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COLLABORATIVE DEVELOPMENT ON A DIGITAL LEARNING PLATFORM: THE POTENTIAL OF AI TOOLS FOR FACILITATION

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Abstract: *Digital learning platforms featuring artificial intelligence (AI)-based tools are being increasingly used at workplaces. This study investigated the opportunities that AI tools offer for facilitating the collaborative development of work on a learning platform called Howspace. The data comprised interviews with platform developers (n=4) and facilitators (n=10). Content analysis explored the interviewees' conceptions of the use of AI tools in collaborative development. It identified four AI tool functions—task assistant, participant assistant, process assistant, and interaction assistant—along with their associated benefits and limitations. Platform developers saw more opportunities for the use of AI tools, whereas the facilitators saw more challenges. These challenges were primarily related to the facilitators' limited understanding of the algorithms' logic. The study proposes that enhancing the transparency of algorithms could improve the usability of AI tools. A better understanding of algorithmic operations could mitigate the identified challenges, and improve facilitators' experience of employing AI tools.*

Keywords: *artificial intelligence, learning platforms, collaborative development, work development, facilitation.*

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INTRODUCTION

Digital learning platforms that use artificial intelligence (AI)-based tools and applications have been created to support collaborative development (Ouyang, Xu, & Cukurova, 2023; Roll & Wylie, 2016; Rummel, Walker, & Aleven, 2016; Schaefer, Rahn, Kopp, Fabian, & Brown, 2019). By the collaborative development of work we refer to the interactional activities through which a work community or work group identify and solve work-related problems, and design and create something of use value, such as new practices, artifacts or concepts (see Engeström, 2008; 2022). AI, in turn, refers to the various computational applications that perform the cognitive and interactive tasks that usually require human intelligence and reasoning (Luckin, Holmes, Griffiths, & Forcier., 2016; Rienties, Køhler Simonsen, & Herodotou, 2020). These tasks include analyzing natural language, images, or visual environments, and organizing and evaluating information (e.g., Russell & Norvig, 2016).

The evolution of learning platforms has mostly been driven by technological innovations (Dillenbourg, 2016), and the rapid development of generative AI is creating further opportunities for learning and development (see Johnson, 2023; Kaczorowska-Spychalska, Kotula, Mazurek, & Sułkowski, 2024; Mhlanga, 2023). AI also offers potential support for interaction and building shared knowledge (Ferreira-Mello, André, Pinheiro, Costa, & Romero, 2019; Kalakoski, Koskela, Kurki, Toivanen, & Yli-Kaitala, 2021; Maity, 2019; Schaefer et al., 2019), which can help overcome some of the challenges related to learning platforms such as limited interaction and difficulty expressing opposing views (Yoon, Miller, Richman, Wendel, Schoenfeld, Anderson & Shim, 2020). Like other technological innovations, AI generates social innovations (see Pérez, 2002) by, for example, affecting how development activities are conducted and facilitated (see Dillenbourg 2016; Kaczorowska-Spychalska et al., 2024; Leonardi & Treem, 2020). However, the fact that the use of AI inevitably affects social systems has received less attention from scholars (Wojciechowski & Korjonen-Kuusipuro, 2023).

Artificial intelligence in education (AIED) provides a useful framework for examining AI-assisted collaborative development in the work life context (e.g., Pammer-Schindler & Rosé, 2022). So far, the main emphasis of AIED has been on educational settings (Niemi, Pea, & Lu, 2023), and few studies have focused on the work life context. Furthermore, these rare studies have primarily focused on developing tutoring systems, supporting individual employees' skills, and addressing data-related ethics (Porayska-Pomsta, 2016; Sottilare et al., 2018; Pammer-Schindler & Rosé, 2022). AI–human collaboration is an important but still underexplored theme that needs more attention in various contexts (Bhimdiwala, Neri, & Gomez, 2022; Brusilovsky, 2023; Chounta, Bardon, Raudsep, & Pedaste, 2021).

