Learning from errors in digital patient communication: professionals' enactment of negative knowledge and digital ignorance in the workplace

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Abstract

Purpose – The purpose of this study is to investigate how professionals learn from varying experiences with errors in health-care digitalization and develop and use negative knowledge and digital ignorance in efforts to improve digitalized health care.

Design/methodology/approach – A two-year qualitative field study was conducted in the context of a public health-care organization working with digital patient communication. The data consisted of participant observation, semistructured interviews and document data. Inductive coding and a theoretically informed generation of themes were applied.

Findings – The findings show that both health-care and digital communication professionals learn through experiences with digital "rule-" and "knowledge-based" errors in patient communication and develop negative knowledge and awareness of digital ignorance. In their joint efforts, they use negative knowledge to "bend the rules" and to explore digital ignorance in efforts to improve patient communication.

Originality/value – This study provides insight into the importance of collaboration between professionals with varying experience of errors in digitalizing patient communication. Such collaboration is required to acknowledge own shortcomings and create complementary negative knowledge to improve

digital patient communication. This is particularly important when working with innovative digitalization in health care.

Introduction

Public health care has undergone significant digital transformations that continue to shape the nature of work for professionals in the health-care sector (Gjellebæk *et al.*, 2020; Ivaldi *et al.*, 2022). Digitalization has been found to improve workplace services, for example, by providing opportunities to deliver better value at lower costs (Kokshagina, 2021), offering a more timely and tailored approach to the patient (Cegarra-Sánchez *et al.*, 2020) and supporting workers' learning (Fischer *et al.*, 2018). Still, digitalization also brings novel digital errors to the workplace, and to prevent errors, professionals need to develop digital expertise or collaborate with people holding digital expertise (Anthopoulos *et al.*, 2016; Busch *et al.*, 2018). Nevertheless, although unwanted, errors are also considered to provide opportunities for learning (Bauer and Harteis, 2012). However, in terms of digitalization, little attention has been given to errors as providing opportunities for learning to improve digitalized health care and develop expertise (cf. van Acker and Bouckaert, 2018).

In research fields of learning from errors, findings show that such learning involves actors sharing reflections on errors and developing knowledge of causes for and solutions to these errors (Bauer and Mulder, 2007b; Billett, 2012; Jonasson, 2015; Leicher and Mulder, 2016). In this regard, the concept of negative knowledge has been introduced (Gartmeier *et al.*, 2008; Oser and Spychiger, 2005; Parviainen and Eriksson, 2006). Negative knowledge is conceptualized as experiential knowledge about, for example, "what not to do" and "what is not (yet) known." Primarily, the latter form has been related to epistemological understandings of ignorance and the awareness of such ignorance to develop one's skills (Gross and McGoey, 2015; Parviainen and Lahikainen, 2021). In the present study, awareness of own ignorance in digitalization could thus be important for identifying the needs for new knowledge. Negative knowledge has been found to be central to learning how to improve prior error-prone practices (Bauer *et al.*, 2012). Supplementing this research, we suggest it is important to examine how professionals learn from varying experience in public health-care digitalization and thus develop and use negative knowledge and expertise. This view is supported by a recent study on health-care professionals who found that workplace reforms challenge prior expertise and knowledge of health-care professionals (Olsen *et al.*, 2018). Moreover, as Harteis *et al.* (2020) suggest, digital transformations may require particular capacities in workplaces already bringing together workers with different prior knowledge. Along this line of thought, Wilkesmann and Wilkesmann (2011) have suggested that every person can simultaneously be an expert and novice, holding mutual complementary knowledge in various fields, all needed to conduct work. However, a recent study of hospital physicians shows that professionals have difficulties with disclosure of their own limited or lack of knowledge (Wilkesmann, 2016). It is thus relevant to explore the relations of professionals, as both novices and experts, and how such relations influence their development and use of negative knowledge and awareness of ignorance.

Based on this, the present study is guided by the following research question:

RQ1. How do professionals learn from varying experiences of errors in digitalization and develop and use negative knowledge and awareness of ignorance in efforts to improve digitalized health care?

To answer this question, we conducted a two-year qualitative field study in a Danish public health-care organization working on digitalizing patient communication. We selected this context because health-care providers across all clinical practice settings are progressively adapting and relying on communication and information technologies to perform their professional activities (Jarva *et al.*, 2022).

Below we present the theoretical framework centering on learning from errors, elaborate upon the role of experience in digitalization in public health care and summarize existing research on negative knowledge and ignorance. This is followed by an account of our methodological approach. Finally, based on the presentation of our findings, we discuss the implications for theorizations of handling errors in public digitalization and implications for practice.

