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RESEARCH ARTICLE

A dyadic training to promote technology-related learning and development among age-diverse employees: The power of coworkers' enthusiasm

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Abstract

Age diversity and digitalization create challenges and opportunities for learning and development in organizations. In this study, we designed and tested an age diversity training for digitized work contexts to promote informal workplace learning in age-diverse coworker dyads. The dyadic training frames age differences as an untapped developmental opportunity at digitized workplaces, enabling younger and older coworkers to benefit from each other's complementary resources. By integrating theoretical perspectives on informal learning and training transfer, we conceptualize digital collaboration readiness as a self-regulatory transfer mechanism linking the training to developmental outcomes. We further recognize the social context as a catalyst for individual and mutual learning and argue that training effectiveness is bound by co-learner's enthusiasm about digital technologies. Based on a randomized controlled field experiment with 167 age-diverse dyads ($N = 334$ employees), our results showed that the training had a positive conditional indirect effect on technology exploration and mutual learning via digital collaboration readiness if the dyad partner was more enthusiastic about technology. Our research advances the literature at the intersection of age diversity and digitalization by delineating how and when the age diversity training for digitized work contexts can enhance workplace learning. This study also promotes the advancement of evidence-based management of age-diverse workforces.

KEYWORDS

age diversity, informal workplace learning and development, mutual learning, peer support, technology exploration

Practitioner points

- This study provides a blueprint for dyadic age diversity training in digitized work contexts. We tested the training for younger and older coworkers in a field experiment.
- The training focuses on age-diverse strengths to promote readiness for technology exploration and mutual learning.
- We found that training effectiveness for technology-related learning hinges on coworkers' enthusiasm towards technology.
- This study highlights informal learning among age-diverse co-learners to promote continuous development in organizations facing increasing digitalization.

To leverage the potential of age-diverse workforces in digital work environments, organizations need to enable employees to learn from and with coworkers of different ages effectively. This is generally important because older and younger coworkers can offer each other access to valuable and complementary resources (e.g., mental health and job satisfaction; see Bednall & Sanders, 2017; Li et al., 2021). For example, older employees may provide better socio-emotional skills, whereas younger employees may provide more up-to-date technological knowledge (Mothe & Nguyen-Thi, 2021; Pfrombeck et al., 2023). In digitized work environments, this could be particularly true because older and younger employees may underestimate their mutual developmental potential due to negative age stereotypes about engagement with technology at work (Hampel & Kunze, 2023; Lagacé et al., 2016). For example, younger employees are often referred to as technology-obsessed digital natives, whereas older employees are often viewed as technology-sceptical digital immigrants (Chang et al., 2023; Fazi et al., 2025). As the social context appears to be particularly challenging at the intersection of age diversity and digitization, we need to better understand how and when formal age diversity training can enable age-diverse co-learners to pursue technology-related learning and development.

Formal training can trigger active engagement in informal workplace learning, individually and with others (Ford et al., 2018; Wolfson et al., 2018). However, the training transfer literature highlights that formal training interventions do not automatically translate into informal workplace learning behaviours (Salamon et al., 2023; Wolfson et al., 2018). Motivational and self-regulatory mechanisms, as well as employees' social context, are critical for whether training can function as a catalyst for learning and development (Ford et al., 2018; Massenberg et al., 2015). Studies on age diversity training have yet to adopt this lens and specify how and when training influences developmental processes and outcomes (e.g., Jungmann et al., 2020; Schloegel et al., 2016). Previous age diversity training research has demonstrated positive effects on attitudinal outcomes (e.g., age stereotypes and intergenerational attitudes; see Jungmann et al., 2020; Sun et al., 2019), well-being outcomes (e.g., satisfaction and mental health; see Beyer et al., 2019; Egan & Song, 2008) and interpersonal outcomes (e.g., relationship quality and knowledge exchange; see Burmeister et al., 2021). However, research has yet to examine the potential of dyadic age diversity training to act as a catalyst for older and younger coworkers' informal learning.

This calls for a more comprehensive understanding of the role of age diversity training by deciphering its boundary conditions and underlying mechanisms (Burmeister et al., 2021; Roberson et al., 2022). The role of age-diverse coworkers in shaping the effects of dyadic age diversity training is particularly important because, as co-learners, they represent employees' social work context, which is crucial for training transfer (Ford et al., 2018; Massenberg et al., 2015). Research shows that coworkers can influence each other's developmental processes (Li et al., 2017; Ragins & Verbos, 2017), adoption of new technologies (Venkatesh et al., 2003) and investment in workplace learning beyond formal training (Ford et al., 2018; Tannenbaum & Wolfson, 2022). More specifically, coworkers' enthusiasm about technology may be contagious and create positive social norms around digitization (Tams, 2022; Trenerry

et al., 2021), which affect technology-related knowledge sharing and learning (Fasbender et al., 2023; Flinchbaugh et al., 2018). It therefore seems crucial to understand the technology-related attitudes of age-diverse coworkers as a boundary condition of the effects of dyadic age diversity training for digitized work contexts.

Grounded in theorizing on informal learning and training transfer, we propose a contingency perspective to decipher how dyadic age diversity training can facilitate informal technology-related learning and development. Hereby, we build on opportunity-oriented diversity perspectives more generally (e.g., Dwertmann et al., 2016; Ely & Thomas, 2001), reframing the intersection of age diversity and technology as an opportunity for collective development. This opportunity-oriented framing of the training emphasizes the complementary benefits of age-based strengths for age-diverse collaboration in digitized workplaces. Thereby, the training positions older and younger coworkers as reciprocal co-learners whose interactions foster mutual development (Burmeister et al., 2020). We specifically posit that the dyadic training increases interest and openness towards digital collaboration (i.e., digital collaboration readiness) and, in turn, facilitates informal workplace learning and development, both intrapersonally (i.e., technology exploration) and interpersonally (i.e., mutual learning among age diverse employees). Importantly, we theorize that the effectiveness of the dyadic age diversity training is contingent on the social context. We specifically argue that a dyad partner's technology enthusiasm (i.e., coworkers' eagerness and positive attitudes towards discovering, using and discussing new digital technologies and their implications in the workplace; Trenerry et al., 2021) is a key lever that unlocks the training's potential as a catalyst for personal readiness to engage in informal learning and development (Tannenbaum & Wolfson, 2022). To test our conceptual model, we conducted a randomized controlled field experiment in a large financial organization in Germany.

We aim to advance the literature at the intersection of age diversity, digitalization and workplace learning in three ways. First, we identify coworker influence as a relevant boundary condition for the effectiveness of dyadic age diversity training, which has yet to acknowledge this boundedness (e.g., Burmeister et al., 2021). Integrating literature on informal workplace learning (Tannenbaum & Wolfson, 2022) and training transfer (Ford et al., 2018), our model specifies coworker technology enthusiasm as a boundary condition for unlocking the potential of age-diversity training in digital work environments. Second, we extend the literature on the interplay of formal and informal workplace learning (Kittel & Seufert, 2023; Tannenbaum et al., 2024) by showing how our training can promote informal learning and development, via learners' readiness as a motivational and self-regulation transfer mechanism (Massenberg et al., 2015). By empirically testing how organizations can strengthen personal readiness for informal learning through training, we enable more precise theorizing and more targeted organizational training interventions. Third, we integrate training literature on age diversity and technology by developing a dyadic age diversity training for digitized work contexts that enables employees to learn from each other. Mutual learning has diversity-related implications in our study context because it signifies not merely learning from any coworker, but rather co-learning between younger and older employees. In doing so, we provide organizations with a validated tool to unlock the potential of their age-diverse workforces in digital work settings.

AGE DIVERSITY TRAINING FOR DIGITIZED WORK CONTEXTS

Research on age diversity training interventions and technology-related training interventions has developed in separate streams, despite the interdependencies of age and technology in modern workplaces. As an integrated literature is missing, we first discuss these separate literature streams and then present the conceptual integration on which our age diversity training for digitized work contexts is based.