This study expands the context of AIED research to work development and examines AI–human collaboration, specifically the potential of AI-based tools to support the *facilitation* of collaborative development processes. By facilitation we refer to the intentional actions through which the (human) facilitator supports collaborative development on a digital platform. The facilitator prepares the process and tools, executes the planned tasks, and advances the process by asking questions and encouraging participants to share their ideas and perspectives (Clottes Heikkilä & Kurki, 2024). Our interest was in the platform developers' and facilitators' conceptions of the opportunities that specific AI tools offer

collaborative development on a learning platform. Our aim was to investigate how the use of AI tools impacts the work of the facilitator, and what limitations the tools are perceived to have.

AI-ENHANCED COLLABORATIVE WORK DEVELOPMENT ON DIGITAL PLATFORMS

AIED Technologies in Collaborative Work Development

AIED technologies, integrated into digital platforms, represent a relatively new phenomenon in the field of collaborative work development. However, the expectations of how AI-based tools and applications can facilitate work development are high (Roll & Wylie, 2016; Rummel et al., 2016).

Practitioners have already noted the potential of AIED technologies for facilitation and collaborative development (Bittner, Mirbabaie, & Morana, 2021; Maity, 2019). For instance, Bittner, Mirbabaie, and Morana (2021) found that facilitators view digital assistants as highly beneficial in augmenting and assisting both collaborative development and the work of the facilitator, particularly in task- or process-oriented interventions and interaction facilitation. Similarly, Maity (2019) discovered that HR and training professionals recognize the potential benefits of AI for both supporting individual learners and enhancing interaction in personnel training within their organizations.

During the last decade, the focus of AIED technologies has shifted from supporting individual learners to enhancing social interaction, group discussions and collaboration (Dillenbourg, 2016). Studies conducted in higher education, for example, have indicated that AI-enabled feedback supports collaboration within the group, and positively affects collaborative knowledge building and group performance (Zheng, Fan, Chen, Huang, Lei Gao & Long, 2024). AI can also generate multimodal data on collaborative patterns in student groups, which is valuable for educators for tailoring support and guidance (Ouyang et al., 2023).

However, the emphasis on technological developments in AIED has also faced criticism (Dillenbourg, 2016; Wojciechowski & Korjonen-Kuusipuro, 2023) and studies have revealed that the link between AIED and educational theories is often weak (Kalakoski et al., 2021). This disconnect may hinder the implementation of AIED tools. As Rummel et al. (2016) propose, unlocking the future potential of intelligent technologies requires "work towards *a comprehensive instructional framework firmly rooted in educational theory*" (italics in original) to guide the development of AI tools for collaborative development purposes.

AI as the Facilitators' Tool

On a digital platform, technology only enhances collaborative development through transformed social practices (Ritella & Hakkarainen, 2012). The facilitators play a crucial role in creating conditions for collaborative development and interaction within the group (Clottes Heikkilä & Kurki, 2024; Evans et al., 2019; Martin, Wang, & Sadaf, 2018; Schaefer et al., 2019; 2020). AIED technologies may help here. At best, these technologies can mediate synchronous and asynchronous group interactions, collaborative problem-solving, and the construction of shared knowledge, thereby advancing development (Ritella &

Hakkarainen, 2012; Roschelle & Teasley, 1995; Stahl & Hakkarainen, 2021; Vygotsky, 1978).

Facilitators' social presence and contributions to fostering learner participation are critical for creating collaborative reflection and co-constructing shared meanings (e.g., Evans et al., 2019; Martin et al., 2018; Schaefer et al., 2020). They can employ various pedagogical methods to enhance interaction on the platform and guide and motivate the group in their developmental efforts (e.g., Martin et al., 2018). These methods include providing analytical tools and models to support the process, advancing the process by asking questions and encouraging participants to share their ideas and perspectives, clarifying and summarizing contents, and creating space for open discussion (Clottes Heikkilä & Kurki; Evans et al., 2019).

Trust is an essential precondition for the successful implementation of AI tools in facilitation (Bhimdiwala et al., 2021; Lankton, McKnight, & Tripp, 2015; Modliński & Gladden, 2021). Ejdys, Czerwińska, & Ginevičius (2024) argue that factors such as education, gender, and age influence employees' perceived trust in AI technologies. Moreover, people build their trust in each technology differently (Lankton et al., 2015). Facilitators need to view the technology as capable of assisting them to achieve their goals and providing sufficient support. The technology must also be adaptable to the diverse requirements of each group and meet the facilitators' other needs (Bhimdiwala et al., 2021).

