international studies underlines the need for more

research. Future research should pursue more comprehensive international comparisons that explicitly incorporate welfare regime typologies and governance models. Empirical studies based on network analysis, actor mapping or policy tracing could deepen our understanding of coordination mechanisms in digital ACE. Thus, future research should further investigate how welfare state logics interact with technological change in ACE, particularly through cross-country comparative designs.

Despite limitations due to language scope and database coverage, this review provides a first step toward a more structured understanding of governance in the digital transformation of adult education. The insights gained may inform future empirical work and policy development in this crucial area of educational research.

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Part Three
Theories and Methods

AI & Generative AI in Adult Education

Terminology, Discourses and the Need of a (Gen)AI Basic Education

Henrik Weitzel and Joshua Wilhelm[1]

Abstract

The public discourse on generative artificial intelligence (GenAI) is currently focussing primarily on the question of the 'right' way to use this technology. For adult education, however, it is not only the question of the necessary skills that is relevant, but also which groups of people need to be addressed. This article therefore examines the question of which groups of people are at the greatest risk of being left behind by the AI development and what role adult education can play in counteracting the threat of a GenAI divide. Based on the discussion about the digital divide, initial studies are used in which enabling and restraining factors at the motivational, access and skills level were analysed in order to identify vulnerable groups of people. On this basis, the necessity of a GenAI basic education is postulated, which focuses on critical judgement and ethical aspects.

Keywords: Generative AI, Adult Education, AI Basic Education, AI Divide

Zusammenfassung

Der öffentliche Diskurs über generative Künstliche Intelligenz (GenAI) konzentriert sich derzeit vor allem auf die Frage nach dem ‚richtigen' Umgang mit dieser Technologie. Für die Erwachsenenbildung ist jedoch nicht nur die Frage nach den nötigen Kompetenzen relevant, sondern auch, welche Personengruppen es zu adressieren gilt. In diesem Beitrag wird deshalb der Frage nachgegangen, welche Personengruppen das größte Risiko haben, von der KI-Entwicklung abgehängt zu werden, und welche Rolle die Erwachsenenbildung einnehmen kann, um einem drohenden GenAI Divide entgegenzuwirken. Ausgehend von der Diskussion um den Digital Divide werden erste Studien herangezogen, in denen förderliche und hemmende Faktoren auf motivationaler, Zugangs-, und Kompetenzebene untersucht wurden, um vulnerable Personengruppen zu identifizieren. Auf dieser Grundlage wird die Notwendigkeit einer GenAI-Grundbildung postuliert, die inhaltlich die kritische Urteilskraft und ethische Aspekte in den Vordergrund rückt.

Schlüsselwörter: Generative KI, Erwachsenenbildung, KI-Grundbildung, KI-Ungleichheit

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1   From Digitalisation to Artificial Intelligence

New digital tools based on generative artificial intelligence (GenAI) are currently flooding the consumer market. While public discourse is often dominated by the technological potentials and risks, the role of adult education has been little studied to date. Yet the concept of digitalisation is not new in adult education research. In the 1990s, concepts such as 'information and communication technology' (ICT) and 'new media' dominated (Rohs et al., 2023). Today, however, there is increasing discussion of terms such as 'digitalisation', 'digitality', 'digital transformation', 'mediatisation' and 'datafication' (Rohs et al., 2023). These terms reflect the increasing intertwining of technology and education, which, according to Rohs et al. (2023), manifests itself in three main dimensions:

1. The use of digital technologies in the teaching-learning process, including reflection on their implications.
2. The design of organisational and administrative processes in educational institutions.
3. Management and regulatory perspectives affecting policy frameworks.

As it already became clear in the first anthology on adult education research on digitisation (Bernhard-Skala et al., 2021a), adult education research has long been concerned with digitisation and digital media, but is increasingly obliged to face new challenges posed by the digital transformation (Bernhard-Skala et al., 2021b). This transformation not only has social implications, but also significantly changes individual living and learning realities. Technological advances influence the lives of individuals and lead to significantly increasing learning requirements – even in adulthood (Lerch & Weitzel, 2024).

In this context, not only is the format of learning changing, but so are the demands on teachers. A particularly radical change has been brought about by the advent of artificial intelligence (AI). This has ushered in a new era of innovation and change in many areas, including education. AI technologies offer new tools and applications that have the potential to transform traditional teaching and learning methods (Adiguzel et al., 2023). The many possible applications of AI in education include increasing productivity, improving learning outcomes, providing personalised instruction, giving immediate feedback and increasing learner engagement (Adiguzel et al., 2023). UNESCO (2021) emphasises the strategic importance of AI in adult education, particularly with regard to workforce skills development. Forecasts by the World Economic Forum (2023) predict that technological developments will transform nearly a third of all jobs worldwide in the coming years.

However, although the use of AI in education has been the subject of research for around 30 years, most educators are only now recognising the potential educational opportunities offered by AI applications (Zawacki-Richter et al., 2019).

While digital technologies can expand access to educational opportunities, they often reinforce existing social inequalities or even exacerbate them. Studies show that people with higher media literacy in particular benefit from digital learning opportuni-

ties, while others are at risk of being excluded (Rohs et al., 2023). With the availability of generative AI (GenAI) tools that can be used for a wider range of tasks, this pattern threatens to repeat itself, which could lead to a GenAI divide that negatively affects educational and employment opportunities. Adult education has a special role to play in addressing the groups of people who are most at risk of being left behind in the AI development.

This article therefore examines the question of which groups of people are most at risk of being left behind in the AI development and discusses the role that adult education can play in counteracting impending inequality. To this end, we first provide a brief overview of the most important terms and areas of application of AI in adult education. We then draw on the results of initial empirical studies that identify the factors that promote or hinder the use and learning of AI tools. To systematise the research, we drew on van Dijk's (2020) theoretical framework of the digital divide and list studies that have examined the factors motivation and attitudes towards AI, material access to AI tools and the necessary AI competencies.

2   The Use of (Gen)AI in Adult Education

The birth of artificial intelligence can be traced back to the 1950s, when McCarthy first used the term. According to him, AI refers to how machines can solve problems and improve themselves in a human-like manner (McCarthy et al., 2006). In general, AI can be described as an umbrella term that encompasses various technologies and methods such as machine learning (ML), natural language processing and data mining (Zawacki-Richter et al., 2019). ML is a method of AI that enables patterns to be recognised, predictions to be made and new patterns to be applied to situations (Zawacki-Richter et al., 2019). The functioning of AI is determined by algorithms that are capable of learning independently or optimising through controlled training, with large amounts of data serving as a knowledge resource (Rohs et al., 2023).

In adult education, accessing learning content online, remotely and individually has been established for several years. The emergence of chatbots such as ELIZA, which use natural language processing and enable text-based communication, was a first milestone in AI development in the field of education (Storey & Wagner, 2024). The rapid advancement of this communication technology ultimately led to the public introduction of ChatGPT in 2022, which in turn attracted the attention of the scientific community (Nikolic et al., 2024). This evolution demonstrated that GenAI can overcome the limitations of previous AI technologies and create acceptable new content (Nikolic et al., 2024).

Applications such as ChatGPT are based on so-called large language models (LLMs). These algorithmically trained models enable human-like communication in different languages and are capable of solving various tasks. For example, they can be used for quick text revision, simple spelling and grammar correction, and even complex idea generation (Storey & Wagner, 2024). Overall, there is a wide range of different technologies and applications (see Tab. 1).

Table 1: Overview of various AI technologies (own representation) (adapted from Storey & Wagner, 2024, p. 3)

AI Technology	Short definition	Examples
Large Language Models (LLMs)	Text-based AI that can recognise an create phrases and solve text-based tasks.	ChatGPT (OpenAI) Gemini (Google) Chatbots
Adaptive Learning Systems (ALS)	Data-driven system that can be adapted to individual learning experiences and needs.	Intelligent Tutoring Systems Duolingo Aleks
Learning Analytics (LA)	Evaluation system that uses learners' data to improve the learning environment.	Degree Compass eAdvisor
Virtual Reality (VR) & Augmented Reality (AR)	Interactive (immersive) learning experiences to expand skills and teach complex learning content.	Oculus Rift TeachLifeE

ML is the basis of most contemporary AI programs. Unlike traditional machines, ML systems learn from data, recognise patterns and improve their performance increasingly autonomously (Fulmer, 2019). Based on this, adaptive learning systems use ML algorithms to create individual learning paths, while generative AI tools use LLMs to produce and adapt content (Storey & Wagner, 2024). Immersive technologies such as VR and AR also promote deeper learning experiences through interactive environments (Storey & Wagner, 2024). In addition to content delivery, chatbots and virtual assistants support learning processes through automated assistance (Rohs et al., 2023). Learning analytics, in turn, analyses learning behaviour to identify patterns and enable evidence-based decisions (Rohs et al., 2023). This diversity of digital applications demonstrates the potential of AI-supported educational technologies. At the same time, algorithmic biases – especially in generative tools – make it essential to critically examine ethical issues when using them (Storey & Wagner, 2024).

In this context, UNESCO representatives from academia, practice and politics from over 100 countries have agreed on ethical standards for the use of AI in education (Rohs et al., 2023). UNESCO (2023) has published these standards to ensure the responsible and effective use of AI in education: The aim is to promote learning processes while maintaining ethical and legal standards. The focus is on strengthening digital and, in particular, AI-related skills at all levels of education – from programming and digital literacy to critical thinking and awareness of data ethics and social impacts (UNESCO, 2023). At the same time, AI should be integrated responsibly into educational processes and the participation of disadvantaged groups should be strengthened in order to reduce digital inequalities (UNESCO, 2023). The following chapter presents the results of the first studies that examined factors that could potentially cause a person to be left behind in the AI development, with the ultimate goal of identifying particularly vulnerable groups.

3 (Gen)AI Divide: First Indications of Potentially Left Behind Groups of People

Research into the causes of unequal access requirements and the skills required to effectively use AI applications is still in its infancy. However, when it comes to the broader topic of digitalisation, a great deal of research has been conducted under the term 'digital divide', analysing factors that lead to some groups of people benefiting from digitalisation while others are disadvantaged by it.

The term 'digital divide' first appeared in the 1960s (Rogers, 1962) and underwent relevant reinterpretations and extensions by Norris (2001) and Hargittai (2002), among others. In his work 'The Digital Divide' (2020), van Dijk comprehensively systematised the discourse and created a relevant model of digital inequality. According to this model, a person first needs the right motivation and attitude towards digital media before deciding to invest in the appropriate material access, which in turn depends on the person's socio-economic resources, in order to finally learn the necessary digital skills (Fig. 1).
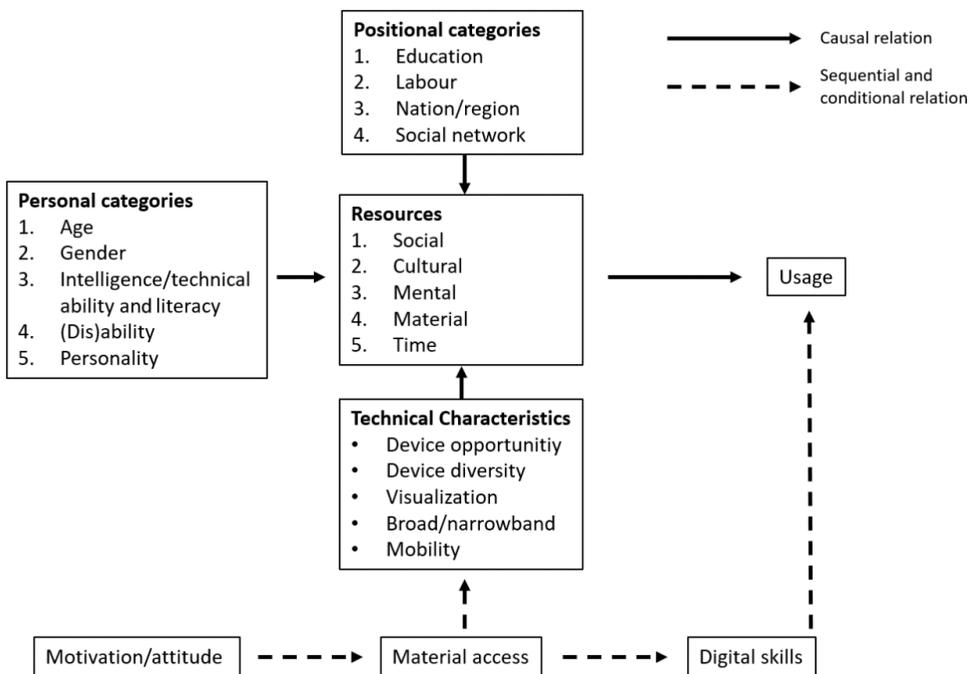

Figure 1: Causal and sequential model of divides in digital media use (own representation based on van Dijk, 2020, p. 91)

However, (Gen)AI technologies differ from other ICTs in two relevant ways for consumers. Firstly, the pace of development is comparatively high, which increases the

potential for people to be left behind if they are too late in acquiring the necessary skills. Second, people who are already active in the digital space cannot reliably avoid (Gen)AI technologies and content, as large organisations and governments can decide to adopt (Gen)AI technologies without consulting end users beforehand (Schepman & Rodway, 2020, p. 2).

In this context, the first authors describe a potential (Gen)AI divide, which, due to the intertwining of AI technologies and ICTs, would have to build on the digital divide discourse (Adarkwah, 2024; Carter et al., 2020; C. Wang et al., 2024). Carter et al. have created a model comparable to van Dijk's, which specifically addresses the AI divide and builds on the digital divide (Carter et al., 2020, p. 262). The authors also identified the following factors as likely to influence material access and the necessary AI skills: demographic and socio-economic factors, culture and regulations, infrastructure (e. g. end devices on which AI is already integrated) and beliefs (Carter et al., 2020, p. 262).

The digital divide model, with material access as the first level and skills as the second level, serves for the following as a framework for exploring which groups of people are at greatest risk of being left behind by the AI development. To structure the factors that influence access to AI and the development of AI skills, we distinguish three levels: macro, meso and micro. Based on van Dijk's model, we first consider the effect of the psychological factors of motivation and attitude.

4   Who Wants to get Involved with (Gen)AI?

4.1   The Importance of Trust in (Gen)AI Technologies

Many literature-based and empirical studies suggest that trust in (Gen)AI is a prerequisite for a positive attitude towards the technology, which in turn is considered a decisive predictor of whether someone will engage with (Gen)AI or not (Carter et al., 2020; Chan & Hu, 2023; Kang et al., 2024; Ng et al., 2021; C. Wang et al., 2024; G. Wang et al., 2025). Both socio-demographic and psychological factors influence trust and attitude towards (Gen)AI.

An international study has shown that specific socio-demographic factors of students are significantly related to their trust in AI. For example, males and students in higher semesters show more trust in AI than other cohorts (Kozak & Fel, 2024, p. 7). Greater exposure to other ICTs and proficiency in the operating language of AI programs, which is usually English, also appear to have a positive effect on trust in current AI programs (Kozak & Fel, 2024, p. 7).

From a psychological perspective, the fear of losing control and autonomy over decisions and outcomes can negatively impact the acceptance of new technology, a perception that is reinforced by negative reporting (G. Wang et al., 2025, p. 11). Conversely, it has been shown that people are more confident in using new technologies, such as GenAI, when others around them have a positive attitude towards this technology (Kang et al., 2024, p. 12).

4.2   Attitude Towards (Gen)AI

Studies that use a socio-demographic approach to investigate attitudes towards (Gen)AI show that older, female and less educated individuals have more negative attitudes towards (Gen)AI than individuals who are male, younger and have a higher level of formal education (Méndez-Suárez et al., 2023; OECD, 2024; Schepman & Rodway, 2023).

A Spanish study also showed that attitudes towards innovation are directly related to attitudes towards AI, and that the socio-demographic characteristics that correlate with a positive attitude towards innovation (male, higher socio-economic status, younger age) also correlate with a positive attitude towards AI (Méndez-Suárez et al., 2023). This picture is complemented by a study by the OECD, which concludes that males with university degrees, as well as foreign-born and non-White workers, are more positive towards AI than other cohorts (OECD, 2024, pp. 38–43).

A Korean study examining middle school students' attitudes towards AI found that those experiencing difficulties due to their socio-cultural background were more positive towards AI than those who did not (Kim & Lee, 2024). A positive effect between interest in AI and positive attitudes was also demonstrated (Kim & Lee, 2024, p. 9928).