Review of technology-related training literature

Research on technology-related training interventions has yet to recognize the potential of age-diverse learners for a wider spectrum of training outcomes, including individual and mutual learning and development. To date, technology-related training predominantly focuses on increasing the acceptance or adoption of domain-specific technologies, digital competencies or technology-related well-being (Cheng et al., 2011; Makowska-Tlomak et al., 2022; Ng et al., 2024; Richardson et al., 2023). For example, Ng et al. (2024) showed that variations in digital technology training content and trainer capability can improve academics' digital competencies regarding specific tools. Makowska-Tlomak et al. (2022) showed that online technology training can reduce technological stress. However, prior research largely leaves the effects of technology-related training on subsequent informal workplace learning and development insufficiently specified. Moreover, such interventions rarely foreground age, although lifespan research emphasizes its relevance for training design and implementation (Davenport et al., 2022). When age is considered, it is typically operationalized to examine differences in the effectiveness of digital training, for example, age differences in the acceptance of e-learning or mobile microlearning modules (e.g., Cheng et al., 2011; Richardson et al., 2023). Overall, existing research provides limited insight into how technology-related training supports learning and development among age-diverse employees in digitized workplaces.

Review of age diversity training literature

Although age diversity training can positively impact work-related outcomes, existing research remains narrowly focused on stereotype reduction and provides limited insight into its boundary conditions and underlying mechanisms. Indeed, age diversity training research has shown that organizations can successfully support age-diverse collaboration through training (Burmeister et al., 2021); for example, by reducing negative age stereotypes and conflicts (Jungmann et al., 2020), fostering positive age-diverse interactions (Sun et al., 2019) and increasing job satisfaction and commitment (Egan & Song, 2008). However, the majority of age diversity training, in line with diversity training more generally, is rooted in social identification and categorization theories and typically focused on reducing stereotypes and discrimination (Boehm & Dwertmann, 2015). Identity-based interventions draw upon perspectives that tend to emphasize challenges and differences (e.g., Beyer et al., 2019; Wegge & Bertolt, 2020), which can sometimes even reinforce age-based stereotypes (Burmeister et al., 2021). Despite their relevance, such narrow approaches ignore the potential of age-related opportunities, for example, learning from age-diverse co-learners.

Furthermore, prior research only provides limited insights into boundary conditions and underlying mechanisms of age diversity training. For example, regarding boundary conditions, Jungmann et al. (2020) showed that younger (vs. older) participants benefited more from leaders' age diversity training. Schloegel et al. (2016) demonstrated that their age diversity intervention had a greater effect for software developers (vs. non-developers). Regarding the underlying processes of age diversity interventions, research focused on psychosocial (Burmeister et al., 2021) and attitudinal processes (Levy et al., 2014). Taken together, existing age diversity training research provides an insufficient understanding of beneficial work-related outcomes beyond stereotyping and discrimination (e.g., informal learning and development) of the possible underlying self-regulatory processes that may translate the effects of age diversity training into workplace learning and development, and of social boundary conditions, such as co-learners' enthusiasm.

Age diversity training for digitized workplaces: An opportunity-oriented framing

To be an effective instrument for informal workplace learning, dyadic age diversity training for digitized work contexts needs to leverage the unique resources of employees of different ages as well as the

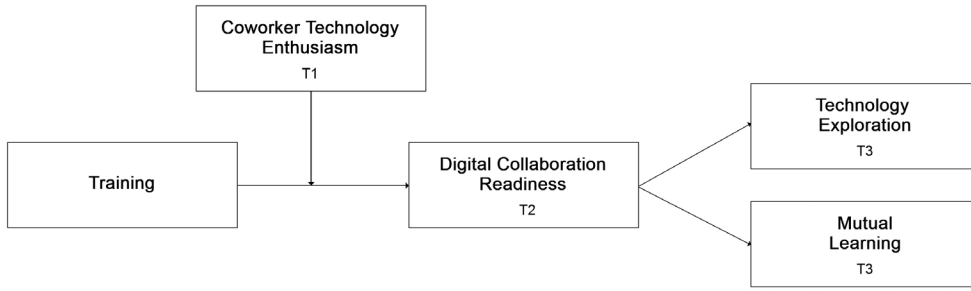

FIGURE 1 Conceptual model.

opportunities that digital technologies offer. In doing so, formal age-diversity training can be a catalyst for informal learning and development in digitized work contexts as theorized in literature on training transfer (Bell & Kozlowski, 2008; Ford et al., 2018) and informal workplace learning (Tannenbaum & Wolfson, 2022; Wolfson et al., 2018). Our age diversity training for digitized workplaces builds on opportunity-oriented diversity frameworks, such as the information/decision-making (Williams & O'Reilly, 1998) and the integration-and-learning perspective (Ely & Thomas, 2001). Hereby, demographic diversity, including age diversity, is understood to offer distinct resources that yield benefits when effectively integrated, leading to a broader range of abilities, different perspectives and better-informed decisions (Dwertmann et al., 2016; Van Knippenberg et al., 2004). Specifically, in digital work contexts, we frame age-based differences as a valuable source of complementary resources for collaboration and an opportunity for learning and development (Carter & Katherine, 2017; Li et al., 2021). This framing challenges deficit-oriented assumptions regarding age-based technological competencies and highlights the pool of complementary resources for learning. It positions age-diverse coworkers not merely as sources of unilateral support, but as reciprocal co-learners whose interactions can foster mutual learning unique to age-diverse workforces (Burmeister et al., 2020; Pfrombeck et al., 2023). The opportunity-oriented framing of age diversity and digital technologies informs our conceptual model and hypotheses development.

HYPOTHESES DEVELOPMENT

Dyadic age diversity training for digitized work contexts may promote informal workplace learning between older and younger coworkers by helping them access each other's diverse knowledge reservoirs (Bednall & Sanders, 2017; Kittel & Seufert, 2023). We assume that such training can direct employees' attention towards the opportunities of complementary age-related resources relevant in digitized work environments (Fasbender et al., 2023; Hampel & Kunze, 2023). The opportunity-oriented framing of the training promotes the strengths inherent in older and younger co-learners whose interactions foster mutual development unique to age-diverse workforces. Moreover, we propose that the social context must be considered to better understand coworkers' influence on training effectiveness. Our conceptual model is shown in Figure 1.

Training effect on digital collaboration readiness

We first posit that our opportunity-oriented age diversity training for digitized work contexts has a positive effect on learners' readiness for engagement in workplace learning and development (Schilpzand et al., 2025; Tannenbaum & Wolfson, 2022). Drawing on informal workplace learning theory by Tannenbaum and Wolfson (2022), we conceptualize *digital collaboration readiness* as the learner's overall action readiness to engage in informal technology-related learning and development. It describes

employees' active regulation by generating, pursuing, and adjusting developmental goals, indicating an overall personal readiness to improve collaboration through technology (Hirschi et al., 2021; Schilpzand et al., 2025). Aligned with the continuous, self-directed character of informal workplace learning (Tannenbaum & Wolfson, 2022), planning is not only related to creating plans but also to adapting development goals in the process (Hirschi et al., 2021).

We argue that our age diversity training for digitized work contexts increases digital collaboration readiness because it orients employees towards the potentially underutilized opportunities inherent in age-diverse interactions and digital technologies. First, the training can help to identify development opportunities among age-diverse co-learners through reflection. This can help participants to exert self-regulatory control over their learning and facilitate involvement in each other's learning process (Devine & Ash, 2022; Ely & Thomas, 2001). Specifically, the training can support co-learners to specify self-directed digital learning goals according to their potentially differential age-based needs. The training also prompts age-diverse co-learners to think about and anticipate collaborative and technology-related learning opportunities (Dwertmann et al., 2016; Hirschi et al., 2021). Second, we argue that the training may raise participants' recognition of the complementary value of age-based resources as learning opportunities. This helps to overcome categorical and stereotypical beliefs in age-diverse and digitized workplaces, while strengthening beneficial socio-relational processes (Burmeister et al., 2021; Ely & Thomas, 2001). Through interactions and reflection between older and younger coworkers, this can promote readiness for mutual development that is unique to age-diverse workforces with complementary age-related strengths (Burmeister et al., 2020).