The algorithms behind these technologies are not value neutral and are designed to highlight certain behaviors or operations (Leonardi & Treem, 2020; see also Craiuț & Iancu, 2022). However, the logic of these algorithms is often opaque to end-users: in this case, facilitators. If AI systems are not transparent, users cannot understand how different AI tools generate their outcomes, which decreases their trust in and limits their use of the tools (Brusilovsky, 2023; Qin, Li, & Yan, 2020; see also Siemon & Wolff, 2024).

In summary, previous research suggests that AI can support group interaction, participant collaboration, and facilitation in the contexts studied, but that several critical concerns, including those related to technological emphasis and trust, arise when AI is applied to support collaborative development activities in work organizations. Since the operational logic of different AI tools varies, and the tools are used in various contexts, it is crucial to evaluate each AI tool's benefits and limitations in specific situations from the user's perspective.

Our study focused on how such AI tools can help facilitators support group collaborative development. In this study we asked, RQ1: What kind of benefits and limitations do platform developers and facilitators associate with using AI tools in collaborative development? RQ2: How do AI tools support the facilitator's work?

DATA AND METHODS

The Case: A Digital Learning Platform and its AI-based Tools

Howspace, the platform under study, is a commercial digital learning platform for organizational development and facilitation that enables interaction between participants. It was built by entrepreneur educationalists to support the facilitation of collaborative processes

in organizations. The platform was launched in 2018 and is used daily by over 30 000 people in over 50 countries. The platform and its tools are constantly under further development.

Like many other digital platforms, Howspace aims to enhance collaboration between a large number of people and to overcome their temporal and spatial distances. It enables the facilitator to build a custom workspace that can be equipped with chats, polls, exams, and custom activities that enable both synchronous and asynchronous development and facilitation.

The increased ability to involve more people can result in a large amount of text-based data, i.e., discussions generated during the development processes. The volume of the text can make it difficult for the facilitator to understand and synthesize the content and main topics of the discussions. To help facilitators' work, the Howspace company has developed tools that can help in cases in which discussions and commentary abound. These tools, originally developed in 2018–2019, are based on AI technology. They rely on natural language processing, i.e., computational techniques to analyze and synthesize natural language and speech (Agarwal, 2019). Table 1 presents the AI tools in question and their purpose.

Table 1. AIrtificial Intelligence (AI) -Based Tools, their Users and Purpose]

AI tool	User	Purpose
AI Summary	Facilitator	To compile the content of a group discussion into a five-sentence long summary (including the most often-mentioned themes).
Interactive Word Cloud	Facilitator and participants	To highlight the central themes of a discussion in word cloud form. To analyze sentences and paragraphs and recognize synonyms. The original discussion on the theme can be accessed by clicking on a word of interest
Theme Cluster	Facilitator and participants	To classify discussion contents into meaningful data-driven categories. To analyze both the words and larger themes of the discussion. The original discussions associated with a category can be accessed by clicking on that category.
Sentiment Analysis	Facilitator	To categorize individual comments on a sentiment scale ranging from concerned to neutral to appreciative.

The tools enable the facilitator to, for example, classify discussions into thematic categories and condense rich and multi-voiced discussions into summaries of a few sentences. Some of these tools can also be used by the participants.

The Data

To understand the benefits and limitations of the AI tools in question, we interviewed both the platform developers (n=4) and facilitators (n=10) during the spring of 2020 and the summer of 2021. We use the term *platform developer* in a broad sense to refer to the interviewees who were involved in developing the AI tools in question. Their backgrounds varied from education and business to technical coding. The interviewed facilitators worked in six organizations in the field of research, education, and consultancy. They had different specialist roles and positions, including the facilitation of workplace development.

We interviewed the platform developers to learn about the purpose of the AI tools, how the developers intended them to be used, and the ways in which they saw that the tools could benefit collaborative development. To gain an understanding of how the AI tools were used

in practice and how they served the work of the facilitator, we interviewed nine facilitators who had practical experience of using AI tools and facilitating collaborative processes.