Theoretical framework
Learning from errors and varying digital experience
Errors broadly refer to deviations between an action's intended and actual outcome (Reason, 1990). Thus, by definition, errors represent actions that fail to achieve their goal. In addition, evaluating an action as an error implies making a judgment as to explicit or implicit normative criteria in relation to the goal (Rasmussen, 1987; Reason, 1995). Relatedly, Billett (2012) advances the position that errors are never wholly objective events and that recognizing an error is conditioned upon a specific situation and context. While this definition captures the broader conceptualization of errors, errors are also multifaceted and different taxonomies have been developed (Frese and Altmann, 1989; Frese and Zapf, 1994; Rasmussen, 1982; Reason, 1990). Reason (1990, 1995) distinguishes between "rule-" and "knowledge-based" errors. Rule-based errors are actions that do not achieve the desired outcome, either due to the wrong application of a good rule, the nonapplication of a good rule or the application of a bad rule. Knowledge-based errors refer to mistakes where the individual does not achieve the intended outcome due to knowledge deficits. The distinction between different types of errors is important because previous research demonstrates that different types of errors provide different learning opportunities. Specifically, rule- and knowledge-based errors, as compared to more simple slips, contain a higher potential for reflection on experience (Bauer and Mulder, 2007a; Gartmeier and Schüttelkopf, 2012; Keith and Frese, 2005; Reason, 1990).

In its exploration of learning from errors, some research emphasizes the importance of sharing reflections on errors (Bauer and Mulder, 2013; Bell and Kozlowski, 2011; Billett, 2012; Jonasson, 2015). Moreover, some research emphasizes the collaborative handling of errors as an important part of becoming a competent knowing insider (Gherardi, 2001). This view on learning and knowing is mirrored in theories of situated learning and legitimate peripheral participation, conceptualizing learning as changing participation in changing practices (Lave, 2011; Lave and Wenger, 1991). Here, learning connotes the movement, and knowing connotes the participation with the ongoing practice (Lave, 2008). Knowing is situated in practices that involve sharing and negotiating knowledge as part of the social processes of becoming an experienced participant in a given work community (Lave, 2011). Drawing on such theories for analysis, we suggest that employees with more or less digital experience learn through sharing reflections on errors. Through this, they might develop knowledge that changes their participation in collective efforts to improve their practices.

These theories might help illuminate ways of becoming a legitimate participant, yet prior empirical research shows that becoming competent in health-care digitalization is rather complicated. For example, a previous general assumption has been that novel technologies render the human gaze superfluous. Nevertheless, there is general agreement that this is far from the case (cf. Orlikowski, 2007; Shestakofsky, 2017). For instance, Shestakofsky (2017) calls into question the purported autonomy of technologies, emphasizing the essential role of human activity in their development, implementation and update to adapt to changing environments.

Fischer *et al.* (2018) supplement this argument by suggesting that although technologies may free up workers from repetitive tasks, they simultaneously allow them to use their skills in new and innovative ways. This creates a labor market that depends on highly skilled workers able to reflect on the nature of their work and the opportunities offered by digital tools and technologies (see also Harteis *et al.*, 2020). Thus, as technologies and digitalization continue to develop, working life is becoming increasingly complex and challenging with digitalization reshaping the work tasks and tools associated with it. Based on digitalization then, professionals need to constantly develop their skills and knowledge to coproduce relevant digital services (Ivaldi *et al.*, 2022; Saari *et al.*, 2019). In doing so, health-care professionals have emphasized a need to widen skills and knowledge of more traditional patient–professional interactions with knowledge of digital means (Jarva *et al.*, 2022). Concerning learning and the development of knowledge in digitalization, there may thus be a need for both health-care professional novices in digitalization and digitalization professional novices in health care to collaborate for the purpose of widening participation and collaboration to develop mutual complementary knowledge (cf. Wilkesmann and Wilkesmann, 2011).

Ignorance: negative knowledge and known unknowns
The emerging field of ignorance studies attempts to fill theoretical and empirical gaps by addressing how different forms of ignorance affect various sectors of society (Gross, 2007; McGoey, 2016; Vitek, 2008). One of the key insights of ignorance studies is that ignorance is not just a vicious epistemological condition of lacking knowledge. A readiness to admit one's own ignorance and the ability to be open to unexpected situations are important resources for both individual experts and organizations to cope with rapidly evolving technological environments. In recent research, ignorance is understood as an intrinsic element in all social organizations and professional work (Bakken and Wiik, 2018; Essén *et al.*, 2022; Roberts, 2013, 2015; Wilkesmann, 2016). For instance, practitioners who understand the usefulness of ignorance are often better positioned in advancing their knowledge and skills as well as negotiating successfully with their colleagues (Gross and McGoey, 2015). Ignorance may take form as either "unknown unknowns" or "known unknowns" (Gross, 2019; Witte *et al.*, 2008). *Unknowns* are understood as uncertainties whose existence we can sometimes anticipate and identify, even if we do not know what they truly are. While *unknown* unknowns are by definition necessary knowledge that a person is unaware of not having acquired, this type of ignorance can be observed by another person or recognized by the individual in retrospect. On the other hand, *known* unknowns concern necessary knowledge that the person is aware of lacking and has the possibility of pursuing, or ignoring, yet to ignore something is different from being ignorant/ignorance. Ignoring (something) connotes deliberate overlooking or inattention, and in this sense, it is concerned with more malignant actions, such as when knowledge is suppressed, disregarded or concealed to hold others in the dark (Wilkesmann, 2016). Such examples are not found in the present study, which is why this kind of conceptualization is omitted here.