Taken together, we propose that our training promotes digital collaboration readiness.

Hypothesis 1. *The dyadic age diversity training for digitized work contexts has a positive effect on an employee's digital collaboration readiness.*

Coworkers' technology enthusiasm: Amplifying training effectiveness

Integrating theorizing on informal workplace learning (Tannenbaum & Wolfson, 2022) and training transfer (Ford et al., 2018), we argue that the co-learner's technology enthusiasm is crucial to unlock the full benefits of dyadic age diversity training for digitized work contexts. *Coworker technology enthusiasm* is understood as the eagerness and positive attitudes towards discovering, using and discussing new digital technologies and their implications in the workplace (Trenerry et al., 2021) and represents a context-specific form of social influence.

Social influence refers to the degree to which individuals adopt behaviours based on how the actions and attitudes of coworkers are perceived (Flinchbaugh et al., 2018). It can manifest through coworkers' behaviours (e.g., feedback) or motivational aspects (e.g., openness), facilitating learning and utilization of digital technology as a contagious resource for learning (Snoeren et al., 2016; Zeike et al., 2019). Through comparison and normative influence, employees are likely to adopt positive attitudes or behaviours from coworkers who spread curiosity or optimism (Fredrickson, 2004; Li et al., 2017). As such, enthusiasm can serve as a social stimulus that sparks positive emotions and broadens the focal employee's momentary thought-action repertoires, for example, openness or joy in putting the training content to use (Ely & Thomas, 2001; Tyng et al., 2017). A co-learner who is enthusiastic about technology may create a stronger shared energy and synchronized positive emotions towards the technology-focused training content (Fredrickson, 2004; Marchand & Gutierrez, 2012). This is likely to spark interest and courage to explore, thus facilitating active engagement in technology-related learning (Cerasoli et al., 2018; Ely & Thomas, 2001). This view aligns with the training transfer literature, which underscores the importance of the social environment, including coworkers' support, for learning and development beyond training, such as transfer motivation (Massenberg et al., 2015; Salamon et al., 2023; Wolfson et al., 2014).

In our dyadic training setting, coworker technology enthusiasm may amplify the training's opportunity-oriented framing by setting an example in seeing positive aspects of a digital transformation. This can create a learning environment to invest more effort in planning and pursuing their self-directed learning (Keith & Frese, 2005; Tannenbaum & Wolfson, 2022). A coworker who perceives the use of technology as fun or thinks that technology makes work more interesting can help to perceive digital technology as an opportunity rather than a threat. This may enable more positive conversations about the unique age-diverse contributions in a digital work setting or raise sensitivity regarding hindering learning aspects of the dyadic age-diverse coworker's technology-related learning (Ely & Thomas, 2001; Tyng et al., 2017). If an age-diverse peer is enthusiastic about technology, the positive social norms around digital technologies will make them more approachable as a source of technology-related learning (Gerpott et al., 2017; Tams, 2022). In sum, we propose that coworker technology enthusiasm amplifies the positive effect of our dyadic training on digital collaboration readiness.

Hypothesis 2. *The positive effect of dyadic age diversity training for digitized work contexts on digital collaboration readiness is moderated by coworker technology enthusiasm, such that the positive effect will be stronger if the technology enthusiasm of the co-learner is higher (vs. lower).*

From readiness to learning: Increasing technology exploration and mutual learning

Drawing on the informal workplace learning perspective (Tannenbaum & Wolfson, 2022), we furthermore argue that digital collaboration readiness is positively related to informal learning and development, specified as technology exploration and mutual learning. The informal learning literature broadly distinguishes between intrapersonal (e.g., experimenting) and interpersonal (e.g., observing) behaviours (Jeong et al., 2018). A central mechanism is learners' readiness, encompassing the capability, awareness and motivation to engage in informal learning behaviours (Wolfson et al., 2018). This conceptualization is consistent with the training transfer literature that has emphasized self-regulative mechanisms as key drivers for learning transfer beyond training (Ford et al., 2018; Massenberg et al., 2015; Salamon et al., 2023). For example, Ford et al. (2018) concluded in their review that the transfer resides with each participant, emphasizing the importance of individual readiness, as suggested in the informal learning literature (Wolfson et al., 2014). We thus propose that digital collaboration readiness enables employees to translate formal training input into both intrapersonal and interpersonal informal learning and development in digital work environments.

First, digital collaboration readiness can facilitate technology exploration because it promotes the self-directed and intentional nature of informal learning (Beier et al., 2025; Tannenbaum & Wolfson, 2022). Technology exploration refers to behaviours intended to expand the scope of technology use by incorporating existing technologies in new tasks, using known technologies in new ways or experimenting with new technologies (Maruping & Magni, 2015). We argue that digital collaboration readiness supports employees' active regulation by providing goal orientation, technology-related on-the-job learning opportunities and acceptance for making errors in the learning process (Beier et al., 2025; Hirschi et al., 2021). Hereby, learners have the awareness and capabilities to monitor their work environment to plan and adjust their own technology-related learning, thus exerting self-regulatory control over their own development to improve digital collaboration (Devine & Ash, 2022). Technology exploration as an intrapersonal form of informal learning offers employees the flexibility to adjust their informal technology-related learning and development to idiosyncratic (e.g., age-related differences) learning needs and resources (Davenport et al., 2022).

Second, digital collaboration readiness may encourage mutual learning because it builds on the relational nature of informal learning (Bell & Kozlowski, 2008; Cerasoli et al., 2018). Mutual learning encompasses knowledge sharing, observing and giving feedback (Johnson & Johnson, 2015; Tannenbaum & Wolfson, 2022). In our study context, mutual learning is both a learning behaviour and an indicator

of a strengthened age-diverse relationship because the co-learners are younger and older coworkers. We argue that digital collaboration readiness supports employees' active regulation by raising the motivation to learn from and with age-diverse others, as well as the awareness of complementary technology-related learning benefits and age-based resources (Hirschi et al., 2021; Wolfson et al., 2014). In doing so, learners are likely to identify potential learning opportunities and instrumentalize socio-relational processes for reciprocal learning, eventually leading to improved collaboration with their age-diverse dyad partner (Ely & Thomas, 2001). Mutual learning with coworkers of different ages can thus have cognitive and motivational benefits that are unique to age-diverse workforces (Burmeister et al., 2020; Pfrombeck et al., 2023). For technology-related learning, this is particularly important because older and younger employees may underestimate their mutual developmental potential (Hampel & Kunze, 2023; Lagacé et al., 2016).

Taken together, we argue that by planning a proactive and intentional exposure to digital technology and collaborative learning with age-diverse coworkers, digital collaboration readiness is positively related to both technology exploration and mutual learning.

Hypothesis 3. *Digital collaboration readiness is positively associated with (a) technology exploration and (b) mutual learning.*

By integrating our arguments made in Hypotheses 1 and 3, we propose an indirect effect of our training on employees' informal learning behaviours at work (Hypotheses 4a and 4b). By increasing employees' digital collaboration readiness, the training can stimulate motivational and self-regulatory processes that encourage learners to engage in personal development, indirectly promoting technology exploration and mutual learning (Ford et al., 2018; Hirschi et al., 2021; Tannenbaum & Wolfson, 2022).

Hypothesis 4. *The dyadic age diversity training for digitized work contexts has a positive indirect effect on (a) technology exploration and (b) mutual learning*, via *digital collaboration readiness.*

We further suggest a conditional indirect effect by integrating Hypotheses 2 and 3, and propose that coworker technology enthusiasm amplifies the indirect effect of our training (Hypotheses 5a and 5b). By being enthusiastic about technology, a co-learner can unlock the full potential of our age diversity training that promotes technology exploration and mutual learning through the active regulation of digital collaboration readiness (Salamon et al., 2023; Tannenbaum & Wolfson, 2022).