They were interviewed via the Teams application by six researchers (the authors and their colleagues), using a semi-structured interview method. The length of the interviews varied between 46 and 114 minutes, and the average length was 72 minutes. The interviews were audio-recorded and transcribed verbatim.

Ethical pre-evaluation and institutional permission to use the data for research purposes were obtained from the Finnish Institute of Occupational Health Ethics Committee (16th April 2020). Informed, audio-recorded consent was obtained from all the interviewees. The anonymity of the interviewees was ensured by altering any details that could enable their identification in the text and the data excerpts.

Analytical Process

We used content analysis (Silverman, 2010) to examine the platform developers' and facilitators' conceptions of the benefits and limitations of using the AI tools in the collaborative development of work. The analysis of the interview data proceeded through several reading rounds, first inductively and later informed by theory. The first and second author conducted the analysis. The research team discussed and refined the main themes and categories and their meanings until they reached consensus.

First, we read through the data carefully and selected the episodes that concerned the objectives for and consequences of using AI tools (n=100; n=53 episodes from the facilitators' interviews, n=47 episodes from the platform developers' interviews). We then categorized the selected episodes on the basis of their content. This categorization was informed by a facilitation scheme applied by Bittner et al. (2021; original by Bostrom. Anson, & Clawson, 1993), according to which facilitative acts can be classed as being targeted toward either the task, the process to accomplish the task, or the activities that affect the interaction within the group. Based on their designed function, AI tools can assist the team or the facilitator in the *task, process,* and *interaction* functions, or in the application of specific facilitation methods or techniques (Bittner et al., 2021). Using this interpretative framework, we classified the episodes into four use categories: assistance related to 1) single tasks, 2) participation, 3) the developmental process, or 4) interaction on the learning platform. We further observed that the interviewees associated both benefits and limitations with these different uses and included them in the analysis. Table 2 presents examples of this categorization. The categories were not exclusive, and some episodes were placed in more than one category.

Table 2. Example of Categorization

Use of Alartificial intelligence (AI) in	Platform developers' conceptions	Facilitator's conceptions
Single tasks	*About the word cloud…gives you access to information sources and the right context…truly a tool that speeds up compilation work.*	*Regardless of the size of the group and how long-windedly things are being told…we get a word cloud. From there someone says... look up self-directedness...and from the chat we get all the comments that mentioned it.*
Interaction	*...can be accessed by the participants, and thus also supports, you know, dialogicity... the facilitator can... what has been discussed about this word or around this theme... [make] sense of the conversation*	*you can connect to the conversation in your own time and see what went on there...you could, you know, just find the things that interest you and go on from there.*

Through the categorization process, we found that the interaction between the AI and the facilitator was an important, cross-cutting theme in the data. Thus, we conducted a supplementary analysis on episodes that concerned "the AI as a facilitator's tool" (n=97, n=56 episodes from the facilitators' interviews, n=41 episodes from the platform developers' interviews). We further observed that the interviewees' conceptions of the theme were diverse and partly contradictory. Therefore, we included the tensions between the expectations and practice in the analysis.

RESULTS

The Benefits and Limitations of AI tools

The benefits associated with the four AI tools were related to four functions: 1) Task assistant, 2) Participation assistant, 3) Process assistant, and 4) Interaction assistant.

First, the AI tools were useful as **task assistants**. This means that they helped the facilitator summarize, visualize, and categorize task-based discussions. According to the interviewees, the main value of the tools was their ability to summarize long discussions easily and quickly during the developmental process. However, this added value of the AI tools was limited to small groups, when the facilitator could easily do the summaries and categorizations. The interviewees also saw it as a benefit that some of the AI tools enabled access to the original comments when keywords and categorizations were clicked on. This helped the participants understand and follow the discussions in each category.

Second, the AI tools worked as **participation assistants**. They could be used as a means to support group members' participation in the developmental process. The interviewed facilitators and platform developers expected the AI tools to promote inclusive participation, even when a group was large. This was because they made the contributions of each participant visible, even in multi-voiced discussions. One of the interviewed facilitators described how AI compilation (AI output) could be used as a tool to crystallize the "*group opinion"*. Thus, the AI tools helped the facilitators discover the most important themes in the

discussion. The interviewees also pointed out that AI created at least *"a feeling that everyone's voice had been important"* and that their contribution had been noticed.