Using a psychological approach, Schepman and Rodway identified correlations between the Big Five personality traits (Costa & McCrae, 1992) and attitudes towards AI. They were able to show that "[...] introverts had a stronger tendency to have positive attitudes towards the positive aspects of AI and were more forgiving towards the negative aspects of AI" (Schepman & Rodway, 2023, p. 2735). Higher ratings on conscientiousness were also linked to more positive attitudes towards AI in relation to the negative aspects (Schepman & Rodway, 2023, p. 2735). Schepman and Rodwy were also able to show that the stronger a person's distrust of corporations, the more negative their attitudes towards AI (Schepman & Rodway, 2023, p. 2736). In addition, they were able to show in an earlier study that people clearly distinguish between the task classes in which they currently accept AI (Schepman & Rodway, 2020, p. 11). Applications that mimic aspects of human judgement, empathy, skills or social understanding led to negative attitudes towards AI, while applications that already perform partially automated tasks tend to be received positively (Schepman & Rodway, 2020, p. 11).

4.3   Motivations for Engaging with ChatGPT

From the perspective of motivation and learning resistance research, intrinsic (perceived) motivation to learn (Deci & Ryan, 1993) and the absence of learning constraints (Holzer, 2017) were considered essential for successful learning. However, in a comparative country study, Boeren et al. were able to show that, particularly in Central and Eastern European countries, extrinsic motivation for further education in the form of economic pressure does not necessarily lead to a lower perceived intrinsic motivation (Boeren et al., 2012, p. 81) and, as a result, does not hinder learning. External, work-related reasons for engaging with the topic of (Gen)AI therefore have the potential to be a goal-oriented motivator for continuing education, in addition to intrinsic interest.

A quantitative study by Skjuve et al. (2024) examined the motivation to use ChatGPT. Both work-related and non-work-related reasons became apparent. More than half (55 %) said they use ChatGPT to improve productivity, 18 % use it to facilitate creative work, and 17 % use it to enhance their own learning or for development (Skjuve et al., 2024, p. 7). However, at the same time 51 percent stated that they only wanted to try out ChatGPT because it is a new technology, and for 20 percent, the motivating factor was that ChatGPT can be used for amusement (Skjuve et al., 2024, p. 7).

Novelty and amusement are unlikely to lead to long-term or sustainable engagement with GenAI. This makes it all the more important to offer continuing education programmes that can build on existing job-related motivators.

5   Who Can Engage with (Gen)AI?

5.1   Access Prerequisites at the Macro Level

Whether someone has access to (Gen)AI technologies is already predetermined at the macro level by political regulations and the available infrastructure. A trend towards a dominant Global North is emerging. At the same time as the hype surrounding ChatGPT, high- and upper-middle-income countries in particular ruled the roost with published AI strategies, while low- and lower-middle-income countries have only been catching up since 2023 (Hankins et al., 2023, p. 6). Although GenAI is now widespread, especially in middle-income countries, "[...] the depth of integration and per-user intensity still favours high-income economies" (Liu & Wang, 2024, p. 28).

One of the biggest problems is the average infrastructure and data availability of countries, which are basic prerequisites for the use of (Gen)AI. The geographical regions of North America and Western Europe are pioneers in this respect, while sub-Saharan Africa lags significantly behind (Hankins et al., 2023, p. 7).

Another hurdle for low- and lower-middle-income countries is the high cost of GenAI. The development costs of current GenAI models amount to several hundred million US dollars (Maslej et al., 2024, p. 64), and Western countries and China have invested several billion US dollars in local AI infrastructure (Maslej et al., 2024, p. 247).

The United States, Canada, Great Britain, China, France, Germany and Switzerland dominate the number of 'notable machine learning models' from 2003 to 2023 (Maslej et al., 2024, p. 48), with most models attributable to Silicon Valley's Big Tech companies (Maslej et al., 2024, p. 60).

Consequently, it is evident that Western GenAI tools in particular account for the majority of global GenAI data traffic. Of the 40 GenAI tools with the highest data traffic worldwide, ChatGPT alone accounts for 82.5 percent, followed by Gemini with only 4.7 percent (Liu & Wang, 2024, p. 13). Although data traffic for China can only be estimated (Liu & Wang, 2024, p. 13), with the release of DeepSeek, it can be assumed that a relevant percentage of global AI traffic runs through the new Chinese platform.

The monopoly position of Western and Chinese tools favours a Western or Chinese bias in the data sets, which can at least reduce efficiency for people from third

world countries. At the same time, GenAI tools can currently only be used with a limited number of languages, with English achieving by far the best accuracy (85.5 %) in the case of the ChatGPT-model GPT-4 model (OpenAI, 2023, p. 8). This can exacerbate the disadvantage of all those people who do not master the languages with which the higher accuracy can be achieved.

5.2   Access Perquisites at the Meso Level

The role of companies in accessing (Gen)AI can be described at the meso level. Initial reports show that GenAI has arrived at many companies, but staff training often lags behind. The McKinsey Global Survey concludes that by 2024, 72 percent of all organisations will have adopted AI and 65 percent will have adopted GenAI in at least one business function (McKinsey, 2024, p. 2). However, while 68 percent of companies with the highest investment in GenAI recognise that GenAI risk awareness and mitigation are necessary skills for technical talent, only 43 percent of these companies have curated learning journeys to build critical GenAI skills for these talents (McKinsey, 2024, p. 19). Among all companies, only one-third (34 %) recognise GenAI risk awareness and mitigation as necessary skills, and only 18 percent have curated a learning journey (McKinsey, 2024, p. 19). At the same time, half (48 %) of US employees would like formal GenAI training from their employer, and 41 percent would like access to GenAI tools (McKinsey & Company, 2025, p. 14).

While many companies, particularly in the US, have not yet responded to the demand for company-organised material access and training, the impending skills gap in dealing with AI is being addressed in the EU in the European AI Act. Article 4 states that providers and operators of AI systems should be responsible for providing training in the necessary AI skills (Regulation – EU – 2024/1689, 2024, p. 51). In the case of company-owned AI systems, companies are therefore required to provide appropriate training for their workforce. Only time will tell whether this can effectively counteract a knowledge gap.

5.3   Access Prerequisites at the Micro Level

Taking into account the findings from the digital divide discourse, it can be deduced that for individuals, the costs involved will play a decisive role in whether or not they can access GenAI. Van Dijk notes that it is a common misconception that the problem of the digital divide will be solved once everyone has a digital device and internet access (van Dijk, 2020, p. 47). Although physical access is a prerequisite for learning the necessary skills and ultimately benefiting from them, he argues that the problem of access in Western countries is now not a quantitative one, but a qualitative one, and is related to the latest devices or available bandwidth (van Dijk, 2020, p. 47). He also describes with the term 'conditional access' that devices and connections are often not enough, as specific services cost additional money or require a membership (van Dijk, 2020, p. 49).

These potential sources of inequality are particularly evident in the access requirements for (Gen)AI technologies. System-internal AI programmes require comparatively new and powerful end devices. For example, to use Apple's system-internal AI, Apple Intelligence, you need at least an iPhone 15 Pro (released in September 2023) or

higher, and for tablets or laptops, a device with an M1 processor or higher (Apple Inc., 2025). For Google mobile phones, the in-house Gemini system has only been the standard assistant since the Google Pixel 9 (released in August 2024), although it can be installed as an app on older devices (Google, 2025a). At the same time, most GenAI tools can only be used to a limited extent without a subscription. ChatGPT and Gemini each cost $20 per month for the cheapest subscription option (Google, 2025b; OpenAI, 2025), and according to CNBC, Apple Intelligence will also be converted to a subscription model in the future, which is also expected to cost USD 20 per month (Kharpal, 2024). While (Gen)AI technologies are finding their way into more and more programmes and devices, end users sometimes have to incur considerable costs in order to use the most powerful AI models on the corresponding devices, which can be a barrier for people in a less favourable economic position.

6   Evolving Adult Education: From Digital Literacy to (Gen)AI Literacy

The rapid evolution of AI challenges our understanding of what it means to be human: What defines human competence in an era in which intelligent systems are increasingly taking on complex tasks (Ehlers, 2025)?

In order to understand which competencies are becoming more relevant through the use of AI systems, we must first consider which concepts have been used to date when discussing the competencies required for the use of digital applications.

The terms digital competence and digital literacy are central to this discussion. In a systematic review study, Spante et al. showed that in higher education research, the two concepts often remain undefined and are used in a more commonsensical manner, with digital literacy being more prevalent in English-speaking countries and digital competence being more prevalent in Europe (Spante et al., 2018, p. 14).

In the German-language discourse, Baacke's media competence model (1996 & 1999) is central, as it often forms the basis for political decisions on digitisation in education. It distinguishes between four dimensions: media critique, media science, media use and media design. This old model seems to remain relevant in relation to AI programmes. In an international literature review study on AI literacy, Ng. et al. (2021) coded competence facets that closely resemble Baacke's media literacy model. Comparable to media science, they define the competence facet 'Know and understand AI', the facet media use is reflected in 'Use and apply AI', and media critique and media design are found in the combined facet 'Evaluate and create AI' (Ng et al., 2021, p. 4).

Media critique in particular is becoming increasingly important in light of technical developments such as AI. Media education concepts are therefore needed that incorporate ethical aspects more strongly and promote personal development and social participation through reflective self-care (Niesyto, 2008).

In line with the access requirements for AI described in Chapter 3–5, different requirements at the macro, meso and micro levels also apply to media literacy.

6.1 Social and Political Concepts: Media Literacy at the Macro Level

The connection between technology and education is becoming increasingly important and could transform adult education in the long term. In order to promote equal opportunities, it is essential to continuously adapt to technological developments and the needs of learners (Carter et al., 2020). Lifelong learning and continuing professional development remain key prerequisites for social participation in a digitally shaped world (Carter et al., 2020; Conceição & Biniecki, 2024). The impenetrability of various media products highlights the relevance of media literacy at the macro level. Through critical social analysis, apparent facts should be exposed and the truth behind ideologies revealed (Baacke, 1996). At the supranational level, the UNESCO (2021) also addresses this aspect in its concept of 'media literacy'. In addition to the term 'media literacy', which refers more to mass media, the term 'digital literacy' is gaining importance, as described in the 'European Reference Framework for Digital Competence' (DigComp) (Redecker et al., 2017). The DigComp framework, with its five dimensions and eight competence levels, is widely used in German adult and continuing education (Rohs et al., 2023), for example in the strategies of the Standing Conference of Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany (KMK, 2017) and the 'Volkshochschulen' in Germany (DVV, 2019).

6.2 Implementation of Media Literacy at the Meso Level

However, Gapsi & Tekster (2009) show some obstacles to implementing these competency models at the meso level, as DigComp does not take into account application competencies and exploitation logic for digital media. For this reason, information and data literacy in the form of critical media literacy is coming into focus (Gapski & Tekster, 2009). In particular, the economic use of data is viewed critically, as it encourages unwanted intrusions into privacy (Rohs et al., 2023). Overall, it is clear that digital competence concepts vary between technology orientation and social orientation (Rohs et al., 2023). This spectrum can serve as a guide for adult and continuing education providers when designing their programmes (Rohs et al., 2023). For example, AI-supported systems can be used to customise learning paths, creating space for dialogical learning, creative projects and ethical discourse (Ehlers, 2025). However, these are areas in which human strengths are indispensable and skills such as tolerance of ambiguity, critical thinking and ethical judgement should be promoted (Ehlers, 2025).

6.3 Individual Digital Skills Development at the Micro Level

In order to subsume the various necessary digital skills under one umbrella term, the term digital literacy has become established since the late 1990s. The term goes back to Glister, who defined it as "[...] the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers. [...] It places demands upon you that were always present, though less visible, in the analog media of newspaper and TV" (Glister, 1997, pp. 1–2). In its contemporary interpretation, digital literacy encompasses both the ability to use digital technologies competently to search for, evaluate and process information effectively, and the competence to critically evalu-

ate information in order to verify sources and the accuracy of information (Joseph et al., 2024). Digital literacy thus encompasses the multitude of skills an individual needs to succeed in an increasingly digital world (Yazon et al., 2019). It is considered particularly important in the teaching-learning process, as the use of digital tools in learning environments is virtually a prerequisite (Yazon et al., 2019).

For digital literacy at the micro level, this means that learners should be empowered not only to recognise the opportunities offered by digital media, but also to understand their risks, particularly with regard to data protection, cyber security and algorithmic bias (Storey & Wagner, 2024).

7   AI Literacy for Different User Groups

Education in the context of AI must shift from the mere transfer of knowledge to a focus on skills that cannot be imitated by machines: the focus here is on so-called 'future skills' (Ehlers, 2020). These describe the ability to deal with uncertainty, make ethical judgements and reflect critically (Ehlers, 2025). A Chinese study by Wu et al. (2024) on the use of AI in language acquisition showed that students find AI useful when it is easy to use. Overall, ease of use was rated as more relevant than usefulness for learning success, which is why appropriate skills in using such applications must be taught (Wu et al., 2024).

With regard to the first part of the question – which groups of people are most at risk of being left behind in the AI development, and how can adult education counteract this – initial studies point to unequal material access, as well as psychological and structural sources of inequality in terms of trust and attitude towards (Gen)AI. A social environment that reacts positively to (Gen)AI and high exposure to (Gen)AI and other ICTs have a positive effect on trust in (Gen)AI. Against the backdrop of inequality research, it is noteworthy that foreign-born and non-White workers, people who face difficulties due to their socio-cultural background, and introverted people are also more positive towards (Gen)AI than the comparison cohorts. Overall, however, the studies show that older people, women and people with lower formal education and lower socio-economic status are already more likely to be left behind in technological development due to their negative attitude towards (Gen)AI.

Similar to the digital divide, the high importance of individually available economic capital as an access requirement is becoming apparent in (Gen)AI. The latest hardware and subscriptions for sometimes multiple AI tools can be a considerable financial burden that not everyone can afford.

Due to the high development and operating costs of AI programs, Western and Chinese companies dominate the AI sector. The programs are adapted to the respective markets by training the dataset accordingly and using the optimal operating language corresponding to these markets. This has a direct impact on the degree of efficiency with which the programs can be operated and the resulting potential to benefit from the technology.

Due to the novelty of everyday GenAI technologies, it is not yet possible to conclusively state who ultimately benefits from the technology in terms of a third level of the GenAI divide. However, the studies cited on attitudes/motivation and material access to (Gen)AI already describe the prototype of the AI beneficiary as a young, Western or Chinese man with a high level of formal education and high socio-economic status, who is positive about (Gen)AI and has the financial resources to finance access. While people with other characteristics are not only less likely to engage with (Gen)AI tools, AI algorithms also tend to discriminate against them through data bias, while these personal characteristics are also intersectionally entangled (Fisseler, 2023).

Media literacy plays a central role at the macro, meso and micro levels. At the macro level, political regulations such as DigComp address digital literacy as a prerequisite for equal opportunities. However, existing models must be continuously adapted to keep pace with social and technical changes. At the meso level, concrete application skills are often lacking, while at the micro level, 'future skills' such as tolerance of ambiguity and ethical judgement are a priority. Adult education must promote these skills in order to shape the use of (Gen)AI.

In adult education, digital literacy must therefore encompass not only technical knowledge but also a critical understanding of social and ethical challenges, and should focus not only on the learning objective but on the entire learning process with regard to AI (Storey & Wagner, 2024).

One answer to this can be found in the AIComp competence model (www.ai-comp.org), which includes a practice-oriented approach to an AI-shaped living and working environment. It describes competencies that enable people to act confidently in complex, changing situations. Key elements include the development of a productive culture of cooperation in which AI systems are perceived as supportive partners rather than competitors in order to strengthen human judgement (Ehlers, 2025).

The development of the generative technologies described in this article points to the need for digital literacy adapted to (Gen)AI, with a focus on the importance of ethical aspects. A systematic literature review by Ng et al. (2021) makes it clear that AI literacy will be a basic skill for all people in the future, going beyond the functional use of AI systems and requiring a deeper understanding of how they work and their social impact. Building on digital literacy, Long & Magerko (2020) define AI literacy as the ability to critically evaluate AI systems, which requires basic digital skills but not programming knowledge.