Hypothesis 5. *Coworker technology enthusiasm moderates the indirect effects of the dyadic age diversity training for digitized work contexts on (a) technology exploration and (b) mutual learning* via *digital collaboration readiness in the first stage, such that the positive indirect effects will be stronger if the technology enthusiasm of the co-learner is higher (vs. lower).*

METHOD

Procedure and sample

We conducted and tested the effectiveness of our training in a randomized controlled field experiment with a sample of age-diverse coworker dyads from a large financial organization based in Germany with around 10,000 employees. Participants represented a broad range of functional areas, including Information Technology (IT), Human Resources, Bank Advisory and Sales or Risk and Credit Management. Overall, the sample consisted of white-collar employees, most of whom can be classified as knowledge workers or employees in operations and support functions, who use digital technologies to analyse information, collaborate digitally and deliver different services to internal or external clients. To recruit age-diverse dyads, a call for participation was published by the company's Human

TABLE 1 Demographics across experimental groups.

group	% females	% same gender dyads	Age		Dyadic age difference		Organizational tenure		Dyad tenure	
			M	SD	*M*	SD	*M*	SD	*M*	SD
Intervention group	54.9%	58.8%	42.8	12.7	22.0	6.3	17.4	11.3	3.8	3.8
Waiting control group	59.4%	56.1%	42.5	12.6	22.1	7.0	17.7	12.2	4.0	3.8

Note: We found no significant ($p<.05$) baseline differences across the experimental groups on the focal variables (i.e., digital collaboration readiness, coworker technology enthusiasm, technology exploration, mutual learning), and across demographic variables (e.g., chronological age, gender, dyadic age difference).

Resources team. Two employees jointly signed up for the study as an age-diverse dyad. Participation in the study was voluntary, non-incentivized and the training took place during standard working hours. Age-diverse coworkers could sign up as a dyad if they met three inclusion criteria: (1) the age difference was at least 10 years, (2) they were working together in a collaborative work setting (e.g., interdependent tasks), and (3) the dyad partners were not in a hierarchical relationship (e.g., no direct reports). These criteria were based on existing research with age-diverse coworker dyads to eliminate bias due to power and status differences in hierarchical relationships and allow for mutual learning opportunities (Burmeister et al., 2021; Horn et al., 1998).

Data collection took place over a time span of 12 weeks. Participation in this study involved one training session and three online surveys (i.e., T1: baseline survey, T2: midline survey, T3: endline survey). At the start of the study, we randomly assigned dyads to either the intervention group or the waiting control group and invited all participants via email to the baseline survey. With the baseline survey, we collected sociodemographic information and our moderator variable (i.e., coworker technology enthusiasm). The midline survey was distributed right after training of the intervention group to assess the proposed mediating mechanism (i.e., digital collaboration readiness). The endline survey was administered 8 weeks after training of the intervention group to collect data on the dependent variables (i.e., technology exploration, mutual learning). The waiting control group received the training after the completion of the endline survey.

In total, 346 individuals in 173 age-diverse dyads signed up for the study. The coworker dyads were randomly assigned to either the intervention group ($n=87$ dyads) or the waiting control group ($n=86$ dyads). Dyads whose participants had actively withdrawn from the study or did not participate in one survey ($n=12$, 3.5%) were excluded from the analysis. A total number of 334 individuals, nested in 167 dyads, were used for analysis. The demographics of the two training groups are shown in Table 1. Overall, 57.2% of the participants were female, and 57.5% of dyads were gender-homogeneous. The average age was 42.7 years (SD = 12.6), ranging from 21 to 69 years, and the average age difference between dyad members was 22.1 years (SD = 6.6). The average organizational tenure was 17.6 years (SD = 11.8), and dyad partners knew each other on average for 3.7 years (SD = 3.6). Almost all participants (95.0%) had completed a tertiary education (i.e., apprenticeship, diploma, university degree).

Training design

The training took place in person and involved the participation of both dyad partners at the same time. It was administered in German and lasted for 4 h. Each training session included between 8 and 12 age-diverse coworker dyads. The structure of the training is shown in the Appendix (see Figure A1). We included different training activities and allowed for a high level of participant interaction. The training design and content were built on our opportunity-oriented perspective of age diversity, understanding age as a resource for digital collaboration that yields benefits when effectively integrated. It consisted of scientific inputs from the trainer, followed by reflections in age-diverse dyads, and plenary discussions to integrate learning across participating dyads. At the

end, the dyads developed an individual as well as a joint action plan to support each other in their technology-related development beyond training.

The first module framed age diversity as an opportunity, where dyads reflected on their perceptions of the opposite age group and shared experiences of stereotypical, discriminatory or inclusive behaviour based on age. The module aimed to increase awareness of age-based categorization and the often simplistic or biased nature of intergenerational views, especially regarding the use of technology. By emphasizing the developmental potential and synergies between age groups, the module encouraged a more differentiated and opportunity-oriented perspective on age diversity. The second module focused on development opportunities, where dyads explored how age-specific resources, such as technology literacy and experience, can complement each other to create a shared resource portfolio to improve digital collaboration. By understanding and visualizing how different age groups contribute to digital transformation in unique, sometimes unexpected, and complementary ways, the second module aimed to frame the intersection of digital technology and age as a reciprocal learning opportunity.

The intervention materials (i.e., training notes, slides) and data analytics script are available on OSF (osf.io/de5xw/) under a CC BY 4.0 licence. The data are not publicly available due to their proprietary nature and the data confidentiality agreement with the partner organization in which the field experiment was conducted. The data is available upon request.

Measures

Surveys were administered in German, and items were translated and back-translated following standard procedures (e.g., Brislin, 1970). If not indicated otherwise, all measures were assessed on 7-point Likert-type scales (1 = *strongly disagree*, 7 = *strongly agree*). The items are displayed in the Appendix.

Training

The random assignment to the training at the dyad level was coded as a dummy variable (1 = intervention group, 0 = waiting control group).

Coworker technology enthusiasm

At Time 1, coworker technology enthusiasm was measured with four items by Venkatesh et al. (2003). Participants assessed the degree to which their dyad partner is enthusiastic about digital technologies. A sample item was: 'My coworker thinks working with new digital technology is fun.' Cronbach's alpha was .96.

Digital collaboration readiness

At Time 2, digital collaboration readiness was measured with the three planning items of the action regulation scale by Hirschi et al. (2021). For the present study, the items were adapted to the context of digital collaboration. Participants indicated the degree to which they engage in planning behaviour on how to use technology to improve digital collaboration. A sample item was: 'I think about different options to achieve my goals for improved digital collaboration.' Cronbach's alpha was .81.

Technology exploration

At Time 3, technology exploration was assessed with three items by Nambisan et al. (1999). Participants indicated the degree to which they explore new digital technologies and use existing ones in new ways to work more effectively (Maruping & Magni, 2015). A sample item was: 'I explore ways that the digital technologies I'm using may enhance my effectiveness.' Cronbach's alpha was .90.

Mutual learning

At Time 3, mutual learning was measured with five items from the mutual learning for mentoring scale by Allen and Eby (2003). We adapted the items to the context of the dyadic intervention setting. Participants indicated the degree to which they learn from and with their dyadic partner. A sample item was: 'My coworker and I learn a lot from each other.' Cronbach's alpha was .95.

Analytic strategy

Our employee-level data (n=334) were nested within age-diverse coworker dyads (n=167), consisting of one older and one younger coworker. To ensure unbiased standard errors and coefficient estimates, we addressed this nonindependence by designating the dyad as the grouping variable in our multilevel regression analyses (Bliese & Hanges, 2004; Klein & Kozlowski, 2000). We used the lme4 package in R with model-based standard errors (REML), which provides larger and more accurate standard errors for the random effects by accounting for the uncertainty in estimating the variance components themselves (Bates et al., 2015). Examining the missingness of the data showed that, in total, 89.9% of the participants provided complete item-level data, and in total, only 5.6% of values were missing. Missing data were handled according to recommendations, adopting multiple imputation to create unbiased parameter estimates and accurate standard errors (Newman, 2014). We used the mice package in R (Van Buuren & Groothuis-Oudshoorn, 2011), creating 10 imputed datasets for repeated analyses and pooled results (Sinharay et al., 2001). All analyses were executed using R, version 4.4.3 (R Core Team, 2025).