Third, the AI tools served **as process assistants** as they helped the facilitators strengthen the continuity of the development process. One platform developer claimed that the AI compilations should not be interpreted as a completely accurate summary of the discussion, but should be approached as a stimulus for continuing the process. The interviewees claimed that AI output could highlight central or interesting themes in the discussion. The facilitator could, for example, direct further discussions toward these themes. This may help the group achieve the goals of the development process. Furthermore, the platform developers also saw the potential for more profound outcomes. For example, one interviewee suggested that these AI-enhanced assignments could have a major impact on the quality of participants' thoughts and discussions, and in the long run, even on organizational change.

Fourth, the AI tools could potentially act as **interaction assistants**: the AI summaries and categorizations provided a stimulus for additional discussions. The interview data showed that AI tools could assist dialogue in two ways. First, the "*imperfect"* AI compilations could generate topically rich discussions on some important viewpoints, or bring new nuances into a group's discussion. Second, the AI-based categorizations enabled participants to choose the themes in which were interested and to join the relevant discussions. This offered the participants the opportunity to deepen their understanding of the themes in question. The platform developers further suggested that in addition to promoting dialogue, AI tools could make sense of large volumes of dialogue, which is helpful especially with larger groups. This could also help participants contribute to the dialogue. Table 3. summarizes these benefits and presents a data example of each function.

Table 3. Functions and Benefits of Artificial Intelligence (AI) in Collaborative Development

Function	Benefits	Data example
Task assistant	Summarization, visualization, and categorization of discussions	*F2: "With large organizations I use these analytic [AI]tools… It's crucial to get a picture of what we think and where we are now."*
Participation assistant	Supports the equality of contributions; everyone's voice is heard. Supports forming a common vision (only platform developers)	*F 6: "Everyone wrote down their ideas, for two or three minutes, then we used 'likes'… After I showed the [AI] summary, it was easy for the participants to keep nodding – yes, that's what we talked about."*
Process assistant	Supports the continuity of the process. Stimulus for additional discussions.	*PD 2: "It's like you don't think that the summary produced by AI is the right solution, rather let the AI make some kind of summary from the masses of text and then people can continue on the basis of that."*
Interaction assistant	Categorizations stimulate dialogue e.g., enable contributions to interesting themes. Supports sense-making (only platform developers).	*PD 1: [Lots of] people have been invited to the debate, and there will be hundreds of pages of data… what would make it easier to understand what issues are being discussed in the debate? So, help to help the dialogue itself, but also to help our understanding of it, that of both the participants and the facilitators.*

The table shows that the platform developers presented a larger repertory of the AI tools' practical applications than the facilitators, including using them to promote a common vision and sense-making.

The interviewees also identified some limitations of AI tools, which were mainly related to the operational logic of AI. First, the accuracy of AI outputs varied, and AI did not recognize all the nuances in comments. Non-topic-related comments may also feature in summaries, and not all the similarities between the comments that AI recognized corresponded with human logic. Secondly, the studied tools used natural language processing to analyze text-based data, and this may have limited inclusive participation, as writing may not be the preferred communication method of all the participants. Third, as the use of tools was limited to single tasks, they could not capture the longitudinal development of the discussion topics, nor the development in individual participants' responses.

AI as the Facilitators' Tool: Trust and Usability

As presented above, AI tools can support collaborative activities and discussion within groups and facilitate the continuity of the collaborative development process. However, from the facilitators' point of view, the use of AI was also sometimes problematic.

According to the platform developers, the primary driver for developing AI tools has been the need to find ways to assist facilitators in their work. The tools are intended to reduce the amount of facilitation work and to help facilitators analyze and summarize discussions on the platform and use this knowledge to serve the development process. The platform developers highlighted that AI "*doesn't replace anyone: neither trainers nor facilitators, but it helps their work".* They suggested that the facilitators benefitted from the AI tools the most, when they *"experimented"* and *"applied"* the AI tools and *"reflected on"* their outputs with the group to support shared development. The platform saw the AI–human interplay as complementary and unproblematic.