The increasing use of GenAI technologies in education and work by teachers, counsellors and educational professionals requires an awareness of the limitations of these technologies and the ethical risks involved. Chatbots (e. g. ChatGPT) in particular can perpetuate and even reinforce existing social prejudices and injustices due to algorithmic bias, which has a negative impact on teaching and learning processes and their outcomes (Storey & Wagner, 2024). It is clear that critical engagement enables effective interaction with AI for use in everyday life and work. AI literacy is particularly closely linked to data literacy, as machine learning and algorithmic decision-making processes require an understanding of data analysis (Long & Magerko, 2020). This is because AI

models are trained with pre-existing data and can produce discriminatory results for certain groups of people. Therefore, a key skill is recognising such limitations: learners should be aware that ChatGPT works on a limited database and that they need to validate information through their own research and source criticism (Storey & Wagner, 2024).

For the successful teaching of AI literacy in an educational context, technological, pedagogical and content-related requirements must be taken into account. The importance of this is exemplified by the TPACK model developed by Ng et al. (2021), which distinguishes between technological, pedagogical and content-related knowledge in teaching AI literacy, but still considers pedagogical and content knowledge to be essential. In an empirical validation of the model, Celik (2023) was able to show that, in addition to technical knowledge, ethical knowledge also plays a central role.

To this end, teachers must receive targeted training in order to be able to use suitable AI-supported technologies profitably and enable personalised learning (Ng et al., 2021). In this context, learners are no longer perceived merely as end users, but as potential designers of AI solutions who are able to analyse and solve problems in different life and work contexts with the help of AI. AI should therefore not only be mastered technically, but also reflected upon and used responsibly in the interests of the common good. The aim is to educate critically reflective, socially responsible citizens who help shape AI in society in terms of fairness, inclusivity, transparency and accountability (Ng et al., 2021). Consequently, skills relating to the ethical implications of AI as well as technical and critical reflection skills are required.

Finally, AI is also changing the role of adult educators by transforming learning environments into intelligent systems. However, open questions such as data protection, intellectual property and fraud prevention must be continuously addressed. Adult educators must develop research-based curricula, promote digital skills and adapt their abilities to AI collaborations (Storey & Wagner, 2024). Looking at the different levels, it becomes clear that at the macro level, AI can be used to develop targeted support programmes through continuing education databases or trend analyses. At the meso level, AI can simplify administrative and organisational processes and support communication. At the micro level, teachers receive support from AI-based learning management systems (Strauch & Lattke, 2025).

In order to enable equal opportunities in the digital world, adult education must increasingly promote critical and ethical media skills. However, adult education programmes and staff are themselves influenced by digital transformation processes and AI. Therefore, adult educators must be the first to understand the necessary AI skills. In a survey by Strauch & Lattke (2025), adult education teachers were asked about their use of AI. The results show that a large majority already use AI and feel confident in its use (Strauch & Lattke, 2025). Nevertheless, the majority see an acute need for specific training on the use of AI (Strauch & Lattke, 2025), which raises the question of what skills adult educators have and how they have acquired them.

8   Conclusion

The article shows that the rapid development of GenAI has a significant impact on adult education and that existing competence models need to be expanded to include key components. In addition to basic technical application skills, critical analysis and reflection skills as well as ethical judgement regarding the use of GenAI are particularly necessary. Against the backdrop of a looming GenAI divide, basic GenAI education seems essential, focusing on these very skills and targeting not only potentially disadvantaged groups (see Chapter 7), but also adult educators.

In order to counteract a GenAI divide across society as a whole, a three-pronged strategy is needed: (1) lowering barriers to access through public infrastructure, (2) promoting critical media design skills, and (3) integrating ethical AI reflection into continuing professional development (Celik, 2023). Specifically, state-funded AI literacy programmes (similar to the UNESCO guidelines) could be formulated and developed at the political level. Educational institutions should design basic GenAI training courses for various areas of AI application. For example, for administrative staff, educational and career counsellors, but also for teachers in various forms of education (school, university and adult education).

Future challenges for adult education practice include the development and implementation of educational programmes that specifically target the teaching of GenAI skills. It is necessary to develop concepts that incorporate ethical aspects more strongly and promote personal development and social participation through reflective action. However, this is an interdisciplinary task and addresses adult education as well as media pedagogy. The focus must be on promoting equal opportunities and avoiding digital inequality. Concepts must be continuously adapted to technological developments and the needs of learners. Adult education must shift from a reactive model (catch-up digitalisation) to a proactive model (shaping AI literacy) in order to ensure social participation in a world shaped by AI. At the same time, this means that adult education teachers must also actively engage with the use of AI and attend appropriate training courses.

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How Digitalisation Affects Adult Education Research

Issues, Data, and Methods

FALK SCHEIDIG

Abstract

Digitalisation processes lead not only to changes in adult education but also to new possibilities for acquiring scientific knowledge about this field. Hence, this chapter asks how digitalisation is influencing research on adult education. It emphasises three perspectives: first, digitalisation processes in the context of adult learning lead to new research questions. Second, the increasing use of digital technologies produces new data that can be utilised by adult education research. Third, digitalisation is leading to the emergence of new methodological approaches to the study of adult education. The chapter structures and discusses digitalisation-associated developments in adult education research and underpins these with examples from current research.

Keywords: Digitalisation, adult education, research, methods, data

Zusammenfassung

Mit Digitalisierungsprozessen gehen nicht nur Veränderungen im Lernen Erwachsener einher, sondern auch neue Möglichkeiten zur wissenschaftlichen Erkenntnisgewinnung über Erwachsenenbildung. Der Beitrag schließt hieran an und wendet sich der Frage nach Einflüssen der Digitalisierung auf die Forschung zur Erwachsenenbildung zu. Dabei werden drei Perspektiven akzentuiert: Erstens resultieren aus Digitalisierungsprozessen im Kontext des Lernens Erwachsener neue Forschungsfragen. Zweitens werden mit der zunehmenden Nutzung digitaler Technologien neue Forschungsdaten generiert, die die Erwachsenenbildungsforschung nutzen kann. Drittens ergeben sich in Verbindung mit der Digitalisierung für die Forschung zur Erwachsenenbildung in methodischer Hinsicht neue Forschungsansätze. Der Beitrag strukturiert und diskutiert digitalisierungsassoziierte Veränderungen in der Erwachsenenbildungsforschung und unterlegt diese mit aktuellen Beispielen aus der Forschung.

Schlüsselwörter: Digitalisierung, Erwachsenenbildung, Forschung, Methoden, Daten

1   Introduction

The term digitalisation describes the wide-reaching and impactful processes of transformation of everyday life and work that are leading to new social conditions (Stalder, 2018). These processes are not merely isolated, but rather multi-layered and entangled, with digital technologies affecting social subsystems such as the education system in ways that make it more and more difficult to distinguish between the digital and non-digital (Kerres & Buntins, 2020): 'Like air and drinking water, being digital will be noticed only by its absence, not its presence' (Negroponte, 1998). The adult education sector is also influenced by digitalisation processes in terms of both its content and its provisions (Rott & Schmidt-Hertha, 2024). In a digital world, new skills such as problem solving in technology-rich environments (Iñiguez-Berrozpe & Boeren, 2020) are becoming increasingly important; and by enabling the acquisition of these skills, adult education contributes to individual and social sovereignty in digital contexts and therefore also to the ongoing digitalisation processes. At the same time, processes of digital transformation are also taking place among adult education providers themselves – for example, when courses are offered part-time or exclusively online (McKenna et al., 2020) or when artificial intelligence (AI) is used to plan programmes and create teaching materials (Gollob, 2025). These examples point to dynamic developments in recent years: during the Covid19 pandemic starting in early 2020, digital learning was strongly promoted in adult education (Boeren et al., 2020; Kaiser & McKenna, 2021; Käpplinger & Lichte, 2020), and the release of ChatGPT 3.5 in late 2022 resulted in generative AI being adopted more rapidly in society than PCs or the internet (Bick et al., 2024). This also raises the question as to how AI will change adult learning (Milana et al., 2024).

There is growing academic interest in not only digitalisation processes in educational practice but also the potentials and challenges associated with the use of digital technologies in adult education. Even if some digitalisation-related questions are not entirely new (Baacke et al., 1990; Faulstich, 1985), research on adult education in the context of digitalisation can be seen as a young, broad, and diffuse field; and it is also starting to ask how digitalisation is also influencing adult education research itself (Bernhard-Skala et al., 2021). This chapter addresses this question and explores the implications of digitalisation for adult education research. It does not aim to provide a comprehensive and final answer to this question, in particular because digitalisation processes are highly dynamic (making the label 'new' time-relative), and because the broad scope of the chapter requires a selective approach, which inevitably means that some developments, perspectives, and studies cannot be taken into account. Therefore, this chapter is not intended as a complete overview, but rather attempts to structure the digital perspectives in the field of adult education research. For this purpose, the chapter distinguishes three dimensions – which are considered central to the research process (Anderson & Arsenault, 2005; Mertler, 2019; Scott & Usher, 2011) – with a further differentiation of three subdimensions in each section: First, it addresses (new) issues in adult education research that are associated with digitalisation. These can be arranged in the figure of the didactic triangle as questions concerning the supply side, the

learner side, and the learning content (Chapter 2). Second, new data sources are coming into focus that adult education research can use to gain knowledge, because they contain data on courses, learners, and learning processes (Chapter 3). Third, emerging digital research approaches can also be used to gain scientific knowledge about adult education. These include computer-based qualitative and quantitative methods, forms of data collection, and the processing of data with digital tools (Chapter 4). The concluding section brings these three dimensions together and formulates further perspectives for adult education research (Chapter 5).

2   New Issues

The core of scientific work is the aspiration for knowledge, and this manifests itself in research questions (Andrews, 2003; Dillon, 1983). Digitalisation raises new questions for adult education research that relate particularly to digitalisation processes in adult education practice. One way of structuring the landscape of digitalisation-related research issues is the figure of the 'didactic triangle', according to which education and learning unfold between the three poles of teacher, learner, and content (Reusser, 2018). If this micro-didactic model, which is often used against the background of school teaching, is adapted to the multi-level system of adult education, adult education can be characterised by a supply side (adult education provider, adult educators, courses), a learner side (learner, (non-)participation, learning processes), and a content side (learning content, aims, competencies).

On the supply side, digitalisation is shifting the focus to the use of digital technology in the provision and didactical design of adult education courses. This concerns both lecturers (Koschorreck & Gundermann, 2020) and non-teaching staff such as programme planners (Housel, 2022) and managers (Bonnes, 2024), because these people create the underlying conditions for digitalisation processes in adult education organisations and are responsible for many decisions including those on the use of digital technologies in courses (Scheidig, 2021). This raises questions about the media-related competence of adult educators, and which factors influence their attitudes towards digitalisation (Bonnes et al., 2020; Rohs et al., 2020), because these components are central to the intensity and quality of the digitalisation of adult education. Another question is how digitalisation processes change the tasks and challenges of staff in adult education organisations: for example, what role do teachers play when learning processes are framed increasingly by digital technologies (Koschorreck & Gundermann, 2020)? Since the Covid19 pandemic, with more courses having to be offered online, the question has arisen as to how important online courses for adults might be in the future (Boeren et al., 2020).

A recent analysis shows that, on the one hand, new online courses often complement the existing programme (insofar as there are often comparable face-to-face courses at the same institution), whereas, on the other hand, earlier face-to-face courses are also being displaced by online courses (Scheidig, 2024a). This links up with the

question regarding the strategies that adult education providers follow: for example, whether they position themselves as local education service providers without online courses or whether they want to increase their reach online (Scheidig, 2024b). Providing online courses also raises new questions about cooperation and competition: when offering online courses, adult education providers can more easily organise and deliver courses together with other non-local institutions, because online courses are not tied to one location (Scheidig, 2022a). On the other hand, this means that they are entering a supra-regional or even international education market in which many providers of online courses are competing (Echarti et al., 2023). Participants in the online education market also include organisations outside the spectrum of traditional adult education providers. These include learning platforms such as Coursera, whose growing importance is leading to a platformisation of adult education – also a topic for further research (Karger et al., 2024).

With regard to the learner side, it is necessary to investigate the consequences of digitalisation processes for the addressees of adult education. In this context, it is crucial to consider the opportunities and challenges that arise with digital forms of learning – for example, whether online courses reduce barriers by increasing the flexibility of learning. Some recent studies have shown that digital learning opportunities tend to reinforce the known disparities in participation in adult education (DiPietro & Karpinski, 2021; Eynon & Malmberg, 2021), and that this mirrors a general digital divide (Lythreatis et al., 2022). Consequently, this draws attention to the relationship between digital skills and digital learning as well as the effects of digitalisation on the education of low-skilled adults (Weßner et al., 2024). Research in this area is still in its initial stages; and, for example, the relationship between the course format (online, hybrid, blended learning, etc.) and the many other factors of (non-)participation and the choices made by adult learners (Boeren, 2023) has yet to be investigated in depth. However, questions about the consequences of digitalisation for adult learning relate not only to participation in digital adult education courses (Egetenmeyer et al., 2021; Robak et al., 2022) but also to the quality of the learning processes and learning outcomes of technology-enhanced learning (Scheiter, 2021) – and not just in courses offered by established adult education institutions, but also in digital learning environments (e. g., adaptive learning software) outside of organised adult education. One current question is how AI will influence adult education (Milana et al., 2024) – for example, whether AI can contribute to the individualisation of learning. Possible potentials are discussed particularly with regard to generative AI tools such as ChatGPT (Kasneci et al., 2023) – for example, how chatbots can facilitate self-directed learning of adults as virtual tutors (Lin, 2023).

With regard to the content side of adult education, the question arises as to how it addresses topics and skills that become relevant with digitalisation processes. Several studies have examined whether and how learning programmes for adults are addressing those needs that are becoming increasingly important in the digital world such as media literacy (Hellriegel, 2022), data literacy (Brinkmöller & Scheidig, 2024), cybersecurity literacy (Daugherty & Dark, 2021), digital health literacy (Kim et al, 2023), or AI

literacy (Hachem & Heintz, 2024; Petridou & Lao, 2024; Scheidig, 2025b). When dealing with digital phenomena in educational courses, the question arises as to which generic learning outcomes are targeted (e. g., knowledge, skills, attitudes, Vuorikari et al, 2022), which aspects are focused on (e. g., basic understanding of technical functionality, personal use, societal implications, Brinda et al., 2016), and what is the underlying attitude towards technology (technology as a tool that can be used or as a system to which one is exposed, see Brinkmöller & Scheidig, 2024). Studies on how educational courses for adults approach digital technology have shown that this is often functional with an application-oriented focus (Hellriegel, 2022; Rohs et al., 2021; Scheidig, 2025b) and does not pay enough attention to critical reflexivity (Hachem & Heintz, 2024). Although research into technology-related courses for adults has a certain tradition (Hellriegel, 2022), studies on the participants and their motives for participation – such as that by Pihlainen et al. (2023) on the reasons why adults engage in digital skills learning – are rather rare.

3   New Data

Data are a central resource that research uses to generate knowledge; and with the increasing digitalisation within so many areas of life, the amount of potentially research-relevant data is increasing too – also in relation to adult education (Scheidig, 2022b). Big data has become a major buzzword and can be characterised by several Vs: volume, velocity, variety, value, and veracity of data (Boeren & Lido, 2023). The scientific utilisation of new data has given rise to interdisciplinary fields such as computational social science and digital humanities (Lazer et al., 2020). In educational research, the last ten years have seen the emergence of specific discourses and examples of the use of data that have usually been generated incidentally in educational contexts. These are known under such headings as Learning Analytics (Long & Siemens, 2011), Educational Data Mining (Romero & Ventura, 2013), or Assessment Analytics (Scheidig & Schweinberger, 2022). The focus has been primarily on higher education institutions, but there are also considerations with regard to adult education about 'lifelong learning analytics' (Pham & Klamma, 2013). Based on typologies of education-related data types (e. g., Lai & Schildkamp, 2013), a distinction can be made between programme data, learner data, and learning-process data. This could also become more important for research in adult education as the use of digital technologies increases.