We combine the conceptualization of "known unknowns" with the conceptualization of negative knowledge. In the fields of professional education and organizational psychology, negative knowledge is defined as a specific form of experiential knowledge uniquely associated with experiencing and learning from errors. Following Gartmeier *et al.*'s (2008, 2017) studies, negative knowledge encompasses procedural knowledge, which refers to "knowing what not to do" or "how not to proceed" in a specific situation. This has been found to be central for driving efforts to improve erroneous practices (Bauer and Mulder, 2007b; Jonasson, 2015; Leicher and Mulder, 2016). The development of negative knowledge and ignorance is assumed to be based on, and further promote, in-depth reflective processes

(Gross and McGoey, 2015; Oser *et al.*, 2012), which is important because reflection is considered an essential component of the development of professional competences (Parviainen and Lahikainen, 2021).

Our concepts of *digital ignorance and negative knowledge* comprise professionals' ability to become aware of what they or their colleagues do not know about digital systems and their experiential knowledge of knowing what not to do, respectively. In the same way that digital skills can be seen as a source of power and action, digital ignorance and negative knowledge can be a source of possibility to, for example, improve current practices.

The enactment of knowledge entails that knowledge is both developed and further shared and used through ongoing participation in social practices, referred to as "knowing" by Gherardi (2001). Following the situated perspective (Lave and Wenger, 1991), the *negative* aspect of knowledge relates to the heterogeneous character of activity, where knowledge is socially exchanged and negotiated. This involves diverse knowledge claims and conceptions of errors and negotiated understandings of what are, and is not, proper ways of doing (Lave, 2009). Knowledge also involves more explorative improvization with social and material resources at hand (Lave, 2008, 2009). In our analytical framework, we understand the enactment of negative knowledge and ignorance as entailing different stakeholders' socially exchanged claims of what not to do in digitalization, as well as also their challenging of own *ignorance* through explorative improvization with digital solutions. Such enactment of negative knowledge is learning in that the stakeholders thereby change their participation (cf. Lave, 2011). It is relevant to note that the heterogeneity and explorative improvization with materials relate to what Billett (2006) refers to as the requirements of work. When such requirements change due to, for example, digitalization coming with new standards, technical–social procedures or information availability, so does the access to expertise and resources, which therefore needs more scholarly attention (Billett, 2021; Billett and Choy, 2013).

Methodology
Research site, sample and selection
A qualitative field study design (Bernard, 1995) was found appropriate for exploring how professionals learn from varying error experiences and for developing and using negative knowledge in efforts to improve digital patient communication. The present study is part of a larger ongoing research project focusing on digitalization in public organizations. For the present unit of analysis, we focus on digitalization of patient communication in a large public health-care organization. The findings are presented based on two examples of how digital patient communication is being implemented within this organization. The first example of digitalization concerned various digital systems and templates for patient communication under way of being implemented across all organization departments, whereas the second example concerned a novel digital solution to be implemented in one department. For the sake of anonymity, we will not disclose further specificities of the digital tools and solutions. Nevertheless, the researched tools had in common a focus on improving communication and collaboration with patients. This was in line with the organization's overall digital strategy (official document not listed for the sake of anonymity) emphasizing that digitalization should prioritize patient quality. A shared aim was to develop and implement digitalized patient communication, which could improve patients' insight into their condition and related decision-making in their treatment. Furthermore, the digital tools should enable the professionals to communicate better with their patients and not become a hindrance in their work. Moreover, it was also important to ensure that digital patient communication could suit all patients of diverse backgrounds.

The present unit of analysis comprises a selection (Flick, 2018) of altogether seven different departments, that is, four health-care departments and three departments with focus on developing and providing support in digital communication. Three of the four health-care departments were involved in the development and use of digital systems and templates for patient communication. The fourth health-care department was involved in the novel digital solution, where a project group of four employees with health-care and administrative backgrounds and one manager were responsible for planning the intake of the novel digital solution.

In regard to the sample for interviews and participant observations, we relied on purposive sampling (Flick, 2018), that is, participants were sampled based on their experiences with developing and implementing digital patient communication. In particular, workshops focusing on digitalization (held in the studied organization) were central social situations (cf. Spradley, 1980) for the sample and selection. Two main sample groups were identified during the ongoing analysis. One group was employees and managers from the health-care departments. They were health-care professionals (e.g. nurses and physicians) or health-care administrative employees with expertise in communicating with patients (henceforth referred to as health-care professionals), yet they were relatively more novices in the digital technologies as compared with the other group of employees. The other group of employees had a professional background in digitalization and communication (henceforth referred to as digital communication professionals) and thus expertise in digital communication technologies, yet they had little daily experience with patients.

The unit of analysis comprises situations in which the two groups of professionals identify various errors in relation to the digital patient communication tools living up to the shared aims. Yet, in accordance with the notion of errors being identified by experts as deviations from the intended behavior (Reason, 1990), it sometimes became questionable whether, for example, rule-based errors were only identified as errors by one group and not by another group of professionals. The unit of analysis also comprises situations relevant for exploring learning from identified errors in terms of developing negative knowledge and expertise.