For the facilitators, in turn, the human–AI interplay was more complicated. They raised two major challenges. The first was related to their own competences in using the AI tools. The facilitators pointed out that the AI compilations may turn out to be irrelevant if they "*just put out a question and ask people to answer it"* without any deeper consideration or design idea. Thus, designing "*AI-friendly tasks"*, i.e., tasks that correspond with the AI logic, requires new competences of the facilitator.

The second challenge concerned the usability of AI tools and the facilitators' confidence in the algorithm programmed into these tools. As the facilitators did not always trust the AI compilations, they took time to make themselves familiar with the original contents: *"I check [the discussions] at least few times to see if I agree".* This extra work obviously contradicts the platform developers' original idea of reducing the facilitators' work. In the interviews, the facilitators recurrently questioned their trust in the algorithm and AI outputs, as exemplified in the following data extract.

> *F 10: The biggest thing is always that the person who uses it [AI] has to trust it. When you don't know, and I've interviewed Howspace people many times about it, asked them to tell me how it [AI] works…, and I've had the vector space in the background explained to me. And then you're like, damn it, as you're not able to understand it,*

> *how it does it. And then there's also the fact that I don't quite know where this is coming from…could it be some form of interaction with the AI? I'd like to understand interactional processes and how new ideas are built within them. So, of course, I'd like to understand how artificial intelligence builds them from this human reality.*

In the excerpt, the facilitator emphasizes that one of the most important requirements is confidence in the AI compilations. They find it difficult if they do not understand the logic through which the AI tools form their outputs. The facilitator describes how, in their quest to understand the operational logic of the AI tools, they had contacted the platform developers to try to extract the information, but to no avail. The facilitator above emphasizes the need for transparency in this regard; so that the AI compilations are not just be something that appears from nowhere. For the facilitators, confidence in the AI compilations was a prerequisite for presenting them to participants. Regardless of whether the compilation was created by AI or not, what was relevant for the facilitators was that all the central aspects of the conversation were taken into account.

To sum up, the tensions related to the utilization of AI tools in collaborative development are intertwined with the facilitators' understanding of the logic of the algorithm (see Figure 1).

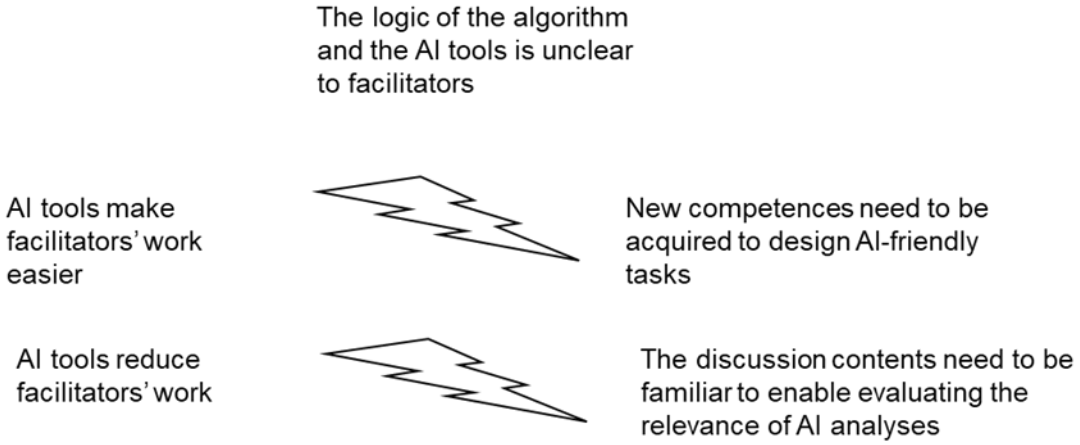

Figure 1. Utilization of artificial intelligence (AI) -based tools; tensions between expectations and practice

First, AI tools are intended to support the facilitator by reducing and easing their work. However, for the facilitators, the challenge was that utilizing AI tools requires acquiring new knowledge and pedagogical competences. The facilitators have to learn how to formulate AI-friendly tasks so that the participants' contributions correspond with the logic of the AI, enabling it to produce relevant outputs from them. They must also find ways to utilize these outputs in a pedagogically meaningful way.