Due to the open structure of adult education, data on courses are of great interest, because they provide an opportunity to describe the confusing landscape of adult education in a scientific manner, and, for example, analyse the ways in which topics are addressed. New data sources for research on adult education programmes include, for example, digital programme archives in which a large number of historical programme brochures can be retrieved and browsed. There are already several examples of the use of digital programme archives for longitudinal analyses (e. g., Brinkmöller & Scheidig, 2024; Käpplinger, 2018; Nylander & Holmer, 2022; Rohs et al., 2021). However, the fact that adult education programmes are being advertised increasingly on the Internet pro-

vides even more extensive research opportunities. For example, websites of adult education providers and course databases can be captured automatically via web scraping, a computer-operated procedure in which the content of a website is searched and specific data is collected, copied, and saved (e. g. Lacher & Rohs, 2023). Data on educational programmes can also be extracted directly from the underlying databases (Scheidig, 2025b). Reichart et al. (2024), for example, show how the regional distribution of almost two million courses can be analysed using data from a cross-provider and cross-sector German metadatabase that uses data from 164 search portals to advertise adult education courses.

Data on learners is often collected via surveys designed to obtain information on, for example, socio-demographic characteristics. The ways that adult education providers have started to use software to manage both courses and participants and the ways that these data are interlinked offer new opportunities for gaining insights. The data collected when booking a course allow analyses of, for example, demand behaviour, participation patterns, and the composition of participants in different courses. For example, the question whether location-flexible online courses can also attract adults living further away can be analysed using the postal codes of the registered participant addresses. Further data on (potential) learners, such as search terms from the search field of course platforms, can also be analysed; and log data of the clickstream on the websites of adult education providers reveal (potential) learners' interest in content. Data on learners can also be gathered apart from the websites and databases of adult education providers. Lido et al. (2016), for example, have illustrated how one can also use the GPS data of adult learners.

Learning process data are data on the behaviour of learners in digital learning environments. These digital trace data are tracked continuously and are therefore very extensive (Salganik, 2018). Typical examples include log data from users of learning management software such as login time, time spent in use, interaction intensity, pathways, task performance, and discussion activities. These are already being used in research into higher education. The spectrum of possible data sources ranges from learning platforms, massive open online courses (MOOCs), and learning apps to serious games, virtual and augmented reality applications, and interactive info screens at public learning centres. There are already a few research examples in which the potential of learning-process data in digital learning environments for adults has been utilised scientifically: Viertel et al. (2021), for example, have researched music learning on a tablet using screen capturing, and Yun et al. (2019) have varied the difficulty level in digital simulation training for emergency services using the heart rate measured with wearables.

As digitalisation in adult education progresses, data sources and the volume of data, and, thus, also opportunities for linking different data sources (Cielebak & Rässler, 2022) will continue to increase. So far, the potential of these data has yet to be fully utilised. The advantage of using the aforementioned data sources is that the data are already available or are generated incidentally when using digital technologies. They do not first have to be collected by researchers. Accordingly, these are non-reactive meth-

ods of data acquisition that avoid possible biases arising from selective participation, the response tendency of social desirability, the Hawthorne effect, and so forth that can occur in questionnaires, interviews, or observations. However, there are also disadvantages, because the data were generated under uncontrolled conditions; the data collection was not based on a specific scientific question, operationalisation of the measurement constructs, or a sampling strategy; and the researchers may lack important information on the context of data generation (Trübner & Mühlichen, 2022). In addition, utilising the aforementioned data usually requires very complex data preprocessing steps and, depending on the data structure and analysis method, specific skills (e. g., programming).

One key challenge lies in ethical, legal, and privacy issues: Personal data require special protection, because they can contain sensitive information (including that disclosed by combining data). Learners can be harmed in their informational self-determination, and they may not know and understand what can happen with their data. Moreover, they are structurally in an asymmetrical relationship, because they often have no real choice when the decision not to disclose data usually means that they have to opt out completely from using a digital service (Trübner & Mühlichen, 2022). Therefore, research should not only comply with legal requirements for data protection and agree on standards for data use (Scheidig & Holmeier, 2022), but also critically reflect on the ethical dimension (Rohs & Bernhardsson-Laros, 2022).

4 New Methods

Research methods are procedures for acquiring scientific knowledge. In empirical research, this refers to approaches that collect, process, and analyse data, thereby already showing the close connection to research data. The traditional distinction between qualitative and quantitative research methods offers a scheme for classifying the new methodological possibilities associated with digitalisation. In addition, digital applications also open up potentials for data collection, processing, and presentation.

In the field of qualitative research, one current topic of discussion is how AI can be used in interpretative content analysis (e. g., Schäffer & Lieder, 2023). Qualitative research is often limited to small samples with regional or time-related restrictions due to the high effort involved. In this context, some researchers are exploring how large language models such as ChatGPT can be used to code in qualitative research when, for example, categorising large qualitative text data or reviewing interrater reliability (Theelen et al., 2024). Martin (2025) points out that most of the available data on adult education are qualitative, and that AI can be used to analyse not only small sections of them, but also large amounts in a text-as-data logic. However, this poses numerous challenges such as the fact that AI is not neutral, that results cannot be replicated, that 'hallucinations' occur (Ji et al., 2023), and that there is a lack of transparency with regard to operations and the protection of intellectual property (training data, input data). Furthermore, the enormous ecological footprint (energy and water consumption) and

the precarious conditions of click workers raise ethical questions about the use of AI (Bengio et al., 2025).

With regard to quantitative research, computer-operated methods can be used to analyse large volumes of unstandardised data that cannot be analysed conventionally for capacity reasons. For example, methods from the field of text mining can be used to analyse a text corpus for its structures regardless of its volume. This includes basic methods such as frequency analysis (How often do certain words occur? Is there a change over time?) as well as more complex methods such as sentiment analysis (Is a text corpus characterised by a positive or negative opinion? What are the strongest sentiment-bearing words?) or topic modelling (Which latent thematic structures can be identified? How present and interwoven are these latent themes?) (Scheidig, 2025a). Nylander and Holmer (2022) have shown how text mining can be used for programme research by using topic modelling to analyse the content of the national catalogues of Swedish folk high schools from 1954 to 2007. Topic modelling has also already been used to map latent topics in adult education research on the basis of publications (Nylander et al., 2022; Theurer, 2024). However, the example of topic modelling makes it clear that even automated text analyses require interpretative steps, and that the depth of analysis can be less than that with established qualitative content analysis methods. It seems worth considering a combination of conventional and automated processes in order to utilise the advantages of both approaches. It should also be noted that the character of research changes with data-driven methods, because theoretically based questions and hypotheses no longer form the foundation for empirical research, but rather the data material alone. This is somewhat problematic (Trübner & Mühlichen, 2022), especially when such data analyses are equated with 'the end of theory' (Anderson, 2008).

In addition, digitalisation processes also open up new perspectives for other aspects of the research process. These include data collection methods such as web crawling and web scraping that can be used to automatically identify and collect data on the internet (Neylon, 2017). Dorn et al. (2024), for example, used web scraping to capture public CVs from LinkedIn profiles of 8.75 million college graduates from the US and used the semi-structured data stored there to analyse the relationship between skills, educational pathways, and current and prior jobs. The processing and communication of research results can benefit from the fact that it has now become easier to visualise complex results with the aid of computers. Examples from adult education research include the visualisation of results with heat maps (Nylander & Holmer, 2022), social network maps (Boeren & Lido, 2023), bibliometric network maps (Schrader et al., 2022), or Sankey diagrams (Scheidig, 2024a). Other examples of digital changes in research processes include research data repositories that can be used to store data sets and for secondary analyses, or software such as audio-to-text tools that can facilitate the time-consuming transcription of oral interviews.

5 Conclusion

In response to the question of the relationship between digitalisation and adult education research, this chapter has outlined how new issues, data, and methods (can) stimulate adult education research in the context of digitalisation. The distinction between these three dimensions covers the central aspects in which the digitalisation of life areas has resulted in benefits for adult education research. Research issues, data, and methods are closely related in many scientific disciplines, because (empirical) methods generate or analyse data, and because the choice of suitable methods and which data they require depends on the research question in focus (Anderson & Arsenault, 2005; Mertler, 2019; Scott & Usher, 2011). With regard to the implications of digitalisation for adult education research, these three dimensions are closely interlinked for further reasons. New data sources for adult education research are emerging primarily because adult learning is framed increasingly by digital technologies, and the use of these technologies generates data that may be relevant for research into these digital learning processes. In some cases, digital transformation processes also lead to changes that may even require the use of new data sources and research methods. If, for example, adult education programmes are increasingly advertised online instead of in printed programme brochures (Käpplinger, 2021), then new approaches to data collection and storage such as web scraping or database queries will be required (Lacher & Rohs, 2023; Reichart et al., 2024; Scheidig, 2025b). Furthermore, new data can also enable or even require new approaches to data analysis. For example, analysing many thousands of texts on educational courses cannot be done using established methods of qualitative content analysis due to time constraints, whereas (partially) automated digital methods can easily analyse large amounts of data (Nylander & Holmer, 2022). However, there is not always a close relationship between digital research issues, data, and methods. Research questions on digitalisation-related changes in adult education organisations, staff, learners, learning processes, content, and learning objectives can also be investigated using traditional research methods. Vice versa, new data sources and computer-based research approaches can also be used to address research questions on adult education that are not (directly) related to the digitalisation of educational practice.

The above cartography is necessarily selective and incomplete, because it cannot adequately represent either the breadth or depth of the aspects mentioned. Each of the research issues, data, and methods mentioned here covers a wide range of specific discourses that could only be referenced here using selected examples. Moreover, digitalisation is an open process, meaning that new developments can be assumed that are not even predictable today. Nonetheless, even a brief look at (possible) digitalisation-related changes in adult education research indicates that digitalisation processes open up a wide range of new fields of activity. Here, potentials can be seen, for example, by emphasising new possibilities for research through new data sources and research approaches. However, this can also be interpreted as a challenge to the scientific community: if there are substantial changes in educational practice (e. g., through the adoption of AI), then science as a framework for reflecting on educational practice needs to in-

vestigate these changes (also in terms of whether they are actually substantial). With regard to new data and methods, the question also arises as to whether research can deliberately decide not to utilise new possibilities for gaining knowledge (Slade & Prinsloo, 2013), should there not be legal, ethical, or privacy reasons for doing so.

From this perspective, researchers need to consider two things: first, they need to address research questions on digitalisation processes in adult education to gain insights into digitalisation-related changes, which, in turn, may be of interest to educational practice and policy. Second, they should also explore new data and research approaches, perhaps with researchers from other disciplines (e. g., computer science), because an in-depth examination of the opportunities, limitations, and risks of new methodological options is often only possible once they have been explored sufficiently to allow for a well-founded judgement as to whether and how they can be used in a meaningful way. Boeren and Lido (2023), for example, call for adult education researchers to be more open to new research methods in connection with big data: 'Lifelong learning is a complex topic that can be studied from a wide range of angles. Answering complex questions might therefore profit from more sophisticated methodological approaches' (Boeren & Lido, 2023, p. 217). Learning Analytics as a leading example of the scientific use of big data in the education sector shows that new research approaches and data not only place new demands on researchers' skills, but also raise new methodological questions that researchers must address – for example, with regard to ensuring data protection and avoiding risks for research subjects.

From a broader social science perspective, digitalisation processes can be understood as a form of modernisation (Scheidig, 2024a). However, modernisation should not be viewed solely in a positive light and equated with progress, because it is Janusfaced in the sense that it can also have negative effects (Alexander, 2013). This is underpinned, for example, by research findings that digital learning opportunities for adults do not reduce educational inequality, but rather increase it (DiPietro & Karpinski, 2021; Eynon & Malmberg, 2021). As a consequence, adult education research should reflect on digitalisation processes not only in educational practice but also in its own research, while adopting the necessary critical distance in order to be sensitive to negative effects. For instance, it could be shown that the use of new data sources and new research approaches, some of which were mentioned above, do not add much value to adult education research. As this chapter has sought to illustrate, there are many digitalisation-related questions and opportunities for adult education research, some of which are already being actively explored. Digitalisation-related changes in adult education research are not deterministic, but an open corridor of possibilities along which the scientific community can and should proceed.

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From Knowledge to Application

Communication Challenges Between Research, Practice and Development in Digital Adult Education

Katja Buntins, Anna Heinemann and Insa Reichow

Abstract

The research-practice gap is a central challenge in educational research and the influencing factors on how to overcome that gap are hence a large research field (e. g. OECD, 2023; Mohajerzad & Schrader, 2022; Miles, 2017). In the field of digital adult education, insights from both practice and research must be translated into concrete information for the technical development of a technology. This article uses an interview study (*N*=37) to analyse the difficulties that exist in the transfer between research, practice and development. The results suggest that there are numerous difficulties in communication between these actors. Targeted research is needed to establish an effective communication model and change the distribution of roles. A separate discourse on digitalisation research is necessary, as it adds the perspective of technological development to the already complex communication between research and practice (Mohajerzad & Schrader, 2022).

Keywords: Research-practice gap, Knowledge transfer, Co-Construction, Cooperation in research projects, Misconceptions in research projects

Zusammenfassung

Die Forschungs-Praxis-Lücke ist eine zentrale Herausforderung der Bildungsforschung und die Untersuchung von Einflussfaktoren, die der Überwindung dieser Lücke dienen, ein wichtiges Forschungsfeld (z. B. OECD, 2023; Mohajerzad & Schrader, 2022; Miles, 2017). Im Bereich der digitalen Erwachsenenbildung müssen zudem Erkenntnisse aus Praxis und Forschung in konkrete Informationen für die technische Entwicklung neuer (Lern-)Technologien übersetzt werden. Der Beitrag untersucht anhand einer Interviewstudie (*N*=37), welche Schwierigkeiten im Transfer zwischen Forschung, Praxis und Entwicklung bestehen. Die Ergebnisse legen nahe, dass es zahlreiche Schwierigkeiten in der Kommunikation zwischen diesen Akteuren gibt. Es bedarf gezielter Forschung, um ein effektives Kommunikationsmodell zu etablieren und die Rollenverteilung zu verändern. Ein eigener Diskurs zur Digitalisierungsforschung ist notwendig, da er die ohnehin komplexe Kommunikation zwischen Forschung und Praxis um die Perspektive der technologischen Entwicklung erweitert (Mohajerzad & Schrader, 2022).

Schlüsselwörter: Forschungs-Praxis-Lücke, Wissenstransfer, Ko-Konstruktion, Forschungskooperationen, Missverständnisse in Forschungsprojekten

1　Background

1.1　The Research-Practice Gap and the Need for Interdisciplinary Work

The need for closer links between science and practice is a recurring theme in educational research (e. g. Farley-Ripple et al. 2018; Ghadiri-Mohajerzad & Schrader, 2024; Kerres et al., 2022; Levin, 2013; OECD, 2023), particularly with regard to the questions of how findings from research can be implemented effectively and sustainably in educational practice and how research can address pressing issues in practice (Miles, 2017). This insufficient alignment of scientific findings and needs for new knowledge in practice is also referred to as "research-practice gap" (Farley-Ripple et al., 2018). In his rather holistic approach of defining research gaps, Miles (2017) defines the "practical knowledge gap" as one of seven research gaps.

The research-practice gap describes the need for reciprocal mediation, application, and further development of knowledge between educational research and educational practice. The German educational system lacks a systematic implementation and transfer research approach (Van Ackeren-Mindl & Endberg, 2023). As a result, scientific findings often find only selective application in practice, and conversely, the needs of practitioners are not systematically integrated into research processes.

A central framework for analysing and structuring the relationship between research and practice is the model proposed by Farley-Ripple et al. (2018). This model does not conceptualise transfer as a linear process but rather as a multidimensional interplay between research and practice communities. It identifies six key dimensions: (1) the use of scientific evidence as a basis for decision-making, (2) the active search for research findings and their institutionalised dissemination, (3) the interpretation of scientific evidence and challenges in comprehensibility and applicability, (4) the involvement of actors in the process of knowledge production, (5) the regularity of integrating scientific knowledge into decision-making processes, and (6) the stage in the decision-making process at which scientific knowledge is utilised. These dimensions illustrate that effective connections between the different domains do not merely depend on the availability of knowledge but are also shaped by structural and interactional factors.

With the increasing digitisation of educational processes, an additional domain of knowledge is being integrated into the discussion of a research-practice gap. In addition to scientific expertise and practical experience, technological development actors are involved. This expansion leads to a communication triangle between research, practice, and technology development (Kerres & Waffner, 2019), in which different logics and objectives merge: While research aims for long-term evidence generation and practice requires immediately applicable solutions, technological development follows iterative approaches.