Data collection procedures
For the present unit of analysis, participant observations of approximately 35 days duration were conducted in relation to the development and implementation of distinct types of digital patient communication services. This involved participating in, for example, workshops (8) and meetings (14) arranged to facilitate the development and implementation. Furthermore, we observed the participants' everyday work with digital patient communication. We carried out the participant observations primarily with a "moderate degree" of participation although we, for example, at workshops, would participate more "actively" by helping the study participants prepare presentations (cf. Spradley, 1980). When we became more familiar with the study participants, we would also be included in their discussions and experimentation with digital templates and tools. This allowed us to experience the context in which the digital patient communication services were used. Observations were written down in the form of descriptive field notes, using both computer and memos.

In addition to participant observations, the researchers for the present unit of analysis conducted 19 semistructured interviews (Kvale and Svend, 2009) with health-care professionals ($n = 10$), digital communication professionals ($n = 6$) and managers ($n = 3$). Using purposeful sampling (Flick, 2018), we interviewed project members centrally involved in developing and implementing the digital patient communication services. The interviews were relevant for gaining insight into the professionals' experiences with the digitalization of patient communication and their collaboration with other professionals. All the interviews were recorded and subsequently transcribed.

Finally, data also consisted of document data generated during the study period and selected with the purpose of understanding the organization's overall digital strategy as well as the local departments' experiences with the digital technologies. This data was derived from the digital patient communication services, e-mail conversations between the participants and between the participants and the researchers and formal documents describing the digital patient communication services. The document data was primarily included to contextualize the interview and participant observation data analysis in regard to, for example, understanding the transformation of a digital template to written copies, or tracing the project members' e-mail correspondence with digital communication experts (cf. Atkinson and Coffey, 2014).

Data analysis
To answer our research question, we included data from both interview and participant observations in our coding and thematic analysis (Miles *et al.*, 2018). We met regularly during the data collection process to review the research progress and examine transcripts and field notes. In this process, first-order, primarily inductive codes were developed through reading the interview transcripts and field notes during and after the field study. These codes were later integrated into second-order codes (Miles *et al.*, 2018). Examples of such codes were "error identification," "digital experience" and "digital changes." Through a theoretical lens of situated knowing and enactment of negative knowledge and ignorance studies, we integrated the codes into patterned themes (cf. Gioia *et al.*, 2013; Miles *et al.*, 2018). Altogether, six themes were generated:

(1) "rule-based errors";
(2) "knowledge-based errors";
(3) "negative procedural knowledge";
(4) "ignorance";
(5) "learning as changing digital standards"; and
(6) "learning as exploration of digital tools."

For an example of how we conducted this data analysis, please see Table 1. We used data triangulation (Flick, 2007) to critically examine our analysis. This involved checking of inferences drawn from one data source by later collected data on the same phenomenon (Hammersley and Atkinson, 1997). An example of how this challenged and brought forward our identification of patterns was regarding the use of digital templates for patient communication. Overall, the preliminary findings from interview and participant observations indicated that digitalizing patient communication was positively received by the various professionals. However, later on, we encountered examples of how particularly the use of digital templates challenged some health-care professionals' opportunities of communication with certain patients. The findings based on this analysis are described below.

Findings
The findings show how professionals learn from varying experiences with errors in digital patient communication, develop negative knowledge of digitalization through widened experience with digital rule-based errors, using this knowledge to improve digital patient communication, and identify and explore own ignorance of digital technologies to improvise ways of expanding potentials in digital patient communication.

Second-order codes	Data examples	Themes	Presented finding
Digital standardization	"When it became a top-down template it became very different. So for the patient there is a lot of information you have to scroll through and it doesn't give you a nice overview." (Interview)	Rule-based errors	Making use of digital negative knowledge: Involving colleagues to "bend the rules"
Diverse patient communication needs	"We do have a digital version with a read aloud solution..." "But we have to deliver something we are not happy with to those who cannot access the digital solution." (Participant observation)		
Interprofessional knowledge sharing	"Of course it is all a process ... We have together been through the features 4–5 times before ending up with this version." (Interview)	Negative procedural knowledge	
Limits of digital patient communication	"We need to keep explicating this ... I see many advantages with i.e. opportunities of pictures and videos. But what are the barriers related to not using it." (Participant observation)		

Table 1.
Example of conduct of analysis: from second-order codes to presented finding

Source: Authors' own work

Making use of negative knowledge: involving colleagues to "bend the rules" of digitalization
In recent years, the hospitals' patient communication has become more digitalized. For instance, letters to patients, patient guidelines and general information about the hospital are among some of the patient communication systems that have been digitalized. Ideally, this should ease the patients' access to information. In addition, digitalizing patient communication enables more efficiency in critical work processes, such as updating and correcting crucial health-care information. As explained by a digital communication employee:

> [We have around] one thousand distinct pieces of patient information that contain an overlap in parts of the information – this can be changed by changing only two blocks of information [as opposed to having to change each document separately and manually]. That is entirely brilliant. (Interview)

To standardize the digitalized communication for both employees and patients and to enable semiautomation, digital templates were to replace previous paper and PDF communication materials. The templates were explicitly suited for online versions and included, for example, scroll-down and foldout menus. Thus, some of the benefits of this standardized digitalization were easy online access for patients to professionally recommended information and easy online editing of the information.