Second, as the logic of the algorithm is unclear to the facilitators, they are often unsure about the *accuracy* of the AI output. To be able to assess the relevance and validity of the AI output, the facilitators need to familiarize themselves with the contents of the original

discussion in question. As this manual reviewing takes time, it is worth questioning whether the AI tools actually reduce the work of the facilitator or, in some cases, possibly increase it.

DISCUSSION

AI and AI-based tools are increasingly being used in organizations as a means to support collaborative development on digital platforms. The aim of this study was to explore the benefits and limitations of using AI tools when facilitating collaborative development and examine how the tools impact the (human) facilitator's work.

The study showed that the benefits and limitations of using AI tools for collaborative development were related to four interconnected functions – AI as a task assistant, a participation assistant, a process assistant, and an interaction assistant. The perceived utility of the AI tools for the different functions varied. With regard to the task and participant assistant functions, interviewees emphasized how the main benefit of the AI tools was their ability to comprehensively summarize or visualize task-based discussions. They felt that the AI outcome can, at best, crystallize the group's opinion and help create a sense that everyone is participating equally in the process. The main limitation associated with the tools was their varying ability to obtain all the relevant content and detect the nuances of the discussions. The facilitators felt that the variance in the accuracy of the AI compilations reduced the tools' value. Regarding the process and interaction assistant functions, the perceptions of AI and its benefits differed from those regarding the two other functions. When the facilitators used the AI outputs as a stimulus for the development process and interaction within the group, they regarded how well the tools captured or summarized the discussion as less important. Instead, they saw the tools' value as being in their ability to stimulate further discussions. Therefore, when used in combination with other facilitative acts or further assignments (see Dillenbourg, 2016), the imperfect compilations were perceived as being able to generate critical, reflective group discussions or promote sense-making within the group in the way envisaged by the platform developers.

The interviews took place about two years after the AI tools in question were first launched. The interviewed facilitators can be characterized as early adopters of a novel technology (see Rogers,1962) who were, at the time of the interviews, weighing the tools' advantages and disadvantages on the basis of their still limited but growing experience of applying them in different situations. At this stage of adapting a novel technology, trust is integral in shaping the users' perceptions of the technology's usefulness (Bhimdiwala et al 2021; Ejdys et al., 2024; Lankton et al., 2015; Modliński & Gladden, 2021). Our results showed that the facilitators did not fully trust the accuracy of the AI outputs, and that this hindered their use. One of the main purposes for developing the AI tools, as described by the developers, was to ease and reduce the amount of facilitators' work (see also Wojciechowski & Korjonen-Kuusipuro, 2023). However, the uncertainty about the way in which the tools form their outputs, and the distrust that this generated, meant that the facilitators felt the need to assess their accuracy by familiarizing themselves with the original content. This, together with the need to improve their own competencies in utilizing the tools, may in fact have increased the facilitators' workload. This perceived uncertainty is linked to the fact that the logic of the algorithm behind the AI tools is "black-boxed", meaning that it is hidden from, or

unclear, to the user (Qin et al., 2020). This presented a problem for the facilitators, particularly initially, because they felt that to fully utilize the tools, they needed to understand how the outputs were formed and conclusions reached (Leonardi & Treem, 2020; Qin et al., 2020). However, when the facilitators had accumulated more experience of the different ways in which the tools could be applied to serve the group's needs (Bhimdiwala et al 2021), they learned to use them in ways and in situations in which the issue of accuracy, and therefore also trust, was not central to the facilitation process. In such situations, the AI tools could be seen as complementing human facilitation (Dillenbourg, 2016). The facilitators' concerns about the AI tools' transparency stemmed from the fact that programmers control data visibility through algorithmic ordering (Leonardi & Treem, 2020). However, views related to this issue were completely absent in the developers' interviews, which raised concerns about their awareness of and willingness to discuss such issues publicly. This is worrying, as full transparency requires user control over some parameters to ensure visibility of their impact on the results (Brusilovsky, 2023).