The research-practice gap, especially when additionally involving technological development, thus demands a differentiated perspective that goes beyond classical dissemination formats and instead focusses on interaction processes. Co-constructive processes contribute sustainable solutions by aligning scientific insights, practical re-

quirements, and technological innovations. In such formats, researchers, practitioners, and technology developers collaborate on the design, evaluation, and continuous adaptation of innovations. Similar thoughts can be found in the concept Design-Based Research (Euler, 2014) or Educational Design Research (McKenney & Reeves, 2013), which iteratively develops (technological) solutions through close cooperation between researchers and educators. Similarly, the concept of "Developmental Evaluation" (Patton, 2011) emphasises ongoing feedback loops among all stakeholders. The joint work in the development of a technological tool predefines the future product as a boundary object (Mark, Lyytinen & Bergman, 2007), in which all involved disciplines have to work together closely and which may serve as a bridge for better mutual communication and understanding. Around this boundary object a developmental partnership (Sesink & Reinmann, 2015; Rau, Gerber & Grell, 2022) can lead to a shared responsibility for the development, testing and final design of the product. Current transfer and cooperation models in educational science show that co-constructing knowledge entails high communication demands among stakeholders involved in developmental processes. Ghadiri-Mohajerzad and Schrader (2024) describe the co-constructive knowledge production as a transfer process of high-level interaction and understanding. In their model of different transfer approaches, the closest form is determined by participation and collaboration processes, which is tied to the idea of a coproduction of new knowledge (Ghadiri-Mohajerzad & Schrader, 2024, p. 25). Similarly, Gräsel et al. (2006), in their model of teacher cooperation, highlight that such high-level interaction between experts leads to the partial loss of individual autonomy. While this applies to teacher groups, it likely holds even more in heterogeneous teams with diverse expertise and goals. Overall, transfer in joint research-practice projects is closely tied to intensive communication processes in the team. Communication strategies for a constructive cooperation of the parties involved, in our contribution considering educational research, practice and development (see Figure 3), can therefore focus on transparency, participation and reflection in the diverse project team, for example the clarification of expectations or openness towards experiences and knowledge of others.

This issue is particularly pressing in the field of digital adult education, where research insights and practical experiences must be effectively translated into actionable information for the technical development of educational technologies.

The German funding line "Innovationswettbewerb INVITE" funded 34 research and development projects between 2021–2025 in the field of digital vocational education and training. This setting gives the opportunity to study how communication and transfer processes happen between different project partners., i.e. researchers, practitioners and developers.

1.2 Bridging Communication and Research Gaps: A Typology for Analysis

Within development projects, co-creative communication plays a crucial role, as it is not only about the exchange between research and practice but also involves the technical development process. Transfer, therefore, can be seen as either successful or unsuccessful communication.

In our study, we focus specifically on the communication that occurs during the project period, examining how these ongoing exchanges shape the eventual transfer of knowledge. To classify the communication gaps observed, we use the framework of research gaps as outlined by Miles (2017), which helps to identify where and why these gaps arise within the research process. This approach allows us to interpret communication gaps as research gaps, highlighting the critical points at which effective knowledge transfer fails or succeeds within the dynamics of the project.

Miles (2017) categorised seven main types of research gaps. Miles' model is theoretical in nature but has been used in some empirical educational studies (e. g. Hackerson, Slominski, & Johnson, 2024). Since the projects to be researched for this study have research foci in the areas of technology development and AI integration, we have added two gaps to the model to do justice to these subject areas. The final model for classifying research desiderata in the field of AI-supported education and training therefore has nine gaps (see Figure 1).

Among these, the practical-knowledge gap is particularly relevant for our analysis, as most of the observed communication and transfer challenges between research, practice, and development relate directly to this category. In the following section, we describe how this analytical framework informed the coding of our interview data, and how communication patterns were systematically mapped to different types of research gaps.
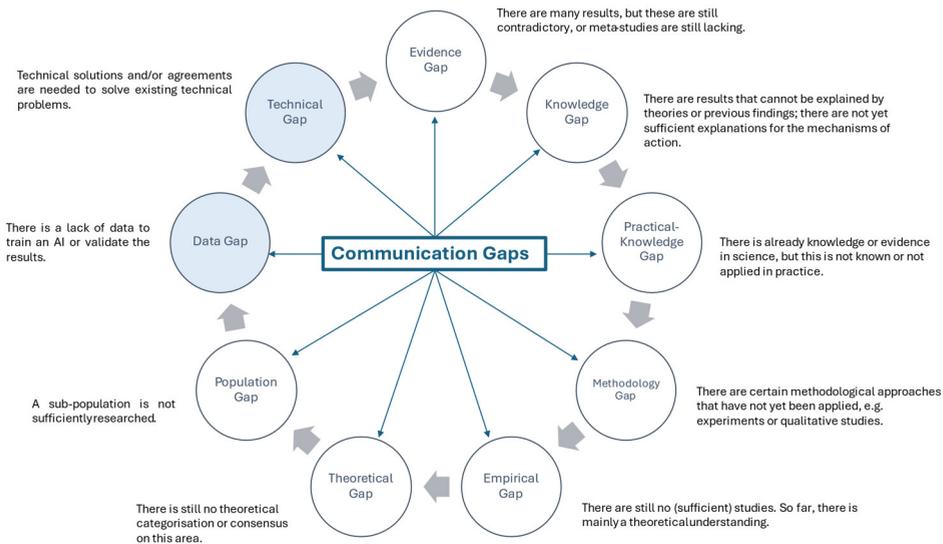

Figure 1: Classification of research gaps, based on Miles (2017), supplemented by two research gaps (highlighted with a darker shade)

1.3   Research Goals and Questions of Our Study

The first main question our study seeks to answer is: What challenges arise from the trialogue of application-oriented digitalisation research in education?

Specifically, this study addresses the following questions:

1. Which communication processes occur between research and practice?
2. Which communication processes occur between technical development and practice?
3. Which communication processes occur between research and technical development?

The second main question of this study relates to the strategies of dealing with these three actors: Which collaboration and communication strategies were established at the project level and at the funding level?

2 Methods

2.1 Interviews

Semi-standardised interviews with key questions were conducted to answer the research desiderata as outlined by Miles (2017). These interviews were conducted with 37 project representatives of 31 research projects, between March 2024 and August 2024. All interviewees of the 31 participating projects received the same base-line questions (see Figure 2) and were asked about both technical and content-related or didactical topics.

Research Need
Can you describe what research desiderata you see in the subject area [topic 1]?

Priority
What priority should be given to addressing them? And why?

State of Research
What relevant research is there on this desideratum?

Research Question
Can you name specific research questions that you see in this area?

Design
How would you go about researching this in practice?

Figure 2: Questions posed in the interviews to assess research desiderata of the participating projects

The interviews were protocoled during the interview; but not transcribed verbatim. This method may limit linguistic nuance but was considered adequate for capturing thematic content. This decision was made for two primary reasons: First, the focus of the research was not on the detailed conversational structure or linguistic framing of responses, but rather on the substantive content of the participants' statements. Second, many of the interviews included highly personal or context-sensitive reflections from project partners. To create a safe and open conversational atmosphere and to ensure ethical handling of potentially sensitive insights, the research team deliberately refrained from audio recordings. Instead, detailed interview protocols were taken in real time, based on a standardised guideline, and immediately reviewed for completeness. In the processing of the results, the research questions mentioned were assigned to the corresponding gaps. The final categorisation was determined by the evaluating research team, who were more familiar with Miles' nomology than the interviewees. The interviews were conducted by the entire INVITE meta-team, comprising of six individuals.

2.2   Participants

The German funding line "Innovationswettbewerb INVITE" encompassed 34 research and development projects (BIBB, 2024), of which 31 were surveyed. Notably, all 31 projects were realised in collaboration with external partners from various sectors, including academia, non-university research institutes, software companies, further education institutions, and craft businesses (Reichow et al., 2025). On average, the 31 projects had 5.2 partners (e. g. universities, non-university research institutes, software companies, continuing education institutions, craft businesses, companies). Fifteen projects focussed on interdisciplinary continuing education, while the other 16 projects conducted research and development for a specific industry (e. g. nursing, skilled trades, industry, logistics).

A total of 37 interviews were conducted with the 31 projects, many of which involved multiple participants reflecting the diversity of the professional backgrounds of the team members. The interviews were initially conducted on a technical or didactic topic. There were significantly more interviews on didactic topics (13 interviews) than on technical topics (5 interviews). For the second round of interviews (14 projects), no thematic focus was set in advance; instead, this was developed during the interviews.

2.3   Validation Workshops

To validate the interview analyses, a workshop was held with representatives of the INVITE projects. Participation in the workshop was voluntary and independent of prior interview participation. The validation workshop lasted one hour and was conducted online.

The workshop followed a standardised structure, which included the following three components: (1) presentation of the interview results, (2) interpretation of the results with the participants, and (3) an open discussion with a focus on the communication strategies employed at the project level. The workshop had nine participants and was led by two team members. The workshop was not recorded but protocoled.

2.4 Coding and Analysis

The protocols were analysed using qualitative text analysis (Mayring, 2014). Due to the difference in research topics of the projects the coding scheme focussed meta topics for analysis, i. e. the communication processes between research, practice and development (Reichow et al., 2025). The following coding scheme emerged:

Table 1: Overview of all codes

Codes (The main codes are in bold)	Description
Practice ↔ Research	**Co-constructive processes in which both sides jointly generate or further develop knowledge.**
Practice → Research	Knowledge, experience and needs from practice that should be communicated to the scientific community.
Degree of differentiation	Implicit empirical knowledge that is known to practitioners but not integrated into research logics.
Requirements from practice	Practical requirements are rarely incorporated into scientific research.
Research → Practice	Research results do not reach practitioners or are difficult to access.
Sustainability	Results are not permanently connectable, as they are not sustainably connectable in practice
Knowledge	Research knowledge is not utilised because it is either not known or not comprehensibly prepared for practical use.
Handling/Best Practice	Research findings are not translated into practical action aids (e. g. checklists, transfer formats).
Development → Practice	Technological developments encounter hurdles when they are implemented in educational practice.
Sustainability	Technologies fail due to long-term utilisation, for example, due to a lack of integration or acceptance.
Data protection	Unclear legal framework conditions or resistance hinder implementation.
Technical solutions	Practice demands practical answers to scaling, integration and interface problems.
Handling/Best Practice	Need for concrete implementation examples or guidelines for new technologies (e. g. VR, AI).
Practice → Development	Development processes do not adequately address practical requirements.
Handling/needs	Examples: Dealing with bias, data protection, target group specifics is not sufficiently anticipated.
Development → Research	Impulses from technology development point to blind spots in research.
Data basis	Lack of data for AI modelling, user analyses or system development.
Degree of differentiation	Standard models are also not sufficiently usable for developers because they are too complex

(Continuing Table 1)

Codes (The main codes are in bold)	Description
Research → Development	Educational science knowledge does not flow sufficiently into technical development.
Knowledge transfer	Didactic perspectives are considered late or not at all and should be easier to utilise
Translation/Best Practice	Research results are not systematically translated into technical design principles, templates or libraries.

The codebook was developed in a discursive and iterative process within the research team. Initial categories were based both on theoretical frameworks – particularly the research gap typology by Miles (2017) – and on inductive insights derived from the interview protocols. This hybrid approach allowed the research team to maintain conceptual alignment while remaining open to empirical nuances.

To ensure analytical validity, the evolving code system was discussed and refined in multiple feedback loops. This included a structured validation workshop with representatives from several INVITE projects, where preliminary findings and coding dimensions were reviewed. Insights gained during this session, as well as follow-up conversations with individual project teams, led to targeted revisions and clarification of code definitions. Through this recursive process, the final coding scheme achieved both theoretical coherence and practical relevance.

2.5   Limitations

A major limitation of our study is that it was primarily aimed at identifying research gaps at the end of the funding period across 34 projects, and the communication gaps were a secondary finding. A study specifically targeting communication gaps might find more diverse results and go deeper into uncovering the reasons for these gaps.

Another limitation of our study is its exclusive use of an inductive analysis approach, which may have restricted the scope of our findings. Additionally, there are no large studies currently available that focus on the specific aspects we investigated, which limits the context for comparison. The data collected were limited to protocol notes, rather than full transcriptions of the interviews, potentially leading to a loss of nuance in the information captured. Moreover, the study involved multiple different interviewers, which could have introduced inconsistencies in how the data was collected. No formal intercoder reliability statistics were calculated. Instead, category consistency was ensured through collaborative discussion and consensus-building among the research team. Lastly, pre-existing relationships and shared prior knowledge (e. g. joint participation in a workshop) between the participants and interviewers may have influenced the results.

3 Results

3.1 Results from the Interviews

Using the methods of qualitative content analysis, 82 codes could be extracted. In several interviews, the communication and transfer processes between different actors (i.e. research, technical development and practice) were mentioned and were consequently looked at more closely.
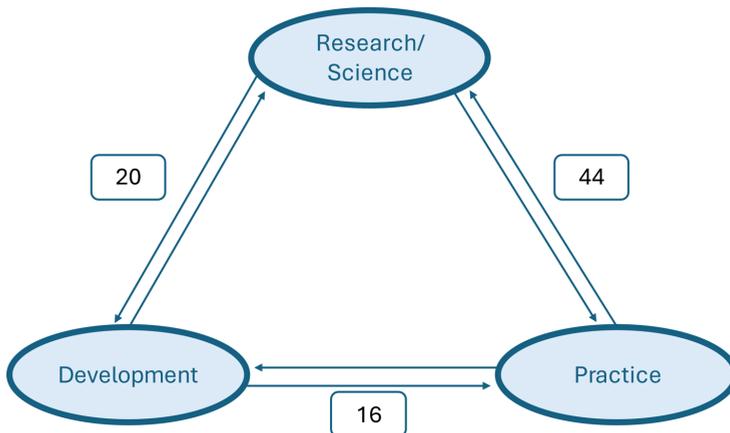

Figure 3: Project work between three perspectives. Numbers indicate the number of interview statements that address the respective relationship.

The 82 codes were analysed regarding the communication processes between these three different actors (see Figure 3). Looking at the paths on a numerical level, the following picture emerges. The arrows indicate the direction of communication – in other words, they show where knowledge, needs or circumstances should be supplied from. A double arrow means that this is not about the imparting of one-sided knowledge, but much more about the exchange between the two actors on an equal footing:

Table 2: Directions and frequency of communication between the three perspectives

From → To	Practice	Research	Development
Practice	–	18	3
Research	25	–	17
Development	13	3	–
Bidirectional	1 (Practice ↔ Research)	0 (Practice ↔ Development)	0 (Research ↔ Development)

3.1.1   Practice → Research

In our study, the area of practice-research communication is particularly relevant in this context. Practice → Research describes the gaps or problems resulting from the fact that knowledge and/or structures from practice are (not) incorporated into scientific discourse.

One project describes this as follows:

> "There is a huge gap between research and practice. What we think about learning in research and what people actually think about learning in their reality is very different. For research, this common-sense understanding of learning as 'all in one room, structured and boring and hierarchical' is a problem."

Additionally, two different topics were extracted inductively:
- Own requirements: 14
- Degree of differentiation: 3

The 'own requirements' code proves to be particularly relevant, which is made clear by 14 statements. The code describes that practical requirements are rarely incorporated into research. This may relate to professional expertise, trial-and-error strategies or implicit knowledge, which practitioners feel are not sufficiently reflected in formal academic sources. The projects note that the diversity of work and life realities is often not compatible with modern learning environments. The reasons given for this are the lack of access to mobile devices and a workload that is perceived as too high, leaving no time for further training contexts. One project formulates the problem in a very general way and states that it "*lacks a connection to practice and does not lack theories*". Another project gave an example where the practical reality challenges how research is being done and poses the question of the criteria according to which personalisation should be organised:

> "What criteria should be used to personalise? According to the occupational group!? It doesn't necessarily have to be meaningful enough to determine the difficulty of a learning unit, for example. There are, for example, super-fit trainees who receive very simple content based on their occupational classification. And there are also people returning to work who may have been out for a long time and are then given totally overwhelming content. A formal qualification is not enough to truly reflect a person and their skills."