Applying multilevel regression analyses, we fitted linear mixed-effects models via restricted maximum likelihood estimation. To test H1, we regressed digital collaboration readiness onto the training. To test H2, we regressed digital collaboration readiness, coworker technology enthusiasm (grand-mean centred), and the interaction effect onto the training. To further examine the moderating effect, we examined and plotted (Figure 2) the slopes at different values, specifically −1 SD, mean and +1 SD (Aiken et al., 1990). To test H3, we regressed technology exploration and mutual learning onto digital collaboration readiness, controlling for the training. To test the indirect and conditional indirect effects, we applied parametric bootstrapping using the Monte Carlo method with 20,000 replications, constructing 95% confidence intervals (CIs) (Preacher et al., 2007). To test Hypothesis 4, we examined the indirect effects of the training on technology exploration and mutual learning via digital collaboration readiness. To test Hypothesis 5, we examined the conditional indirect effects of the training on technology exploration and mutual learning via digital collaboration readiness, contingent on coworker technology enthusiasm. We report the index of moderated mediation (Hayes, 2015).

RESULTS

Preliminary analyses

Table 2 reports the means, standard deviations and intercorrelations of the study variables. To verify successful randomization, we conducted t-tests on the focal variables and age-related demographic

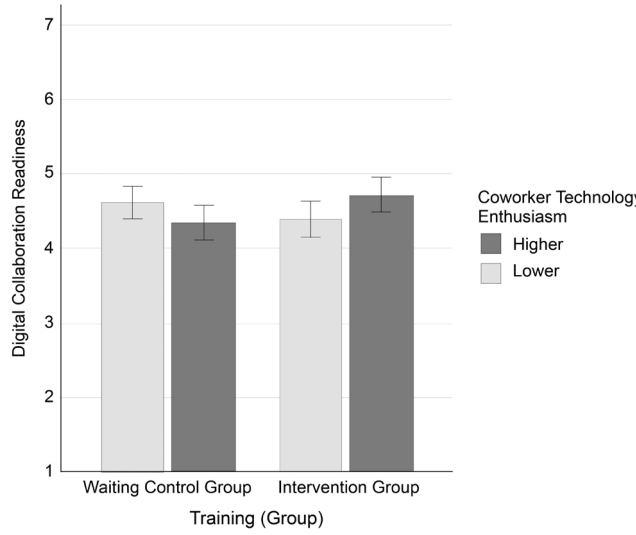

FIGURE 2 Interaction chart at different levels of coworker technology enthusiasm.

TABLE 2 Means, standard deviations and intercorrelations of the focal variables.

Variable	*M*	SD	1	2	3	4
1. Training	.51	.50				
2. Coworker technology enthusiasm (T1)	5.42	1.19	−.03			
3. Digital collaboration readiness (T2)	4.54	1.06	.01	−.00		
4. Technology exploration (T3)	4.86	1.08	−.08	.02	.50**	
5. Mutual learning (T3)	5.47	1.03	.07	.27**	.18*	.19*

Note: $N = 167$ dyads (334 participants). All survey measures were assessed on 7-point Likert-type scales (1 = strongly disagree, 7 = strongly agree); the training was coded as a dummy variable (0 = waiting control group, 1 = intervention group).
*$p < .05$. **$p < .001$.

variables (i.e., chronological age, subjective age, dyad age difference, organizational tenure, functional experience). We found no significant pre-baseline differences on the focal variables: digital collaboration readiness ($t = -.64$, $p = .52$), coworker technology enthusiasm ($t = .79$, $p = .43$), technology exploration ($t = 1.29$, $p = .20$) and mutual learning ($t = .28$, $p = .78$). We also found no significant differences on the age-related demographic variables. Since there were no meaningful differences, results are presented without control variables in line with recommendations (Spector & Brannick, 2011).

We conducted a confirmatory factor analysis (CFA) to examine the construct validity of the focal multi-item variables (i.e., digital collaboration readiness, technology exploration, mutual learning, coworker technology enthusiasm). The proposed four-factor model yielded a good model fit ($\chi^2[84] = 134.44$, $p < .001$, CFI = .99, RMSEA = .05, SRMR = .03), which was superior to alternative models, such as a three-factor model where technology exploration and mutual learning loaded on one factor ($\chi^2[87] = 641.26$, $p < .001$, CFI = .83, RMSEA = .16, SRMR = .14). We further tested two-factor and one-factor models, which yielded less acceptable model fits. The detailed information on these additional analyses is available in the online appendix on OSF (osf.io/de5xw/). The factor loadings on the item level for the four-factor model are reported in the Appendix (see Table A1).

TABLE 3 Results of multilevel regression analysis.

	Digital collaboration Readiness (T2)			Technology exploration (T3)			Mutual learning (T3)		
Variable	**Estimate**	**SE**	***p***	**Estimate**	**SE**	***p***	**Estimate**	**SE**	***p***
Intercept	4.49**	.09	.000	3.02**	.03	.000	4.64**	.03	.000
Training	.07	.12	.569						
Coworker technology enthusiasm (T1)	−.12	.06	.074						
Training × Coworker technology enthusiasm	.25*	.10	.009						
Digital collaboration readiness (T2)				.41**	.06	.000	.18*	.06	.001
Pseudo R^2	.14			.19			.31		

Note: $N = 167$ dyads (334 participants). Training: 0 = waiting control group, 1 = intervention group. Pseudo R^2 reflects the intraclass correlation coefficient, indicating the proportion of total variance in the outcome attributable to dyad membership.

*$p < .05$. **$p < .001$.

Hypotheses testing

The results of the multilevel regression analyses are reported in Table 3. The effect of the training on digital collaboration readiness was not significant ($\beta = .07$, SE = .12, $p = .57$). H1 was thus not supported. The interaction term of training and coworker technology enthusiasm on digital collaboration readiness was positive and significant ($\beta = .25$, SE = .10, $p = .01$), providing support for H2. The plotted interaction effect is shown in Figure 2. The training had a significant positive effect on digital collaboration readiness if coworker technology enthusiasm was higher ($\beta = .37$, SE = .17, $p = .03$); the effect was negative and non-significant if coworker technology enthusiasm was lower ($\beta = -.23$, SE = .17, $p = .17$).

We found that digital collaboration readiness was positively associated with (a) technology exploration ($\beta = .41$, SE = .06, $p < .001$), and (b) mutual learning ($\beta = .18$, SE = .06, $p = .001$), in line with H3a and H3b. We did not find significant indirect effects on (a) technology exploration (*indirect effect* = .03, 95%, CI [−.069; .131]) and (b) mutual learning (*indirect effect* = .01, 95%, CI = −.032; .064) via digital collaboration readiness. Therefore, H4a and H4b were not supported.

In line with H5a, we found that the indirect effect of the training on technology exploration via digital collaboration readiness was positive and significant at higher levels of coworkers' technology enthusiasm (*conditional indirect effect* = .15; 95% CI [.016; .300]), but non-significant at lower levels of coworker technology enthusiasm (*conditional indirect effect* = −.09; 95% CI [−.240; .040]). The index of the moderated mediation for technology exploration was significant and positive (*index of moderated mediation* = .10; 95% CI [.027; .192]).