When it comes to the potential of AI tools, as intelligent technologies, to support collaborative processes, there is particular interest in whether and how AI tools can do this by stimulating group interactions, such as expressing critical viewpoints, solving problems, and creating new knowledge (Engeström, 2015; Roschelle & Teasley, 1995). On the studied platform, the AI tools were at least somewhat effective in this regard, but they required human guidance to have an impact, emphasizing the importance of the facilitators' role and pedagogical knowledge (Ritella & Hakkarainen, 2012). To function as intended, the use of these tools must be designed to support each process's goals and to require participant data, in this case the participants' comments on the platform. This in turn requires the facilitators to learn to formulate assignments that encourage participants to contribute to the discussions on the platform, which can then enhance the interaction that is beneficial for collaborative development (Ritella & Hakkarainen, 2012; Yoon et al., 2020).

Today's rapid development of learning technologies offers new opportunities for digitally mediated collaborative development. AI technologies, though primarily designed for other purposes, can also be beneficial, especially for experienced facilitators (see Johnson, 2023; Mhlanga, 2023). For instance, generative AI, such as ChatGPT, can stimulate analytical thinking and teamwork among students, for example, provided that it does not replace teacher-student interaction (Mhlanga, 2023). However (the still) limited accuracy, transparency, and biases may restrict its usage. Platform developers should explain AI algorithms' logic and values to build facilitators' trust and ensure their suitability for their specific needs (Bhimdiwala et al., 2021; Lankton et al., 2015). Collaboration between researchers, developers, and pedagogical specialists is crucial for designing effective AIED technologies (Stahl & Hakkarainen, 2021). Integrating technological development into educational theories and practices can help AI tools support facilitators in complex tasks, allowing them to focus on more important pedagogical aspects (Rummel et al., 2016; Stahl & Hakkarainen, 2021; Brusilovsky, 2023).

Although the results of this study are promising, more AIED research is needed on collaborative work development. Our study is a snapshot of platform developers' and facilitators' conceptions of the benefits and limitations of using a specific AI tool on a specific platform created for synchronous and asynchronous interaction and development. As AI is developing so rapidly, and the features of the studied AI tools are under continuous

development, the conceptions of their benefits and limitations are also likely to change over time. The central limitation of this study was that it did not include the viewpoints of the participants, i.e., the people who took part in the collaborative development. Furthermore, the use of AI for the purpose of collaborative development is something that cannot be fully captured by merely studying people's conceptions: This would require combining various approaches, methods, and materials (Silverman, 2010). To strengthen our findings, the data derived from the AI-enhanced collaborative development activities on the platforms also need to be analyzed. For instance, it would be valuable to compare different AI-enhanced developmental interventions and to study how pedagogical solutions and different learning platforms affect development processes and outcomes.

CONCLUSIONS

Digital platforms enhanced by AIED tools are being increasingly used to facilitate the collaborative development of work. This study shows that AI tools can be utilized as task-assistant, participation-assistant, process-assistant, and interaction-assistant functions. Through these functions, and in combination with compatible facilitative actions, AI tools have the potential to mediate collaborative development on digital platforms. However, because the operational logic of the AI tools was unclear and opaque to the facilitators, they were not able to utilize the tools' to their full pedagogical potential. This suggests that platform developers should clarify the logic of the algorithms, make visible the mechanisms through which the AI tools form their outputs, and offer users at least some control over the algorithms.

IMPLICATIONS FOR THEORY AND APPLICATIONS

This study expands the scope of AIED research to work development and examines AI–human collaboration, specifically, the potential of AI-based tools to support the facilitation of collaborative development processes. It highlights that AI tools do not generate developmental actions as such, but that they may help facilitators create conditions for collaborative development. By identifying four functions of AI tools (i.e., task assistant, participant assistant, process assistant, and interaction assistant), the study helps facilitators reflect on the ways in which they can utilize these specific tools in their own work. The study also identified some limitations to using AI-based tools, such as the need for facilitators to acquire competences in utilizing AI outputs in a pedagogically meaningful way. Platform developers, on the other hand, should be more aware of the practical challenges that facilitators face when using the tools. The study suggests that to increase the usability of AI tools, platform developers should improve the transparency of their algorithms.

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