A recurring theme is the degree of differentiation, whereby it is noted that many theories, taxonomies and frameworks are too complex for translation into educational practice. The ESCO taxonomy is cited as an example:

> "Everything that has to do with skill profiles has not yet been clarified. And related to this is the inadequate mapping -> ESCO is too fine; KldB [a German classification system of occupations] is far too German and not granular enough. This is not really usable. Some universities and educational institutions are therefore building their own taxonomies, which are then incompatible. This is not an unknown problem, but it is an unsolved one."

3.1.2 Research → Practice

Communication of research into practice was the most frequently mentioned theme with 25 responses. The code describes that scientific findings do not reach practitioners or are simply not available in research. Another issue is that knowledge is not sufficiently processed to be useful in practice. The 25 responses are distributed as follows:

- Sustainability: 3
- Knowledge: 12
- Handling/Best Practice: 10

The sub-code "sustainability" refers to ensuring continuous development through the integration of knowledge in practice and the sustainable implementation of scientific insights within technological developments. Central to this is transparent communication of potential costs and benefits, as well as clearly defined timeframes.

The sub-code "knowledge" was coded most frequently with 12 responses. In this context, the projects formulated questions that remain unresolved – at least from a practical perspective. As noted above, it is important to evaluate whether these questions represent genuine research gaps or whether they merely require improved preparation for practical use. One project summarises this situation as follows:

> "There are studies on gamification with many methods. But in terms of content, there is nothing. We established this with a literature review."

This quote illustrates that research in this area is often not aligned with practitioners' needs and is frequently overlooked in practice-oriented projects. In the interview, the project formulated the aim of closing this gap.

In 10 statements, the interviewees explained that the practice requires an alternative form of presentation or "handling" of scientific insight. For example, one project describes that the existing information is not readily transferable for them:

> "There are many papers about informal learning and definitions of it. But it is difficult to transfer this knowledge to everyday working life."

According to the interviewees many of the theoretical definitions of pedagogical concepts were not suited for the complex realities of the work settings they were dealing with.

3.1.3 Practice ↔ Research

This code describes co-constructive processes in which both sides jointly generate or further develop knowledge. One project explicitly calls for a co-creating ethical guidelines:

> "Co-creation of ethical guidelines together with all stakeholders. Rural and urban environments consider different perspectives that need to be reflected in these guidelines."

It should be noted that, in addition to this general requirement, the comments discussed above also clearly show that a collective process of conceptualisation is required to implement such complex projects in practice on a day-to-day basis.

3.1.4   Practice → Development

This code discusses the extent to which the needs of practitioners are sufficiently considered or known when developing a digital learning environment. The code is therefore synonymous with the code "Handling/needs in the area of practice Research". There are three codes in this area, each of which refers to the specific difficulties of the respective project. For example, a project can indicate that the implementation of digital learning environments is associated with difficulties. These can arise, for example, due to data protection requirements.

> "There may be data protection-compliant solutions, but it is unclear where they are and whether they are permissible for your own company."

Another example that deals with implementation problems of applications is the area of artificial intelligence:

> "A practice partner used a traditional chatbot and wanted to add AI to it. LLMs are associated with problems (e. g. hallucinations, data protection, bias) that have not yet been sufficiently solved. We have taken various measures to deal with the hallucinations, for example, but they 'only' work in ca. 95 % of cases. This is not enough for the partner; he fears a loss of trust and therefore does not implement the feature altogether."

This evidence demonstrates the significant discrepancies between edtech developers, and their perception of practice partners drive to innovate. These discrepancies harbour the potential for significant conflicts of interest.

3.1.5   Development → Practice

This code deals with the question of the extent to which innovative developments can be integrated into practical applications and which barriers need to be considered. It should be noted that the distinction from the code "Practice → Development" is not always clear, as here there is more of an emphasis on interaction to understand each other. Nevertheless, a total of 13 codes can be assigned to this area. As a result, four subcategories were developed:

- Sustainability: 3
- Data protection: 2
- Technical solutions: 4
- Handling/Best Practice: 4

The term "sustainability" is used in the context of implementing technical solutions in practice and refers to long-term implementation. For example, one project draws attention to the fact that the sustainable implementation of projects often fails because continued funding is not guaranteed, and implementation can therefore not be realised:

> "The transfer does not yet fit. There are good projects for the use of AI, but after the pilot phase it's over. But why is it being discontinued? There remains a practical gap."

Another example of sustainability is the retrieval of applications that behave differently in laboratory conditions than in live operation:

> "This works in the laboratory because it is based on optimum inputs. But that's not how reality looks. In reality, I get different data than the model expects."

The area of data protection was addressed in two different contexts, with some overlaps with aspects already discussed in other sections, such as "Practice → Research". The implementation of technical applications can potentially be hindered by data protection implications. On the one hand, this may be due to the inability to recognise the associated risks and, on the other, due to the blocking attitude of works councils or other stakeholders.

The code "Technical solutions" was assigned in four cases. In various contexts, it aims to find a (better) technical answer to a problem that may already be addressed by an existing technical solution. One project that dealt with recommendation systems used synonym tables to make the search as appropriate and efficient as possible in practice.

Another example is the lack of integration of standards around software and education, which makes it difficult to connect with individual backgrounds, such as SAP, and the project formulates not only technical solutions, but also the desire to make more information available to practitioners.

Like the "Research → Practice" code, the "Handling/Best Practice" code includes specific instructions that the practitioners would like to see from the developers. Four codes were assigned in this area, one example being the support of a project in the scaling of an application:

> "Scaling of streamed VR-WB scenarios: How can streamed technology be further developed in a user-friendly way so that it can be used by several users at the same time? This is the question of scalability, which requires large computing capacity: how can the technical infrastructure be designed to enable multiple use? There is a lack of a technical approach as to how this can be solved."

This example impressively demonstrates the close link between the code, technical solutions and handling in the educational practice. A precise instruction for action is manifested in this specific code.

Another example of this code is the concrete implementation of AI in learning environments, which makes AI usable in this specific context.

> "But it will be even more relevant in the future: how can AI be implemented well on learning platforms? Which interfaces can be used so that companies can implement this?"

Concrete indications of how the implementation and stabilisation of technology can be made applicable are yet missing.

3.1.6   Development → Research

The code "Development → Research" is used in cases where the knowledge from development is not available in research and might even point to "blind spots" in academic research. The code was used a total of four times and can be described in two different subject areas.

- Data basis: 2
- Degree of differentiation: 2

The projects addressed the problem of insufficient data in the development of AI-supported learning programmes:

> "We have a data problem. We simply don't have enough data to map all of these contexts. We would also need to know more about the people and map everything with suitable metadata types. And then we would also need the data to develop these models. We need more data than all the universities have collected in the last 20 years."

It is found that research often lacks the necessary data to optimise the functioning of these offerings. This data would therefore have to be compiled or developed by the scientific community itself.

3.1.7   Research → Development

The "Research → Development" code covers areas where scientific knowledge should be incorporated into development processes. Two sub-areas were identified in the analysis:

- Knowledge transfer: 12
- Best practice: 5

The "knowledge transfer" code is very similar to the "research ↔ practice" code, but with different audiences. This code is therefore an indication that there is a great need for action in this area, in whatever direction. Various areas for action can be identified, including the necessity to adapt knowledge from computer science research to the needs of concrete technical solutions. One example is:

> "LLMs have an ocean of knowledge, behind it are huge databases with which the AI has been trained, I merely add a drop of knowledge with my knowledge model; but how can I ensure that the generative AI learns in the way I need it to?"

The other form of knowledge that needs to be transferred is knowledge from didactics and educational sciences. For example, one project stated:

> "There is too little application of knowledge of educational theory to technical matters. It's the familiar problem: 'Computer scientists do something' and this generates surprising findings but is not sufficiently grounded in educational theory."

Some projects gave concrete topics where this knowledge is specifically needed:

> "From an educational science perspective, it is difficult to personalise learning journeys. What criteria should be used for personalisation? According to the occupational group? This is not necessarily enough to determine the difficulty of a learning unit. There are, for example, super-fit trainees who receive very simple content based on their occupational classification. And there are also people returning to work who may have been out for a long time and are then given totally overwhelming content. A formal qualification is not enough to truly reflect a person and their abilities. Thus, more research is needed: what can personalisation really look like, what data would it need to be based on?"

To summarise, it can be stated that the needs in this area can be classified as heterogeneous, and that clear communication is particularly important.

A total of five codes were awarded as part of the "Best Practice" code. These are characterised by the desire for an action-oriented solution for the transfer of scientific knowledge for developmental tasks. One project formulated:

> "There is already a lot of research on transfer, but there is a lack of a toolbox on how best to do it".

The question how empirical findings are to be translated into the technical developments is a central one of all digitalisation projects. As such, the question was also a focus of the subsequent validation workshop.

3.2 Workshop Results: Relationship Between Practice, Research and Technical Development

Overall, the presentation of the interview results was met with approval by the participants. Especially the relationship between the three project actors "practice", "research" and "technical development" was repeatedly discussed in the workshop, as it was a central theme in all INVITE projects.

The challenges of collaboration in interdisciplinary projects were emphasised by the workshop participants. Especially at the start of the project, there was an increased communication effort. The transfer of expertise between the various technical and non-technical partners involved was particularly time-consuming.

The participants pointed out an incongruence of expectations between the three stakeholder groups: Practitioners expect solutions from research that address current and practical problems and are directly applicable to the market and target groups. However, research usually wants to have an impact in the future, develop innovative or new things and publish scientifically reliable results. The role of development, on the other hand, is to set up a technically robust system, primarily by working according to the "trial and error" principle. This leads to irritations or communication gaps, which are also based on the incorrect allocation of roles to those involved. This leads to a great need for dialogue. The participants also suggested constructive solutions to this:

A joint kick-off was recommended several times, allowing sufficient time to realise the various requirements and objectives of the project stakeholders involved. Over-

all, during the project, the research should not claim that the results will be implemented 1:1 in practice. They can serve as inspiration or for the formulation of guidelines.

Another suggestion was to use the internal project evaluation as a recurring opportunity to discuss tensions between practitioners and educational researchers on the one hand and technical developers on the other. Though not explicitly targeted, the low-key internal evaluation provided opportunities to reflect on one's own work and the collaboration with people from other professional backgrounds and objectives within the project.

Above all, it became clear how beneficial and necessary the heterogeneous composition of the project teams is for the success of the projects: the specialist backgrounds involved are needed to produce technically executable, didactically meaningful and marketable developments that bring real added value in educational practice. The participants also saw an ethical obligation to create good developments or products – precisely because they are used in an educational context. This ethical obligation distinguishes educational projects from many other interdisciplinary work teams.

In addition, multi-professional collaboration itself should be a research topic: research should be conducted into how mutual understanding between the actors involved can be achieved more quickly or more comprehensively.

One participant confirmed (with general agreement) that the INVITE projects were very complex overall. In particular, because theoretical-research and technical-implementation work blocks must take place in parallel, although there are actually no parallel development strands here: The derivation of the educational theory assumptions must precede the technical development. Then, the concrete implementation of the technology again determines which data can be collected overall and which assumptions can be tested. Technology development and educational research are thus in a reciprocal process that is not always easy to handle and requires a lot of time – simply because many of the processes cannot take place simultaneously.

Several participants suggested a clearly structured phase approach for future projects: a clear separation of scientific and innovation phases could be helpful to define more clearly what a project can and should achieve. For example, a first phase could serve to analyse the state of research, review data sets and measuring instruments and derive specific requirements for technical development. In a second phase, the ideas and innovations are then implemented – without constantly adding new requirements.

Linked to this, the workshop raised the question of a theoretical process model for funding projects in the field of digital education: How do the derivation of the state of research, development of the technology and practical use of the application and final testing of the research assumptions intertwine? Is there a prototypical process for research and development projects in the field of digital education that should be given greater consideration?

4   Discussion and Implications

Whereas the interaction between research, and practice is currently a thoroughly addressed issue in educational contexts (Ghadiri-Mohajerzad & Schrader, 2024; OECD, 2023; Schlicht-Schmälzle et al., 2024; Biesta, 2010), the collaboration enhanced by technology experts in order to develop common solutions for educational contexts still needs further research and focus. The results of the presented study show that this also needs further research in the case of adult education and digital education concerning the involvement of technological experts and therefore enhance the discourse about collaborative approaches between research, practice and technological development. Still, we see research desiderata concerning the operationalisation of communication strategies in co-constructing knowledge when different disciplines are involved. This may lead to a more specific understanding of successful co-construction and collaboration in general and therefore also enables a targeted support of competences and conditions needed for a beneficial success for the parties involved.

One of the main findings is that bridging the three spheres of research, practice and technological development requires careful consideration of the distinct languages, expectations, and methods of the involved communities of practice (Endberg et al., 2022).

The active role of technological development in the collaboration process brings additional complexities to the described challenges of collaborating within a project and thus defining mutual goals. With the integration of technical development, research must be more specific and actionable: The outcomes of research must be formulated in such a way that they can be translated into concrete technical solutions that are not only scientifically sound but also executable in real-world applications.

The need for a mutual understanding and alignment might be solved by actively reflecting on this issue in the team. Possible solutions are the engagement in existing or new funding of long-term Research-Practice-Partnerships (Coburn & Penuel, 2016) or to cooperate with intermediaries who possess the skills to communicate between research, practice and technical development (e. g. Malin & Brown, 2020; Torres & Steponavičius, 2022). In terms of funding guidelines, it is thus important to ensure that adequate resources are in place to support the communication processes that facilitate effective collaboration between research, practice, and development.

This calls for further research to address the two emerging questions: First, how can interdisciplinary research and development projects be structured and organised to better interlink research, practice and technical implementation? Now, projects do not seem to follow a structured approach or standard for achieving beneficial collaboration. Second, how can research results be produced and processed in such a way that they can seamlessly flow into the design of educational technology that is relevant and useable? This question focuses on the early clarification of how research can be made actionable for developers. It emphasises the importance of addressing the "usability" of an educational technology from the start. By ensuring that research findings are com-

municated in a way that is understandable and applicable, developers will be better equipped to design systems that align with the insights gained through research.

In this context, funding bodies also play a role: Funding bodies must understand the practical needs of digital education projects and provide the necessary resources to facilitate both research and technological developments that are not only theoretically robust but also practically applicable. We hope, our study has provided some insight into the complexities of digital education projects and provided meaningful suggestions on how the interactions between research, practice and development can be supported.

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Innovative Data Preparation for Adult Education Research

Merging Automatic Transcription and OCR to Analyse Screen Recordings of Generative AI Use

Gregor Dutz, Kristin Skowranek and Anke Grotlüschen

Abstract

The increasing use of generative AI raises questions about how adults interact with these tools and how they can be supported in doing so. This article outlines an approach to examine the use of AI text generators, exemplified by ChatGPT. Our aim is to capture the interactions of individuals or groups with such tools and to analyse these using screen capturing, automated transcription and OCR technology. Utilising open-source tools like Whisper and Tesseract, we have developed a method that allows for privacy-friendly recording and analysis of these interactions. The insights gained contribute to a better understanding of the challenges posed by AI in adult.

Keywords: Generative AI, automatic transcription, screen recordings, qualitative research

Zusammenfassung

Die zunehmende Nutzung generativer KI wirft die Fragen auf, wie Erwachsene mit diesen Werkzeugen interagieren und wie sie dabei unterstützt werden können. Dieser Artikel zeigt einen Ansatz zur Untersuchung der Nutzung von generativer KI, exemplifiziert durch ChatGPT. Unser Ziel ist es, die Interaktionen von Einzelpersonen oder Gruppen mit solchen Tools aufzuzeichnen und diese mithilfe von Bildschirmaufnahmen, automatischer Transkription und OCR-Technologie zu analysieren. Durch den Einsatz von Open-Source-Tools wie Whisper und Tesseract haben wir eine Methode entwickelt, die eine datenschutzfreundliche Aufzeichnung und Analyse dieser Interaktionen ermöglicht. Die gewonnenen Erkenntnisse tragen zu einem besseren Verständnis der Herausforderungen bei, die durch KI in der Erwachsenenbildung entstehen.

Schlüsselwörter: Generative KI, automatische Transkription, Bildschirmaufnahmen, qualitative Forschung

1   Introduction

The rapid spread of the use of artificial intelligence in public, especially generative artificial intelligence in the form of chatbots such as ChatGPT, has sparked discussions in educational science, about the challenges and opportunities posed by the use of AI and how educational science should address these challenges and opportunities. The widespread use of AI tools raises questions for adult education about how adults use AI tools, how they deal with the associated pitfalls and risks, and how they can be supported in this use.