In line with H5b, we also found that the indirect effect of the training on mutual learning via digital collaboration readiness was positive and significant at higher levels of coworkers' technology enthusiasm (*conditional indirect effect* = .07; 95% CI [.005, .153]), but non-significant at lower levels of coworker technology enthusiasm (*conditional indirect effect* = −.04; 95% CI [−.118; .018]). The index of the moderated mediation for mutual learning was significant and positive (*index of moderated mediation* = .05; 95% CI [.008; .098]). The results of the indirect and conditional indirect effects are reported in Table 4.

Robustness checks

We conducted additional checks to explore the impact of age-related and technology-related variables on the training effect. Age-related variables included chronological age, subjective age, dyadic

TABLE 4 Results of indirect and conditional indirect effects.

	Technology exploration			Mutual learning		
	Estimate	**SE**	**95% CI**	**Estimate**	**SE**	**95% CI**
Indirect effect						
Training via digital collaboration readiness	.03	.05	[−.069, .131]	.01	.02	[−.032, .064]
Conditional indirect effect						
Index of moderated mediation	.10	.04	[.027, .192]	.05	.02	[.008, .098]
Training via digital collaboration readiness at						
−1 SD coworker technology enthusiasm	−.09	.07	[−.240, .040]	−.04	.03	[−.118, .018]
+1 SD coworker technology enthusiasm	.15	.07	[.016, .300]	.07	.04	[.005, .153]

Note: $N = 167$ dyads (334 participants).

Abbreviation: CI, confidence interval.

age difference, age group, functional experience and digital age stereotype.[1] Technology-related variables included digital leadership, digital job-fit, digital self-efficacy, frequency of IT use and frequency of communication technology (CT) use. First, we included these variables as controls. The pattern of results remained consistent when controlling for each variable individually, as well as when all age-related variables were included simultaneously as controls. Second, we explored these variables as alternative first-stage moderators of the effect of the training on digital collaboration readiness. The age-related variables measured in years were scaled by the factor of 10, following prior research on ageing (e.g., Fasbender et al., 2020; Li et al., 2022), to produce more accurate estimates and facilitate interpretation of results. We found that none of the age-related variables had a significant interaction effect.[2] We then tested the age-related variables as moderators of the effect of the training on both outcomes (i.e., technology exploration, mutual learning). All effects were non-significant, except for chronological age. Chronological age amplified the direct effect of training on technology exploration ($b = .19$, SE = .10, $p = .04$), suggesting that older employees engaged in more technology exploration after the training compared to younger employees. Further, we found that no technology-related variables had significant interaction effects as alternative first-stage moderator variables on the training effect.[3] The detailed information on these additional analyses is available in the online appendix on OSF (osf.io/de5xw/).

DISCUSSION

The purpose of this study was to design and test an age diversity training for digitized work contexts to promote informal workplace learning and development in age-diverse coworker dyads. Framing the intersection of age and technology as an untapped opportunity for organizations, we (a) uncover the motivational processes that translate dyadic age diversity training into informal learning, and (b) provide

[1]Chronological age indicates a person's current age in years since birth; subjective age indicates how old a person feels relative to their chronological age; dyadic age difference indicates the age gap between the two members within a dyad; age group indicates whether a person is the older or younger participant in the dyad; functional experience indicates the number of years of professional experience in a person's current role; digital age stereotype climate indicates the perceived prevalence of age stereotypes based on technology use on a group level.

[2]Chronological age ($b = 0.10$, SE = .09, $p = .16$); subjective age ($b = .03$, SE = .11, $p = .46$); dyadic age difference ($b = -.29$, SE = .16, $p = .10$); age group ($b = .38$, SE = .22, $p = .08$); functional experience ($b = .18$, SE = .12, $p = .16$). Digital age stereotype climate ($b = .05$, SE = .08, $p = .54$).

[3]Digital leadership ($b = -.05$, SE = .10, $p = .58$); digital job-fit ($b = -.09$, SE = .12, $p = .47$); digital self-efficacy ($b = -.10$, SE = .12, $p = .37$); frequency of IT use ($b = -.05$, SE = .90, $p = .61$); Frequency of CT use ($b = -.10$, SE = 0.08, $p = .23$).

insights into social boundary conditions for technology-related workplace learning and development. We conducted a randomized controlled field experiment with age-diverse coworker dyads at a large German financial institute. The results showed that the dyadic age diversity training for digitized work contexts can facilitate employees' technology exploration and mutual learning via digital collaboration readiness if the age-diverse co-learner was enthusiastic about technology.

Theoretical implications

Our research contributes to the literature at the intersection of age diversity and digitalization in three ways. First, our findings position coworker influence as a central boundary condition for whether employees can translate the insights gained in formal dyadic age-diversity training into informal learning. Hereby, we contribute to the literature on social support and peer influence in self-directed learning (e.g., Bell & Kozlowski, 2008; Wolfson et al., 2018) as well as the training transfer literature (e.g., Massenberg et al., 2015; Salamon et al., 2023). Our findings highlight the importance of coworkers' attitudes towards digital technology as a salient social component in digitized workplaces (e.g., Tannenbaum & Wolfson, 2022; Wolfson et al., 2014). The importance of the social environment, including coworkers' support, is well established in both the informal learning and training transfer literature. For example, prior studies have shown that coworker support and participation can facilitate the transfer and application of training content (Massenberg et al., 2015; Salamon et al., 2023). Our findings indicate that even more subtle social signals, such as coworkers' enthusiasm towards technology, can shape employees' engagement in informal learning and development, including technology exploration and mutual learning. A coworker who is enthusiastic about technology can have a contagious effect, thus creating a supportive learning environment through more positive conversations about age-diverse contributions in a digital work setting. In contrast to the informal learning and training transfer literature, prior research on formal age diversity training has largely overlooked interpersonal boundary conditions (e.g., Burmeister et al., 2021; Jungmann et al., 2020), possibly due to limited sample sizes that complicate the detection of moderating effects. Our findings address this gap by conceptualizing age-diverse technology-related workplace learning as a social process that depends on coworkers' technology enthusiasm, particularly in dyadic training. Research on technology adoption and ageing has often focused on individuals' technology use, while ignoring the social context (e.g., Cheng et al., 2011; Makowska-Tlomak et al., 2022) and how technology influences collaboration between age-diverse coworkers (e.g., Bosch et al., 2022; Ng et al., 2024). Our research helps to overcome this contextual gap by taking a social perspective on workplace learning and development for technology-based and age-diverse collaboration in today's workplaces. It underscores the central role of social influence in informal technology-related learning, showing that coworker attitudes can amplify formal dyadic training.

Second, we contribute to the workplace learning literature by showing how formal training can promote informal learning via learners' readiness as a motivational and self-regulative transfer mechanism. Research has shown that organizations can support employees in their ongoing workplace learning processes, for example, with micro-level training (Kittel & Seufert, 2023), e-learning programmes (Svensson et al., 2004) or mere availability of formal learning opportunities (Bednall & Sanders, 2017). The literature on workplace learning consistently highlights the interdependence between formal and informal learning to recognize the adaptive demands of digitized workplaces (Kittel & Seufert, 2023; Tannenbaum et al., 2024) and positions personal readiness as an important antecedent for effective informal workplace learning (Beier et al., 2025; Tannenbaum & Wolfson, 2022). To the best of our knowledge, however, no intervention study has empirically tested how organizations can strengthen personal readiness for informal learning through training. In line with the training transfer perspective, our findings highlight the role of proximal self-regulatory mechanisms in translating formal training input into informal learning and development at work (Ford et al., 2018; Wolfson et al., 2018). Our research thus adds to the understanding of how organizational learning practices can support age-diverse employees

in their self-directed learning processes to meet digital workplace demands (Beier et al., 2025; Cerasoli et al., 2018). This is of particular pertinence to cater for the different needs, competencies and resources of age-diverse employees in the realm of constant technological changes (Torres et al., 2019; van Woerkom et al., 2023). By integrating digital collaboration readiness as a central mechanism in our model, we apply and empirically test the theoretical foundation for continuous and intentional learning by Tannenbaum and Wolfson (2022). Thus, our findings shed light on the underlying motivational and self-regulatory processes through which age diversity training influences behavioural outcomes beyond training.