However, from the perspective of health-care professionals, a central flaw was that the templates for such digitalized communication were not necessarily fulfilling all patients' needs. For example, several health-care professionals mentioned that the templates, while suited for online information, were not suited for those patients who were still in need of a paper version either due to their lack of digital access or need to read on paper. Thus, the rigidity of the digitalized solution did not live up to the overall digitalization strategy of thinking of patients' needs first. As a couple of health-care professionals explained at a meeting:

> [Before all patient information was digitalized, we had] this really lovely, printed version for those who couldn't access the digital [online PDF] version. But now, the printed versions [based on the digital template] look downright grotesque – the information isn't on the same page, and the headings are difficult to grasp. [. . .]. We are extremely challenged with the printed version. (Interview)

In addition to the abovementioned problems with the rigidity of digital communication working best online, the health-care professionals emphasized rule-based mistakes in the digital patient communication templates not fulfilling the tailored solutions as promised:

> It is odd because [digital patient communication] is so ambiguous - and that is the reality we are trying to navigate. We have a strategy stating that we can deselect things [based on the patients' needs] while, in reality, we can't. So, we will have to operate in that schism, which is a paradox. (Participant observation notes)

Thus, while the employees could in fact deselect the online version by printing it out and handing it over to those patients in need of a print, they could not deselect the digital template. However, as mentioned, the digital template was not intended to be printed and thus did not look good. Some health-care professionals expressed much frustration with how to cope with the above-perceived rigidity and rule-based errors in digital patient communication. Still, through working with such shortcomings, other professionals developed negative knowledge in terms of how not to constrain digital communication by making patient-excluding templates and rules. As expressed by a health-care administrative employee with extensive patient communication experience:

> Again, out of respect to the patient group and the practitioner, it should never be an "either-or". It does not have to be digital. [. . .]. There are some dictations from above every once in a while like "all patient information should be digitalized". We [then] ask some of the central employees [. . .]. And then, you also find solutions that pragmatically fit to the needs of patients and practitioners. (Participant observation notes)

Health-care professionals having everyday contact with the patients experienced situations where digital patient communication failed because some of their patients did not use digital tools. As the quote shows, the health-care professionals used such negative knowledge (of what and when patient communication should not be digital) to reach out to colleagues in the communication department, who must approve all digital patient communication to ensure standardization. By reaching out and sharing their negative knowledge, they together tried to find ways to improve the tailoring of digital communication. Thus, the health-care professionals shared their negative knowledge of *when not to* digitalize to loosen the rule-based digital patient communication.

There were also examples of how the health-care professionals shared negative knowledge of *what does not work* with the communication professionals. In some instances, the digital communication professionals agreed to make compromises even though this might not be the easiest solution. A health-care professional working on a new communication project emphasized this:

> Backstage, we have this template from the region, specifying how everything should be set up – and our [patient communication] should then fit this template. But I thought this was a collaboration with the communication department, and they compromised when I said that it didn't work well. [. . .] The second thing is, we had this graphic designer who helped us make a nice layout, but she was not allowed to use her own professional graphic programs. She was not super happy with us [having to use the template]. (Interview)

In this way, through their everyday work with digital patient communication, health-care professionals gained important experience of various rule-based errors that originated

against the backdrop of the digitalization process. Through these experiences, they developed negative knowledge of what did not work or how and when not to create too rigid digital patient communication, which encouraged them to act as experts in patient communication despite being novices in digitalization. In sharing such knowledge with the digital communication professionals, they learned how to collaborate in compromising ways. Here, the digital communication professionals would, when needed, "bend the rules" and adjust the otherwise highly standardized digital patient communication. Vice versa, the health-care professionals in their work had to adjust to, for example, development of new projects to the hospital standards for digital patient communication to ensure consistent and easily updated communication. Thus, negative knowledge of how and when not to standardize digital communication was also negotiated and thereby enacted in ways that mutually enhanced both health-care and communication employees' learning. Bending the rules thus became a shared learning experience of interacting with the technical system. However, as outlined below, there were other situations where employees went further than to "bend the rules" to explore novel solutions for patient communication.

Awareness of digital ignorance: exploring novel solutions for patient communication
In another project, a smaller team of health-care professionals sought to develop a new digital solution for interactive patient communication in their department. What was important was the team's growing awareness of their own digital ignorance in connection with the development of the solution. First and foremost, they acknowledged that they might have made a mistake by buying the technology needed for the solution *before* fully realizing what a reasonable goal for the technology in improving practices would be. This was related to their lack of knowledge of the digital solution. As one of the health-care administrative professionals mentioned:

> I just want to agree that it has gone too fast – we attended this presentation on [the technology] and its use and thought it sounded promising in terms of digital patient communication – we then bought [the technology] but haven't gotten around to using it yet. So here we are with a tool that we would like to use – rather than focusing on a problem that we want to solve. (Participant observation notes)

Moreover, when talking with health-care colleagues who had previous experiences with similar technology, they found out that the technology they had bought did not seem to show an effect. As admitted by one of the health-care professionals:

> Although we don't have much experience with the use of this [technology] in relation to [patient communication], the experience we do have isn't good. (Participant observation notes)

The professionals wished to learn from their mistakes and therefore included digital communication professionals to help them specify the areas of ignorance, or what was not known, regarding possible applications of the new technology.