In this article, we would like to present our approach to preparing data on adults' usage of generative AI tools, using ChatGPT as an example for an AI text generator. We understand an AI text generator to be a generative AI based on a large language model (LMM). With our approach, we pursue two goals: Firstly, we want to capture the interactions of individuals or a working group with an AI text generator, and secondly, we aim to analyse these interactions using software for qualitative data analysis (QDA). The aim of these analyses is to find out how adults use generative AI in different contexts, what difficulties they encounter in doing so, and which competencies are needed to use generative AI effectively. The range of possible research subjects is broad: learning processes, counselling, media practices, or forms of engagement with AI are some examples that can be examined in the context of adult education.

The problems associated with generative AI are well known and the subject of scientific debate: bias, hallucinations, reliability, and accuracy, as well as the enormous energy consumption, are among the technical problems of generative AI (Simon et al., 2024). Associated with this are problems that occur more on the user side: misunderstandings about the functioning of large language models, uncritical trust and overreliance on AI, and cognitive offloading, which can lead to a reduction in critical thinking skills (Gerlich, 2025).

First, we will therefore discuss the challenges for adult education caused by the rapid advancements of AI tools and establish why our research approach can help to explore these challenges by analysing the use of generative AI by adult users. Then we outline possibilities of using AI text generators in the research process to paint a comprehensive picture of the current state of research.

Afterwards, existing methods of researching user behaviour and associated challenges on digital devices will be explained before we describe the implementation of our research method in detail. Finally, we discuss the utility and limits of our research method in the context of (adult) education research.

2   Challenges for Adult Education through AI

Knaus (2024) argues that knowledge about the use of new media and technological possibilities is essential for participation in society. People should recognise that digital technology can be shaped and criticised (Knaus, 2024, p. 6). The goal of education is to

enable people to use digital media and AI-based systems competently and in a socially responsible manner, so that, on the one hand, they can participate in society autonomously and critically through media and technology, and, on the other hand, actively and creatively shape technology and society (Knaus, 2024, p. 16).

It remains a matter of debate which skills are necessary to adequately respond to this technological progress (e. g., Schiefner-Rohs & Grünberger, 2025). In this context, several buzzwords circulate, such as Digital Media Literacy (Buckingham 2020), Data Literacy (Pangrazio & Selwyn, 2023), or AI Literacy (e. g., Ng et al., 2021, Schlemmer et al., 2023). In (German-language) educational research, this discussion also raises the question of whether the classic concept of media literacy (Baacke, 1996) remains useful, or whether alternative concepts are even superfluous (Knaus 2024, p. 23).

Grotlüschen et al. (2024) identify 'three core dangers' in dealing with generative AI: the limited reliability of answers, algorithmic bias and surveillance capitalism. Not all users are affected equally, but certain vulnerable subpopulations more than others. The authors conclude that "users of social media data, newspaper readers as well as AI users have to learn how to protect themselves from misinformation and manipulation" (Grotlüschen et al., 2024, p. 12). They also refer to existing methods of media education, namely a toolbox proposed by Kozyreva et al. (2024). This "toolbox includes nine types of individual-level interventions, all supported by peer-reviewed, published evidence: accuracy prompts, debunking and rebuttals, friction, inoculation, lateral reading and verification strategies, media-literacy tips, social norms, source-credibility labels, and warning and fact-checking labels" (Kozyreva et al., 2024, p. 1046).

Dreisiebner and Lipp (2022) discuss the challenges and opportunities for adult education arising from digitalisation and the use of AI in general. They explain that a complete substitution of educators with AI is currently not technically feasible. Instead, they see promising potential for augmentation, where AI can be used as a complementary tool to support teaching and learning processes. The authors draw on existing application fields within the research on AI in education, such as Intelligent Tutoring Systems, Game-based Learning, and Learning Analytics, to support their arguments. Baidoo-anu and Ansah (2023) come to similar conclusions regarding the use of AI in education. The studies they gather demonstrate that various tasks can be enhanced by generative AI, such as translating learning materials, serving as a tutor, and offering personalised learning experiences (Baidoo-Anu & Ansah, 2023).

In a self-experiment, Stanik (2023) investigates whether ChatGPT can provide online educational counselling. The author concludes 'that the AI can provide both information and suggestions for reflection in the context of career guidance. For example, it not only shows steps for identifying a career perspective but also points out the possible duration of successful career reorientation and motivates people not to be discouraged by this' (Stanik, 2023, p. 26) [English translation by the authors]. Stanik criticises the lack of division of responsibility, as ChatGPT cannot assume any responsibility in the counselling process, and this lies solely with the person seeking advice. The author recommends that counsellors in educational counselling should familiarise themselves with the limits and possibilities of generative AI to understand what information

those seeking advice can obtain from it and to be able to explain the possibilities and limits of these systems.

Kieslinger and Nierobisch (2024) also look at the use of AI in counselling. They stress the need for ethical considerations, particularly concerning the relationship between counsellors and those seeking advice, the quality of advice and data protection. They also point to the need to develop clear criteria for the use of AI that both strengthen the autonomy of those seeking advice and safeguard the responsibility and professionalism of counsellors in a changing social and institutional environment.

Teaching about the chances and risks of generative AI should be part of adult education. This is to support adults in using AI critically and reflectively on the one hand and, on the other hand, to recognise the potentials of generative AI and make them usable for adult education. One example of this is the integration of efficient prompt engineering as teaching content in adult education courses, for example, to support immigrants or adults with low literacy in writing tasks (Grotlüschen et al., 2023).

These considerations show that generative AI is a highly relevant field of research for adult education. Artificial intelligence is a phenomenon that touches every level of adult education and needs research. Technology is not used without moral value; it can be used to destabilise societies but also for positive purposes such as personal development, learning, and creative work.

The task of adult education research is to investigate the use of generative AI and to identify ways of empowering people to resist its negative aspects and use it for their own and society's benefit. One of the major tasks is to closely see, monitor, or observe what people do with AI, how they apply it, handle misinformation, improve prompts, and critically evaluate results. This needs a combination of screen recording, voice recording, and transcription. In the following section, we will give an overview of existing techniques for analysing user behaviour on digital devices.

3   Artificial Intelligence and Qualitative Research Methods

As outlined above, our approach serves two main purposes: capturing how individuals or teams interact with an AI text generator, and analysing these interactions with the help of qualitative data analysis (QDA) software.

The first goal can be achieved by recording the interaction with the generative AI, i. e., the process of drafting prompts and evaluating answers, via screen and audio recordings. To achieve the second goal, the recordings must be transcribed before being analysed in software for QDA.

The transcription can be done manually by people; however, we suggest using AI tools for this purpose. The recording and transcription of the data should be carried out in a data protection- and privacy-friendly manner, i. e., with the help of locally executed AI tools for speech and text recognition, like Whisper or Tesseract. The practical implementation should be carried out within a manageable timeframe and with limited resources while ensuring that even individuals with little programming experience can

undertake the process. Therefore, a widely used programming language (Python) with a large selection of software packages was chosen for the implementation, and ChatGPT was also utilised to support the coding process. The software developed by us can transcribe audio recordings and screen recordings and includes timestamps. This allows for easy simultaneous analyses of screen recordings, audio recordings and transcribed texts in qualitative analysis software.

Artificial intelligence is both an object of research in the form of AI text generators and also a tool for research to recognise and transcribe speech and text. For further discussion, a distinction must therefore be made between generative AI tools, such as ChatGPT, on the one hand, which aims to create new content, is usually used by users in the cloud and is the subject of our research here. On the other hand, we use AI tools that run locally on our computers and do not generate new content but perform specific information processing and transcription tasks (e. g., speech recognition, text recognition). Our approach to analysing AI text generator usage highlights the potential of screen capturing and the use of open-source AI tools in adult educational digitisation research.

The discussion about the use of AI in qualitative research is intense and must deal with rapidly changing conditions. In the scenario of using AI tools in research presented here, the qualitative evaluation of documents or interviews would be the next step. Our approach is independent of the research method chosen afterwards and focuses solely on the recording and transcription of speech and text. Nonetheless, we would like to briefly explore the discourse on the use of AI in qualitative research to present a more comprehensive understanding of the issue at hand. Some of the papers mentioned below are currently only available as preprints and have not been peer-reviewed. However, due to the dynamic development in this area, we believe it is worthwhile to highlight such works as well.

3.1 Generative AI for Supporting Analysis of Qualitative Data

Providers of analysis software are integrating AI tools for analysing qualitative data into their software and promoting them actively. Atlas.ti[1], for example, promises the ability to chat directly with the stored documents and automatically code them according to the researcher's intentions. Similar functionality is integrated in MAXQDA[2], including automatic transcription of audio files. Free and open-source alternatives are also integrating AI tools, which can partly be run locally (e. g., QualCoder 3.6[3]). Other providers offer an interface for using various generative AI models and specially primed analysis models on this basis, e. g., DokuMet[4] for the documentary method.

The introduction of such AI tools is accompanied by scepticism. For instance, Mayring (2025) tests the application of ChatGPT based on qualitative content analysis. The author concludes that ChatGPT 4 "failed with the more complex questions" (Mayring, 2025, p. 10) but adds that "rough content categorizations of text passages are

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1   https://atlasti.com/
2   https://www.maxqda.com/
3   https://github.com/ccbogel/QualCoder/releases/tag/3.6
4   https://dokumet.de/

reasonably successful and that an overview of topics in the material can be given" (Mayring, 2025, p. 11). On the other hand, Kuckartz and Rädiger (2024, p. 260–261) see generative AI as a useful tool for qualitative content analysis, for example when summarising texts as an initial step in data exploration or as support for inductive category formation and data coding. However, the authors also emphasise that the use of AI tools must be guided by legal regulations on data protection. They note that ethical issues have not yet been conclusively addressed, and that problems such as bias and hallucinations can still arise, requiring careful work on the part of the researcher.

Concepts are also proposed in which several different LLM models are used in a specific iterative procedure (Krähnke et al., 2025). The authors claim that the iterative interaction with the AIs used ensures a multi-stage analysis process in which the interpretations and hypotheses introduced into the interpretation group are mutually tested, elaborated, and validated as appropriate to the subject matter.

There is comparatively much literature on the use of AI text generators for thematic analysis, a method that focuses on the detailed description of documents (e. g., Braun et al., 2019). Nguyen-Trung (2025), for example, develops and applies a procedure to use ChatGPT 4 for thematic analysis. The Author assesses that ChatGPT can generate an initial list of codes based on one interview, apply these codes to further interviews, and add new codes in this process, but also makes mistakes by producing overlapping codes or misclassifying codes, which requires the researcher to evaluate the output of AI text generators carefully. Nguyen-Trung also mentions constraints with large datasets due to a maximum of so-called tokens processed by ChatGPT, as well as problems with output variability and consistency. These results are largely confirmed by other research findings, with the dependence of the output on the prompts being a recurring theme (e. g., Goyanes et al., 2024; Lee et al., 2023).

3.2   AI Tools for Transcribing Audio and Text

In qualitative social research, the process of recording and transcribing interviews is crucial but can be quite labour-intensive. An alternative here is automatic speech recognition software. Although automatic speech recognition is not a particularly new development (Juang & Rabiner, 2004) and commercial products such as F4x[5] or Dragon[6] have been available to researchers for some time, developments in the field of natural language processing have led to the inclusion of automatic interview transcription functions in QDA software.

Ethical concerns are generally less focussed on the use of AI as support in the research process – after all, student helpers or assistants have often been employed for transcription in the past – but more on data protection issues, as commercial providers require the interviews to be uploaded to their servers. Such concerns become irrelevant if the speech recognition software runs locally on the computer. Whisper from OpenAI has become particularly important here. Although Whisper was developed by the same company as ChatGPT, Whisper is freely available and can be run locally on a computer.

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5   https://www.audiotranskription.de/en/
6   https://www.nuance.com/dragon.html

A comparison of different speech recognition software has shown that Whisper transcribes both German and English interviews in better quality than commercial providers (Wollin-Giering et al., 2024). However, caution is also advised when using Whisper, as it can hallucinate in a similar way to generative AI (Koenecke et al., 2024).

The main disadvantage of Whisper is that the software cannot be used directly but must be integrated into software by third parties. There are free and ready-to-use solutions to transcribe interviews (e. g., noScribe[7]) and the programming language Python makes it relatively easy for knowledgeable users to program their own tools. Based on Whisper, we have therefore developed a tool that cannot only transcribe audio files, but also extract audio from videos and then transcribe it, which greatly reduces the effort required to investigate the use of ChatGPT as described in this article.

Automatic text recognition, also known as optical character recognition (OCR), is probably not as widespread in qualitative research as speech recognition. It can be used, for example, to make scanned documents machine-readable and searchable so that they can be analysed in QDA software. OCR is often implemented in scanner software or document readers, but can also be used to transcribe text from images like screenshots taken during the use of AI text generators. Freely available implementations of OCR include Tesseract[8] and EasyOCR[9].

These explanations show that AI tools can support a variety of tasks in the research process. The possibilities of generative AI, which have only been developed in recent years, are still in their infancy: their limits and capabilities still need to be explored and ethical issues clarified. In contrast, the 'old' AI tools of speech and text recognition are established in principle, but recent developments have helped to make them more accessible and locally available. This also opens up exciting new applications, for example in researching the use of generative AI.

Researching the use of generative AI is one of the challenges for adult education posed by the dynamic development of recent years, which we will discuss in more detail in the next section.

4 Methods to Analyse User Behaviour on Digital Devices

Analysing adults' use of AI through screen captures of ChatGPT usage yields essential insights into real-world practices, challenges, and learning processes. It allows researchers and educators to understand not only what adults do with AI, but also how they think, reflect, succeed, or struggle during interactions – laying the groundwork for targeted support, critical awareness, and the responsible integration of AI into lifelong learning.

Investigating the use of AI tools is not trivial. For one, apps or websites are usually used for this purpose. Observing usage on a larger scale is, therefore, only possible

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7 https://github.com/kaixxx/noScribe
8 https://tesseract-ocr.github.io/
9 https://github.com/JaidedAI/EasyOCR

reasonably by recording usage on the devices (Krieter, 2020). Furthermore, it is not only the user input that is of interest in the investigation, but also the responses from the generative AI. This makes it possible, for example, to analyse the user's reaction to subjectively or objectively incorrect answers from the AI. In this context, it can also be advantageous to analyse not only the user input but also the thought processes involved in entering the prompts and processing the output. The thought processes must be verbalised by the users and also recorded (Kushniruk & Borycki, 2006).

In human-computer interaction (HCI) research, it is common practice to capture the use of software. There are usually two ways of doing this (Krieter, 2020): The generation of log files, i.e., text files in which various events are stored during the use of an application, e.g., errors, user input or the pressing of buttons. Another option is the recording of screen recordings. This involves continuously recording the entire screen content in a video over a certain period to record interactions with the software (Jansen et al., 2008).

Each method has its own (dis)advantages: Logfiles record events during the use of a system and help detect software errors and analyse user behaviour (Oliner et al., 2012). During development, log files record the use of mobile applications and help to identify usability problems (Balagtas-Fernandez & Hussmann, 2009). However, the collection and analysis of log files are associated with challenges such as missing context, log noise, and varying data formats. In addition, there is often no access to log files, especially on mobile devices, or the relevant events that are necessary for research are not recorded.

Screen recordings provide a deeper insight into specific interactions, but they share similarities with the recording of user behaviour. Their use has increased in research, particularly in usability testing, where screen recordings are combined with a think-aloud protocol and video observation (Kushniruk & Patel, 2004). Screen recordings allow for a very detailed analysis of user input, for example recording input that is later deleted or replaced. Screen recordings are also easy to use on mobile devices, because the function is already available in popular mobile device operating systems. However, the manual analysis of such recordings is time-consuming and is often complemented by technologies such as computer vision and machine learning (Krieter, 2020).

When recording user interactions, the question of data protection and privacy naturally also arises. Efforts to safeguard privacy have included the development of localised data processing methods, which allow users to retain control over shared information (Boker et al., 2015). Despite these advancements, researchers often face ethical dilemmas when using intrusive methods like screen recordings, which capture all user interactions and can lead to potential abuses. This has resulted in participants hesitating or declining involvement in studies due to privacy concerns (e.g., Reeves et al., 2021).