Third, we extend a nascent literature on age diversity training at work (e.g., Burmeister et al., 2021; Gerpott et al., 2021) by developing and evaluating a training tailored to age-diverse coworker dyads in digital work contexts. While prior age diversity training has often focused on mitigating identity-based tensions that can arise within age-diverse workforces, we framed our technology-focused training as an organizational source and learning opportunity for age-diverse and digital collaboration (Ely & Thomas, 2001; Floyd et al., 2023). The training, designed to promote dyadic interactions and collective development, raises workers' readiness for age-based synergies and shared opportunities for technology-related development. Our research integrates age diversity training research with an informal workplace learning perspective to examine formal age diversity training as a catalyst for employees' informal learning and development in digitized work environments. Importantly, mutual learning is not only an indicator of informal workplace learning in this context, but also an indicator of strengthened age-diverse relationships because it involves interactions between younger and older coworkers. Our training builds on and extends knowledge-based age diversity training (e.g., Burmeister et al., 2021) by contextualizing it to technological work demands. By placing age diversity and its inherent opportunities in a technology-related context, it contributes to a forward-looking development of future workplaces in light of digital transformation (Beier et al., 2025). This positive framing strengthens the opportunity-oriented perspective on age-based resources in the design of age diversity training, as highlighted for future research in the age diversity training literature (e.g., Burmeister et al., 2021; Gerpott et al., 2021) and diversity research more generally (e.g., Dwertmann et al., 2016; Ely & Thomas, 2001). To our knowledge, this is the first study to design and empirically test a training for age-diverse coworkers in a digital work setting.

Practical implications

Our study bridges the gap between the theoretical understanding and practical application of workplace learning, focusing on age-diverse coworkers in digitized work contexts. Shedding light on how to support its age-diverse workforce in technology-related learning is particularly important for accommodating the varying needs and resources of age-diverse employees at workplaces that continue to evolve digitally, requiring constant adaptation and learning (Beier et al., 2025; van Woerkom et al., 2023). The opportunity-oriented framing of our dyadic age diversity training guides organizations to embrace the various competencies age-diverse teams offer as a complementary portfolio, and acknowledge the crucial impact of coworkers' social influence for individual and collective technology-related learning (Carter & Katherine, 2017; Ragins & Verbos, 2017).

Our findings have two important practical implications for organizations. First, we developed and validated a blueprint of a dyadic training that is tailored for age-diverse employees collaborating in digitized work environments. Acknowledging employee age in the realm of digital technologies as an opportunity rather than a threat, the training can improve employees' readiness to invest in technology-related workplace learning. Our training design can equip employees with the tools to identify technology-related learning opportunities, harness age-based resources from coworkers and instrumentalize age-diverse work relationships. Rather than focusing on reducing age-related tensions, it allows organizations to enable age-diverse coworkers to recognize and leverage each other's contributions for technological advancements. By fostering learners' readiness for individual and collaborative

learning in daily work practices, employees are equipped to pace and guide their technology-related learning according to their needs and resources. Organizations can use such training for their workforce to stay adaptable in the face of rapid technological advancements while strengthening age-diverse relationships.

Second, our findings demonstrate the importance of coworker influence on learning effectiveness in age-diverse and digitalized work settings. When coworkers are enthusiastic (e.g., curious, open or excited) about technology, this can function as a contagious stimulus that fuels an employee's motivation and curiosity beyond formal training. In contrast, a lack of coworkers' enthusiasm can undermine training efforts, rendering organizational investments in employee training on age diversity ineffective. Consequently, to enhance the effectiveness of technology-related training, organizations may identify employees who are already enthusiastic about technologies. When embedding peer-to-peer learning strategies in training, it is generally important to consider coworkers' attitudes, as they can be contagious and strengthen the training effect. Further, organizations may embed peer-to-peer learning forms in formal and informal learning interventions with a strong focus on reciprocal learning, for example, through age-diverse mentoring or job-shadowing.

Beyond the direct findings of our study, these practical implications can trickle down to influence organizational practices. For instance, organizations can be more intentional when pairing employees for work tasks or digitalization projects. Organizations can also foster positive attitudes towards technology to create a positive technology-related climate with technology-enthusiastic ambassadors, for example, when piloting new technologies or by integrating age-diverse needs for tool implementation.

Limitations and directions for future research

The findings of our research should be interpreted considering its limitations, which suggest several potential avenues for future research. First, the voluntary self-selection into our study might have created selection bias. Those who signed up for the training are likely to be more interested in the topic of age diversity and digital technology than the average employee. The ethical and practical challenges associated with involuntary training participation did not allow for an alternative approach to generate the sample. Additionally, because participants signed up with an age-diverse coworker, a positive selection bias may have been emphasized, as it is likely that the co-learners had a good relationship prior to training, which might limit the variability of the studied variables. This restriction suggests that our results are a more conservative estimate of the effects. Future research can address this limitation by generating the sample through random selection of dyads from a pool of all eligible dyads (Burmeister et al., 2021). Relatedly, given the size of the organization and the fact that participants were from a wide range of different departments and roles, the dyads are expected not to have experienced many shared-context effects, limiting potential contamination across the experimental and control groups. If contamination occurred, it would make our estimates more conservative. Future research can design a control group that is isolated from any potential cross-condition contact, for example, at a different location within the organization.

Second, we conducted several additional models testing for age-related (e.g., subjective age, dyadic age differences) and technology-related (e.g., use frequency of digital technologies, digital self-efficacy) variables to assess the robustness of our observed training effects. Randomized controlled field experiments often impose constraints on sample sizes, for example, because of logistical challenges or time constraints (Lonati et al., 2018). Nevertheless, our sample (N=334 employees) is considerably larger compared to previous age diversity intervention studies, which have generally been limited to smaller sample sizes (e.g., Beyer et al., 2019; Jungmann et al., 2020). Following suggestions by Bliese and Wang (2020), a post-hoc power analysis of our results showed that the observed power was reasonable [70.0%] for the interaction effect (i.e., training × coworker technology enthusiasm), and high [100.0%; 84.7%] for the effects of digital collaboration readiness on the outcomes (i.e., technology exploration,

mutual learning).[4] In contrast, the observed power of the interaction effects from our robustness checks, as reported in the online appendix on OSF (osf.io/de5xw/), was consistently below 40.0%, which is substantially lower than the observed power of our hypothesized interaction effect. These checks should thus be understood as supporting the plausibility of our main model, rather than as definitive tests of alternative first-stage moderators.

Third, we used self-reported measures for the study variables, which may have created common source and method bias, potentially leading to inflated relationships between mediator and outcome variables (Podsakoff et al., 2003). To mitigate common method bias, we adopted a time-lagged study design, collecting data on mediator and outcome variables at different time points (Podsakoff et al., 2003). Future research can benefit from utilizing multi-source data to address concerns of common source bias. To do so, other-source data could be gathered from coworkers or supervisors who are not in the dyad but are also engaged in the focal learner's learning process (Gerpott et al., 2021).

Fourth, we captured informal learning behaviours as technology exploration and mutual learning, whereas the informal field-based learning framework features additional dimensions such as vicarious learning or feedback (Tannenbaum & Wolfson, 2022). Similarly, we understood personal readiness (i.e., capability, awareness and motivation) as one construct and measured digital collaboration readiness as a joint mechanism. According to the framework by Tannenbaum and Wolfson (2022), the absence of one component may reduce informal learning, but can be compensated for by the presence of any other component. Future research is needed to better disentangle how the different components are connected and how they contribute to informal workplace learning. We assessed digital collaboration readiness as a mechanism and proxy for informal learning behaviours, acknowledging that it might not fully capture employees' real learning behaviours. It is challenging to measure informal learning because it can take place in everyday work processes and subconsciously. Acknowledging the positive associations between perceived and actual learning, personal readiness can serve as a reasonable proxy for actual learning (Benbunan-Fich & Arbaugh, 2006; Tannenbaum & Wolfson, 2022). Future studies could include more dimensions or additional mechanisms of personal readiness and direct indicators to understand the cognitive and motivational processes that prepare employees to engage in informal learning.