Based on becoming aware of their own ignorance, the professionals began to explore what they could do to improve patient communication using the specific technology. As an example of such explorative improvization, one of the project members came up with a novel aim of using the device as an educational technology to improve health-care professionals' knowledge of the patients' situations and thereby create high-quality patient communication:

> I made another draft [of the project], which has a different take [. . .]. It's about giving the employees an opportunity to explore the [patients'] worldview [. . .] The idea came to mind after talking with [the digital communication professionals] – I think they were quite clear in their communication when they said that the [technology] didn't work very well with the specific aim we had in mind. This is why I don't think it's a good place to start, rather, we start with the

employees. That was also one of the things [the digital communication professionals] made clear: Include the employees as early as possible. (Interview)

Although, in the end, the project group members decided to continue with the original plan to use the technology for digital patient communication, they also decided to include the patients early on and along the way in developing the digital solution. Again, this exploration was decided in correspondence with an advice given by the digital communication professionals, who encouraged the professionals to gain more experience by exploring step by step what is not known:

On the way towards realizing your project, sometimes things run a little off track if you get all the experiences at once. Maybe you should aim at following the staircase model; start in one place, move one step up [. . .] so [use it as] a way of getting hands-on experience with the technology. In this regard, I think you can move quite a lot on your own. But at some point you'll need to include individuals with more experience and knowledge. (Participant observation notes).

Moreover, the project group did not entirely give up on the other idea of directing the solution to train the employees, acknowledging that they could continue the exploration of the technology. Overall, they praised the opportunity of collaborating with other colleagues having more experience with digitalization and how this helped them develop consciousness of their own digital ignorance and explore the technology in the best possible way. This is exemplified in the health-care professionals' shared reflections:

The time we have spent with the [digitally more experienced colleagues] has been so important because we were allowed a different perspective on the project. We would never have finished the project, if we didn't realize that the technology didn't work well with the first aim we had in mind. (Participant observation notes)

Thus, in this case, the team noticed a deviation from their expectations which they could have chosen to overlook. Instead, they acknowledged having made some near mistakes by unknowingly buying the technology. The health-care professionals enacted such ignorance and thereby changed their participation in close collaboration with their more digitally experienced colleagues. Such changed participation actively reframed the meaning of the unexpected obstacles in a novel way and infused the prior obstacles with new meaning directed at their future implementation of digital patient communication. In other words, with the help of digital communication professionals, the health-care professionals developed an awareness of own digital ignorance, which became the foundation for learning in terms of further exploration of the opportunities and limits of the digital solution for patient communication. It seemed that primarily the health-care professionals had to admit to own knowledge-based errors and identify own ignorance as novices in digitalization. In doing so, the health-care professionals, with the support of digital communication experts, engaged in learning as explorative improvization with the digital tools. This also allowed them to valorize, on a health-care professional level, the open-ended, yet somewhat restricted, opportunities for improving patient communication.

Discussion and conclusion
Below we discuss the main theoretical implications of investigating health-care and digital communication professionals' learning from errors in digital patient communication. Moreover, we relate our findings to the larger context of the present study, that is, digitalization in public health care, and elaborate on related practical implications.

Before moving on to the theoretical implications, we present our findings in an analytical model (Figure 1) of learning from errors in digital patient communication. The model accentuates health-care and digital communication professionals' varying expertise and
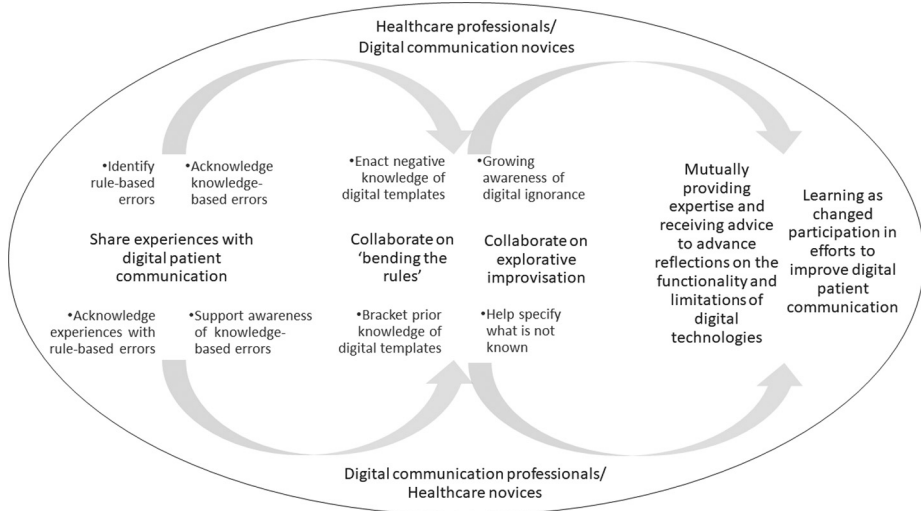
Figure 1.
Learning from errors
in digital patient
communication