While previous research acknowledges these privacy issues, there remains a pressing need for improved strategies that effectively address the privacy of participants while still allowing for comprehensive data collection necessary for research. Brown

et al. (2016) address these concerns in a position paper focused on HCI research ethics. They assert that preventing harm or undue burden to participants is more crucial than imparting the complexities of academic studies, emphasising the need for a balance between privacy and research objectives.

When analysing the use of generative AI, it should also be noted that user input is not only recorded by the researchers, but also by the operators of the generative AI systems. Participants in such studies must be informed about this and advised not to disclose any personal information when interacting with generative AI. In particular, participants should be familiarised with the risks and problems associated with generative AI (Kasneci et al., 2023).

Based on the above explanations, a number of prerequisites can be established for analysing the use of generative AI:

- Informing the study participants about the risks of using generative AI
- Data protection-friendly recording and evaluation of interactions
- The interaction between user and generative AI must be recorded
- The recording of interactions should be technically as simple as possible and not restrict or hinder the user
- The recording of a think-aloud protocol to better interpret the interactions can be useful

In our scenario this means screen recordings and audio recordings are preferable to log files. It may be ethically questionable to carry out screen recordings over a longer period of time. In our case, the screen recordings are only recorded on specially configured devices for the duration of the workshops and stored locally on the devices. The recordings are also not stored on the server of third parties during the further course of the analysis, but are analysed exclusively on university computers (see below).

5   Setup and Implementation

In this section, we want to describe and specify the setup and implementation of hard- and software used during our research and also point to alternative procedures. As mentioned above, we had two goals in mind when designing our research approach: Our first goal is to record the interactions of individuals or a working group with an AI text generator. Our second goal is to prepare the recordings so that they can be imported into QDA software and analysed. Time stamps can be used to ensure that the screen recordings and transcribed content can be kept synchronised and analysed.

The implementation can be divided into three parts: Data collection, data preparation and data transcription. Data analyses is not part of our implementation and is independent of our approach.

5.1   Data Collection

The participants were provided with Apple iPads with external keyboards to use ChatGPT. There are several reasons for this: Firstly, iPads represent a low-threshold option for using generative AI, as the user interface differs only slightly from smartphones. iPads also offer the option built into the operating system of making screen recordings, including an audio track from the integrated microphone, and storing them locally on the device. iPads are also comparatively easy to transport and can be configured with the appropriate software so that participants only have access to ChatGPT (kiosk mode). While there is the possibility to use Android tablets during Literacy Promptathons through browser-based access to ChatGPT, we were unable to test kiosk mode or data collection via screen and audio recordings, due to the lack of Android tablets.

The screen and audio recordings must be started and stopped manually on the iPads. A solution for mobile device management was used to configure the devices (JAMF[10]), which makes it possible to configure several devices at the same time. In addition to activating the kiosk mode, this also prevented the screen orientation from being changed, making it easier to analyse the screen recordings later on.

We also tested external clip-on microphones as an alternative to the iPad's built-in microphone, but could not find any practical advantage. The recording of the iPad microphone is good enough, even in noisy environments, to enable an intelligible recording of the group discussions and later transcription.

To be able to use ChatGPT, the iPads also need access to the Internet. We used an LTE router with mobile internet for this, but a normal Wi-Fi connection can also be used, depending on the conditions at the venue. As a backend for ChatGPT, we used a browser-based service provided by Fobizz[11], based in Germany. Fobizz provides digital and AI tools mainly for teachers and schools. Besides being available at our university, Fobizz offers two advantages when used in this context: Firstly, we can provide participants free and easy to administer access to ChatGPT during the workshops, secondly, as participants do not have to set up an account with ChatGPT, they do not have to submit any personal data and input to ChatGPT cannot be traced back to the individual participants. This allows us to provide participants with a GDPR compliant way to access ChatGPT. This is of course subject to the condition that participants do not enter any personal information while using ChatGPT. A similar service is provided by SchulKI[12] and was used in an earlier project.

5.2   Data Preparation

After the workshops, the recordings can be transferred to a computer for further processing. It is advisable to cut irrelevant parts of the videos, e. g., at the beginning. It is possible to import video recordings (including workgroup conversations in an audio track) into software for QDA, e. g., MAXQDA, for further analysis. Alternatively, the

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10 https://www.jamf.com/
11 https://fobizz.com/
12 https://schulki.de/

audio track can be extracted from the video file, cut, and imported into the software. Helpful and free tools here are DaVinci Resolve (video cutting), VLC (extracting audio), and Audacity (audio cutting).

Since our goal was to go one step further and also transcribe the audio recordings and extract user input and AI output from the screen recordings, we used Python and several freely available software packages to implement transcriptions of audio and ChatGPT input/output. In the following, we will describe the fundamental steps necessary to transcribe the video and audio recordings. Transcriptions can be imported into software for QDA to complement the video or audio files. Automatically generated timestamps allow transcripts to be synchronised with the corresponding video or audio files in the QDA software.

5.3 Transcription

Data transcription was implemented using the programming language Python[13]. One advantage of Python is that there is a large library of free packages that extend the functionality of Python and provide functions for numerous use cases, such as speech and text recognition.

5.3.1 Audio Transcription

We use OpenAI's open-source automatic speech recognition system Whisper[14] to transcribe audio. Unlike ChatGPT, Whisper runs on a local computer and no data is therefore transferred to a third party. The disadvantage of local execution is that the speed of transcription depends on the computer on which the software is executed. Transcription therefore takes a comparatively long time on a laptop without a dedicated graphics card, whereas a computer with a built-in graphics card is significantly faster. The duration also depends on the chosen AI model, where large models take longer but provide better results than smaller models.

In our implementation, we use the Python package faster-whisper,[15] which reimplements Whisper in a faster and easier-to-use way. After extracting the audio from the screen capture video, faster-whisper re-encodes the audio to fit Whisper's requirements automatically. It is also possible to specify the language and different execution parameters. The transcription with timestamps is saved in a text file and can be imported into software for QDA.

5.3.2 Text Transcription

The goal of text transcription here is to capture user input in ChatGPT (or other generative text AIs) and save it in a way that is easy to analyse or present, e. g., in an article or presentation. Optical character recognition (OCR) software is not suited extracting text from videos. To extract text, video has to be disassembled into individual frames and saved as images, which can be handled like pictures of text (e. g., scanned documents).

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13 We are currently preparing the release of the source code. It will be published on the project's website: https://uhh.de/ewkip
14 https://openai.com/index/whisper/
15 https://github.com/SYSTRAN/faster-whisper

The videos captured on the iPads have approximately 24 frames per second. Extracting all frames and using OCR to extract text would result in a lot of redundant information, because new user input or AI output is not visible on every frame. It is therefore necessary to choose a sensible interval for frame extraction (e.g., a few seconds) and check the extracted frames for duplicates. Since the screen capture not only contains the interactions with the AI but also surrounding text, like the day and time in the top bar, it is also advisable to crop the extracted frames to contain only relevant text (see Fig. 1). After the preparation of the images we used the well-established and opensource software Tesseract[16] to extract text and save it to a text file. Like Whisper, Tesseract runs locally.
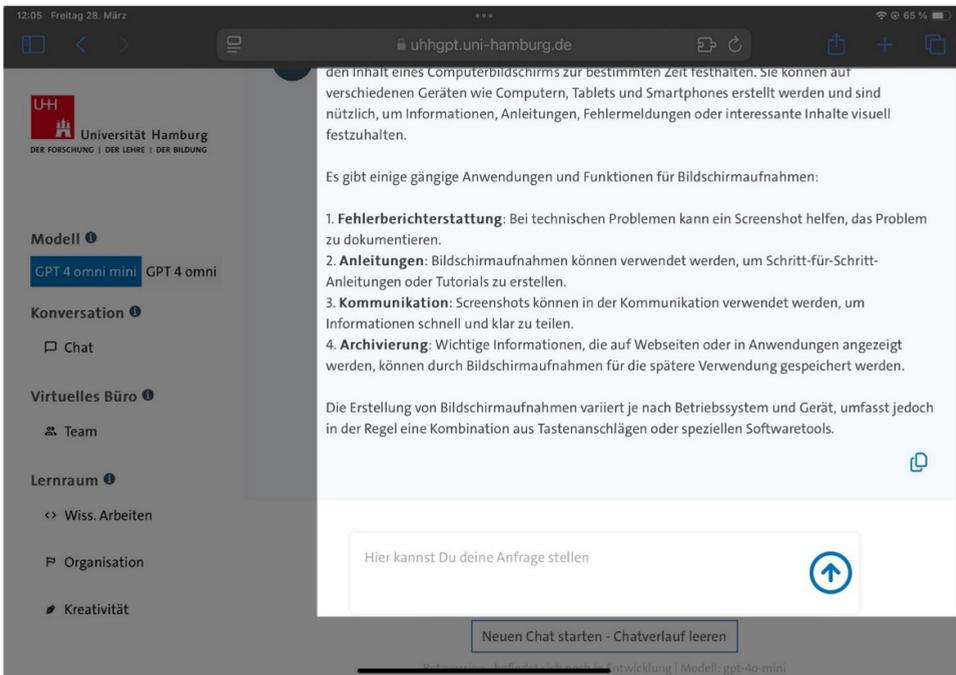
Figure 1: Screenshot of ChatGPTs user interface (UI) and surrounding UI elements. The screen areas not required for the analyses are greyed out and can be cut off (cropped) before text recognition.

5.3.3   Quality Assessment

In regards to audio transcription, the results of Whisper are in general very good and comparable to costly online services. Nevertheless, results are not perfect, require rework before analysis and we also encountered some systematic issues:

- Names are often recognised wrongly
- When a speaker starts a sentence, stops mid-sentence and starts anew, Whisper often excludes the incomplete sentence

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16   https://github.com/tesseract-ocr/tesseract

- Sometimes Whisper 'forgets' to transcribe complete sentences
- Whisper 'hallucinates' or invents pointless words when it cannot understand the spoken word (Koenecke et al., 2024)
- Whisper seems to have problems with audio compression artifacts encountered during online conversations (e. g., Zoom)

In regards to video text transcription, our approach is still not optimal and can result in large amounts of text per video. The recognised text is also not well formatted which requires review by the user. We, therefore, advise to only use this technique for parts of the video relevant to further research.

Figure 2 shows a flow chart of the proposed method, showing each step needed to transcribe video and audio recordings.
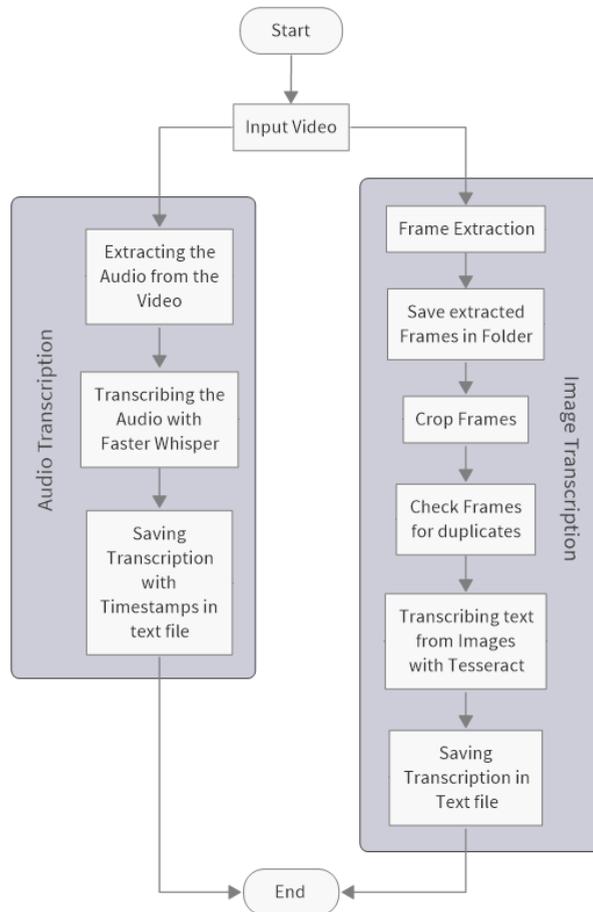
Figure 2: Flow chart for transcribing audio and video from screen recordings

Upon request, the source code for our implementation can be obtained from the authors.

In the next section, we present two research projects in which we have implemented the approach described above.

6   Application Scenarios

One tried and tested use case in adult education is the so-called Literacy Promptathon. Literacy Promptathons are based on a hackathon, which is a problem-solving format known in software engineering with the aim to find (software-)solutions to a given problem during a fixed time window (Briscoe & Mulligan, 2014). A Prompt-a-thon is similar to a hackathon but the problem solving is achieved by prompt engineering in an application based on generative AI (Brackel-Schmidt et al., 2023; Kučević et al., 2024).

During a Literacy Promptathon, participants work in small teams of 2 to 4 people to solve written language-based challenges by prompting and evaluating the outputs of generative AI to adapt their own prompts until a satisfactory outcome is reached (Grotlüschen, Skowranek, & Buddeberg, 2023; Grotlüschen, Skowranek, Buddeberg, et al., 2023). This format was tested in reading and writing courses and language courses for mothers with ChatGPT 3.5. The Literacy Promptathons are an example of exploring the dynamics of AI usage, as they facilitate meaningful engagement with generative AI among low-literate adults in a supportive environment, thereby underscoring the importance of guiding learners through the intricacies of these digital tools.

Skowranek (in Review) uses the approach described above to analyse screen recordings from the Literacy Promptathons. She uses the data to investigate how low-literate adults use generative AI without knowledge of prompt engineering or prompting strategies. The author finds that low-literate adults demonstrate an intuitive understanding of how to use generative AI, but rarely doubt the results of ChatGPT.

Another use case for the described scenario are workshops in the context of counselling. During the counselling workshops, teams simulate counselling on the basis of given or self-selected tasks. Through this approach use cases for generative AI in counselling can be tested in different fields of counselling. This approach is currently being tested using the example of care counselling as part of the research project AI in Care Counselling (KI in der Pflegeberatung – KIP), funded by the Federal Ministry of Education and Research (BMBF). Another use case in adult education could be in career guiding and counselling (Stanik, 2023).

7   Conclusion

In summary, the integration of artificial intelligence into adult education presents both formidable challenges and promising opportunities. While generative AI offers innova-

tive solutions for enhancing learning processes, it also raises critical concerns around ethics, bias, and misinformation. As adult education stakeholders navigate this complex landscape, it becomes crucial to understand how individuals interact with AI technologies, ensuring that they can leverage the benefits while minimising potential risks.

Our approach can be used to analyse various questions relating to the use of AI. On the user side, how is generative AI generally used? Are prompting strategies used? On which topics is the AI used? What questions and problems arise during use? Concerning the output of the AI, it can be examined in particular whether it reacts appropriately and is suitable for certain use cases, e. g., in counselling.

Our examples for implementing our approach show the necessity for adult education research to foster a nuanced understanding of generative AI's role in both teaching and learning practices becomes clear. By advocating for responsible usage and critical reflection, we can empower learners to harness AI's potential to augment their educational experience. Integrating AI into curricula, such as by including prompt engineering, can not only enhance individual learning outcomes but also contribute to the broader goal of digital literacy among diverse populations. In light of these insights, it remains imperative for educators and researchers to collaborate in developing sustainable strategies for implementing AI in educational settings.

Finally, the methodological advancements we explored, particularly the combination of screen capturing and audio recordings, illustrate the potential of qualitative research to better understand user behaviour with AI tools. Our approach allows the simultaneous analysis of screen recordings, transcribed interaction with the AI and conversations that take place in the groups. These innovative approaches will enable researchers to gain deeper insights into how generative AI shapes learning experiences and facilitates collaborative problem-solving.

Nevertheless, there is still room for improvement. One problem is the large amount of text that is generated when individual frames of a video are transcribed. It would be possible to recognise and merge related text from different frames. However, this is beyond our capabilities and resources. Another way to deal with large amounts of text would be to use AI tools. When implementing our approach, other researchers may also face the problem that the necessary technical equipment is not available. We hope that with our contribution we have at least demonstrated a method of how interaction with AI text generators can be researched.

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Adult Education Research on Digitalisation

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