Fifth, our integrated training design that combined age diversity as well as technology-related content raises the question of the extent to which each of the modules contributed to the observed effects. At present, we know that content integration has achieved the observed training effects. Future research may disentangle age diversity and technology-related content in the design of the intervention to estimate their differential effects and possible differential underlying mechanisms (see Burmeister et al., 2021). Additionally, the informal learning literature (Tannenbaum & Wolfson, 2022) suggests multiple contextual support dimensions that may shape participants' readiness for informal learning. Future research can thus further advance contingency perspectives on age diversity training by examining leader support and work environment, such as learning climate or autonomous job characteristics, as boundary conditions for informal learning. This would be particularly meaningful in light of recent conceptual and empirical work suggesting that leaders play a crucial role in enabling older workers to adopt digital technologies (Fasbender et al., 2023; Hampel & Kunze, 2023) and that workplace design can facilitate ageing processes by reducing technological demands and increasing technological resources (Pak et al., 2023; Parker & Grote, 2022). To do so, sampling across different organizations may be considered to increase variance in terms of contextual influences.

Finally, as informal learning incorporates behaviours on the job, formal training only captures part of the organizational efforts to foster informal learning. Thus, scholars may be interested in

[4]Observed power estimates were calculated based on the obtained t-values ($\alpha = .05$ [two-tailed], df = 167). Training × coworker technology enthusiasm ($t = 2.50$) on digital collaboration readiness = 70.0%; digital collaboration readiness on mutual learning ($t = 3.00$) = 84.7%; digital collaboration readiness on technology exploration ($t = 6.82$) = 100.0%.

investigating more enduring learning programmes that incorporate informal learning in a continuous and self-directed way, for example, through micro-learning interventions that prompt technology-related learning behaviours (Kittel & Seufert, 2023). Additionally, by understanding technology-related and age-diverse learning as a social process, our field experiment is the first study that empirically analyses the contagious impact of coworkers in a dyadic training for informal workplace learning. Particularly as informal workplace learning does not happen in an individual vacuum, additional social aspects of age-diverse learning programmes and a more nuanced perspective on interpersonal processes should get our scholarly attention. For example, research has shown the complex relationship between age-diverse friendship and work-related outcomes (e.g., Dietz & Fasbender, 2022). The social context for technology-related development is particularly important in age-diverse and digitized work environments, inviting scholars and practitioners to further elaborate on the complementary resources that older and younger coworkers have for organizational development.

CONCLUSION

We integrated the largely separate research streams of age diversity, technology and workplace learning to develop an opportunity-oriented and dyadic age-diversity training for digitized work contexts. We tested the training in a randomized controlled field experiment and found that its effectiveness to promote older and younger coworkers' learning and development hinges on the technology enthusiasm of the age-diverse training partner and coworker. The training content and approach provide a validated tool for organizations to effectively respond to increasing workforce age diversity and digitalization.

AUTHOR CONTRIBUTIONS

Patrick Vestner: Conceptualization; methodology; software; data curation; investigation; formal analysis; visualization; project administration; writing – original draft; writing – review and editing. **Julian Pfrombeck:** Conceptualization; formal analysis; validation; writing – original draft; writing – review and editing. **Kilian Hampel:** Writing – original draft; writing – review and editing. **Anne Burmeister:** Conceptualization; methodology; validation; supervision; formal analysis; project administration; writing – original draft; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

We have no known conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The intervention materials (i.e., training notes, slides) and data analytics script are available on OSF (osf.io/de5xw/) under a CC BY 4.0 licence. The data are not publicly available due to their proprietary nature and the data confidentiality agreement with the partner organization in which the field experiment was conducted. The data are available upon request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Tabe S1. Results of multilevel regression analysis for age-related constructs on mediator (controls).

Table S2. Results of multilevel regression analysis for age-related constructs on mediator (moderators).

Table S3. Results of multilevel regression analysis for age-related constructs on outcomes (moderators).

Table S4. Results of multilevel regression analysis for technology-related constructs on mediator (controls).

Table S5. Results of multilevel regression analysis for technology-related constructs on mediator (moderators).

Table S6. Confirmatory factor analysis fit indices.

Table S7. Results of post-hoc power analysis for robustness checks on mediator (moderators).

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APPENDIX

TABLE A1 Scale items.

Mediator	Items (factor loadings)
Digital collaboration readiness (Hirschi et al., 2021) Cronbach's Alpha: .81.	I carefully plan what I need to do in order to achieve my goals for improved skills for digital collaboration ($\lambda = .67$) I think about different options to achieve my goals for improved digital collaboration ($\lambda = .88$) I develop plans that I can adjust if things do not work out as originally planned to improve collaboration through digital technologies ($\lambda = .77$)
Outcomes	Items (factor loadings)
Technology exploration (Maruping & Magni, 2015) Cronbach's alpha: .9.	I explore how the digital technologies I'm using for some of my duties can be used for additional tasks too ($\lambda = .88$) I explore ways that the digital technologies I'm using may enhance my effectiveness ($\lambda = .87$) I spend time and effort exploring the digital technologies I'm using for potential different applications ($\lambda = .87$)
Mutual learning (Allen & Eby, 2003) Cronbach's alpha: .95.	My dyad partner and I learn a lot from each other ($\lambda = .90$) My dyad partner and I give each other a new perspective on many things ($\lambda = .91$) My dyad partner and I are 'co-learners' ($\lambda = .85$) There is reciprocal learning that takes place between my dyad partner and me ($\lambda = .91$) My dyad partner and I share a lot of information that helps us in our own professional development ($\lambda = .84$)
Moderator	Items (factor loadings)
Coworker technology enthusiasm (Venkatesh et al., 2003) Cronbach's alpha: .96.	My dyad partner thinks using new digital technology is a good idea ($\lambda = .85$) My dyad partner thinks new digital technology makes work more interesting ($\lambda = .83$) My dyad partner thinks working with new digital technology is fun ($\lambda = .97$) My dyad partner likes working with new digital technology ($\lambda = .97$)

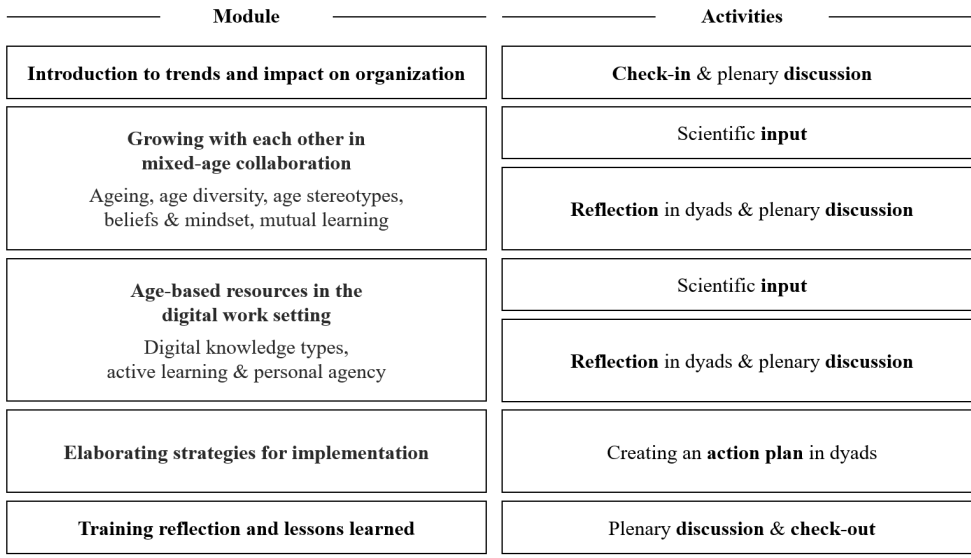

FIGURE A1 Structure of training.