Source: Authors' own work

novice experiences with rule- and knowledge-based errors in digital patient communication, respectively. The model emphasizes that through sharing such experiences, both groups of professionals enact negative knowledge and ignorance to collaborate on bending the digital rules and exploring new digital tools. Furthermore, both groups of professionals advance reflections on the functionality and limitations of underlying digital technologies through mutually providing expertise and receiving advice. These processes entail that learning evolves as changed participation in efforts to improve digital patient communication.

In terms of theoretical implications, the findings show that both discovering and handling errors in the digitalization of patient communication require close collaboration between various professionals. The digital and communication professionals hold much experience in developing digital solutions for patient communication. Thus, they are able to identify both opportunities to reap the benefits of easier online patient communication and potential errors in terms of setting realistic aims for novel digitalized communication. However, the health-care professionals have more direct experiences with the patients and can thus identify errors regarding too rigid digital templates. Besides, they are mainly responsible for experimenting with and providing relevant novel aims for digital patient communication. Thus, we suggest that diverse groups of professionals be occasionally experts or novices in the shared practice of digital patient communication. Based on these findings, we confirm prior suggestions that digital transformations require different employees with different prior knowledge to pool their resources and work together (Harteis *et al.*, 2020; Wilkesmann and Wilkesmann, 2011). Adding to this research, we suggest that more attention is needed to expertise as momentarily challenged by digital practices requiring expertise beyond that related to a specific profession. This may supplement prior understandings of situated learning as the gradual movement from being a novice to being an experienced participant (Billett and Choy, 2013; Dreyfus, 2004; Lave and Wenger, 1991). Adding to this, our findings suggest that health-care and digital communication professionals' learning comprises movements between moments of providing expertise and moments of receiving advice. It is through gaining access to such movements that both

professions gain experience and negotiate their enactment of (negative) knowledge in efforts to carry forward the digitalization process. Subsequently, health-care and digital communication professionals collaborate on mutual learning comprising changing participation in efforts to improve digital patient communication.

The findings also lend support to research emphasizing the importance of shared reflections on errors to improve practices (Bauer and Mulder, 2013; Bell and Kozlowski, 2011; Billett, 2012). Furthermore, we suggest that the shared identification of errors plays an important role for professionals to admit to their own expertise limitations in the conduct of health-care digitalization. As outlined in the Introduction section, errors are multifaceted. In the current paper, we identify two types of errors related to digital patient communication: rule and knowledge based. Through more experiences in working with digital patient communication, the health-care professionals identify rule-based errors in the format of their work. These rule-based errors are shared as negative knowledge of what does not work in meetings with digital communication professionals. The digital communication professionals with less patient communication experience bracketed their professional knowledge of digital communication formats and collaborated to bend the rules. Thus, in this example, negative knowledge impacts the practices that are constituent for the domain of the digital system, which is then being adjusted to the current procedures. In the second example, the health-care professionals bought a technical device, which could be considered a near mistake due to their non-knowing regarding the technical device and its possibilities in digital patient communication. However, in time and with the help of digital communication professionals, the health-care professionals explore digital ignorance and set novel digital patient communication aims, taking into account the specificities and limitations of the chosen technical device. Thus, in this example, negative knowledge is enacted by health-care professionals to exploit the opportunities offered by the digital device.

These findings express how different types of errors provide different development of negative knowledge and awareness of ignorance and how these impact differently the actors involved. In terms of rule-based errors, the results suggest that different professionals' shared learning from rule-based errors in digital solutions generate negative procedural knowledge of what not to do, or which rules do not apply well, to communicate with various patients. In terms of learning from knowledge-based errors admitted to by the health-care professionals, our findings suggest that with support from more experienced digital communication professionals, the health-care professionals' digital ignorance and non-knowing are revealed. This revelation generates reflective awareness of the limits in their own knowledge and regarding the effects of digital devices for patient communication.

It is evident, however, that errors are not solely perceived as errors by the diverse professionals. This observation is not surprising given that errors are defined by expert judgment to some criteria, yet it warrants sensitive discussion. For example, it remains unclear whether the digital communication professionals perceive the rule-based rigidity of digital patient communication as an error. In fact, they praise this rigidity in several ways, for example, for its standardization potential. Still, they include the health-care professionals' experiences of rule-based errors in terms of communicating with the patients. In this shared learning from errors, the digital communication professionals help bend the rules to make the digital patient communication a better fit for the patients. In doing so, the digital communication professionals as well as health-care professionals admit their own ignorance or their known unknowns for the benefit of the patients (Gross and McGoey, 2015; Parviainen and Eriksson, 2006; Parviainen and Lahikainen, 2021; Roberts, 2015).

The findings also show that knowledge-based errors are performed in situations of a lack of experiences with digital technologies. Here, the health-care professionals' growing awareness of their own ignorance encourages them to widen their learning in terms of collaborating with

other more digitally experienced colleagues in explorative improvization to become more experienced participants (cf. Lave, 2009; Lave and Wenger, 1991). In other words, the health-care professionals acknowledge that to become more competent in digitalized health care, they need to continue collaborating with other professionals in their exploration of the technical solution to improve current patient communication. We thus support the situated perspective on learning as also involving the explorative improvization with new material as well as social resources at hand (Lave, 2008, 2009). Moreover, we supplement this by suggesting that the social aspect of being willing to compromise when improving rule-based errors as well as admitting own ignorance of how to use materials (new technologies) are essential for learning through improvization. We do not claim that admitting rule- or knowledge-based errors is easy for either the digital communication or the health-care professionals working with digitalization (cf. Wilkesmann, 2016). Yet, with the help of colleagues with more expertise in how to improve practices and work around the errors, they manage to explore ways of improving patient communication. Besides, the health-care professionals develop awareness of own digital ignorance, which is offset for exploring novel ways of digitalizing patient communication. We suggest that this may also be relevant in relation to other areas of health-care digitalization, where health-care professionals often have to act despite being relative novices in digital systems. It seems that access to consultation with their colleagues as well as openly admitting and acknowledging ignorance are important for the development of health-care digitalization. Yet, more research is needed to confirm this.

Regarding health-care digitalization, we agree with research emphasizing that digital transformations continue to shape the work of professionals with various backgrounds (Gjellebæk et al., 2020; Ivaldi et al., 2022). Our findings suggest that the disruption caused by digitalization creates mutual concern among the diverse professionals. We also find that in joint efforts, they find ways to learn from errors in digital patient communication. These efforts are essential for strengthening expert knowledge to prepare health-care organizations and employees for future digital patient communication solutions. Moreover, this observation in the data aligns with current thoughts on workplace learning where learning takes place in the context of simultaneous use and application, besides it is in a concrete way embedded in everyday problem-solving (Billett, 2004a, 2012). Thus, adding to Harteis et al.'s (2020) argument that digitalization integrates workers and machines in networks, we suggest that digitalization may also further integrate different workers in close networks. As discussed, different workers may have different views on what constitutes an error in digital patient communication. Therefore, a practical implication is that the integration of different workers and machines in close networks may help to promote a more balanced view of health-care digitalization in that a health-care service may not be good (or bad) just by being digital. While our findings do not show any evidence of digitalization involving only either benefits or obstacles for patient communication, we suggest that more attention must be given to the rigidity of digitalization as well as possible rule-based errors. Although digitalization provides novel means and ends, as also suggested by Billett (2021), it also comes with a novel set of rules, conditions and limitations in conducting work, for example, patient communication. Thus, although health-care professionals find that they need to widen their knowledge of digital means (Ivaldi et al., 2022; Jarva et al., 2022; Saari et al., 2019), they might also need to consider whether digital conditions and limitations call for nondigitalized or less digitally advanced means of communication. It could be anticipated that such considerations can be supported through learning as involving a *balanced* enactment of both negative knowledge of "what should not be digitalized" and explorative improvization with advanced digital means of communication (cf. Lave, 2008, 2009). This might support further reflections on the functionality and limits of

digital technologies (cf. Harteis *et al.*, 2020), but indeed such a claim must be further investigated in future studies of learning in health-care digitalization.

The research study holds several limitations. First, the presented findings concern the various professionals' views on and experiences with digital patient communication. Future research could include patients' integration in networks with digital technologies and focus on their learning from errors and use of negative knowledge and awareness of ignorance in efforts to improve digitalization in public health care. Second, as we focus on the development and use of negative knowledge and ignorance in relation to digital patient communication in a public health-care organization, the results do not necessarily transfer to other digitalization contexts. Third, as our methodological approach is explorative, further studies could confirm the generalizability of our findings.

From a practical point of view, we suggest that collaboration and communication between employees with mutually complementary knowledge in both health-care and digital technologies is key for the successful use of digitalization in the future. Access to expertise is generally found important for workplace learning not least when the requirements of work are changing (Billett, 2004b, 2021; Billett and Choy, 2013). Yet, we suggest that digitalization accentuates the need for acknowledging that both professionals with expertise in health care and in digitalization need to mutually change their participation and enactment of knowledge to improve health care. As argued by Harteis *et al.* (2020), to count on formal training opportunities may be less fitting, as the development of digitalization is difficult to predict and therefore to formally train. Thus, in times of digital transformation, the ways of learning directly at the workplace become even more important. Our study suggests that the practical sharing of complementary ignorance and negative knowledge to improve digitalized patient communication should be included in health-care organizations for the benefit of the professionals as well as the patients.

Overall, based on our findings, we conclude that health-care professionals as well as digital communication professionals learn through sharing experiences with different types of errors in the digitalization of patient communication. In doing so, they develop and use negative knowledge and awareness of digital ignorance in joint efforts to improve patient communication. It can therefore be concluded that learning requires that health-care professionals and digitally experienced professionals complement each other to improve and further explore health-care digitalization.

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