A Practice-oriented Approach to Participatory Design

Designing Health Information Systems for Healthcare Networks

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***Abstract*—Active user involvement is crucial to designing a Health Information System (HIS) consistent with users' expectations and needs. Many design projects use Participatory Design (PD), involving users as active co-designers, to promote the democratization of work and empower the workers. While this design approach has worked in local contexts, there is an open question on how to broaden participatory design to healthcare networks in need for coordinating their services for patient-centric care. In patient-centric healthcare, various providers at different healthcare levels must coordinate their actions. In this paper, we discuss different challenges when PD applies to a healthcare network and how practice-oriented approaches can contribute to mitigating these challenges.**

Keywords-Participatory Design; Practice Theory; Health information systems.

I. INTRODUCTION

The increasing demand for healthcare services in several countries [1] puts pressure on health care providers [2] to increase throughput and quality of care, without increasing resources [2]. This pressure has caused more workload, stress, and dissatisfaction among clinicians, resulting in burnout and higher turnover [3]. Health Information Systems (HIS) can have a role to play in supporting clinicians to reduce their workload. However, many information systems fail when introduced [4] due to user resistance as a central contributing factor [5]. For the context of this paper, a HIS is a general term for digital information systems that assist clinicians in collecting, processing, and communicating health information internally and externally [6].

Recent studies on barriers and facilitators to HIS adoption indicate a compatibility gap between clinicians' expectations and the final solution [7]. Such a gap might occur when the final solutions are not consistent with their values, needs, past experiences, and work practices [8]. However, clinicians' needs and knowledge are sometimes hidden or hard to articulate [9]. In other situations, clinicians are not aware of their needs, or the needs change during the design process [9]. Thus, to narrow the gap between their real needs and the final solution, it is crucial to involve clinicians actively during the design process [4][7]. In this paper, we follow the definition by Ehn [10] that design is "a concerned social and historical activity in which artifacts and their use are anticipated; an activity and form of knowledge that is both planned and creative, and that deals with the contradiction between tradition and transcendence".

Participatory Design (PD) has a particular attention to hidden knowledge, needs and advocates an active involvement of users as co-designers [11]. Through active participation, users build competencies, are empowered and stimulated to meaningful work [12][13]. PD involves design and redesign of workplaces, jobs and technologies [14]. PD is a mutual learning process where participants and designers bring their unique expertise [13]. The designers learn about the work practices from the practitioners to give advice of future technological possibilities. The practitioners learn from the designers to be empowered to design their future work.

Much focus has been on situated and local learning in PD, with limited considerations of evolving the learning to broader arenas [14]. The coordination of activities and the need to share knowledge among practitioners across providers and levels of care (healthcare network) increases as the attention on patient-centric care evolves. The question is how to approach PD in a healthcare network, with boundaries among providers and practitioners, potentially containing an uneven distribution of responsibilities, resources, power, and decision rights.

Practice-oriented approaches also study knowledge emerging through mutual interaction. However, practices are the basic unit of analysis in these approaches. New ways of understanding social and organizational phenomena are possible when studying the performance of practices' actions [15]. Through practice-oriented approaches, situated relations between practices and the arrangements keeping

 ISBN: 978-1-61208-984-3

the practices together are analyzed and used for further studies of variations in practices at other sites and contexts [16]. In addition, by changing the arrangements that keep the practices together, this approach is also a resource for change [17].

Currently, we are working on a project, Valkyrie [18], where the aim is to promote healthcare service coordination for patient-centric care across healthcare levels. The ambition is to collect, coordinate, and present health data records from several heterogeneous Electronic Health Record (EHR) systems as a coordinated, standardized, virtual electronic health record system. The project involves clinicians from different autonomous practitioners across primary care (general practitioners and municipalities) and specialist care (hospitals). While boundaries exist between the providers, the broader healthcare network is dynamic and changes according to the individual patients' pathway. We expect to uncover conflicting needs among providers and practitioners during this project. Thus, active user involvement in the design process is crucial for the success of this project.

Many design research methods rely on user involvement. To our knowledge, PD is the only approach with the active participation of users co-designing their work future. To meet the challenges in the Valkyrie project, we decided to focus on the PD approach.

However, because of the known weaknesses of the method in PD, we wanted to see if a practice-oriented approach could help enrich the method to avoid some of its weaknesses. From earlier research, we were aware of the use of practice-oriented approaches in telemedicine [15], Sociomateriality [16], as well as in the study of educational and nursing practices [19]. However, we were unaware of studies using practice-oriented approaches in PD to expand the design process in a healthcare network, and to help overcome known weaknesses in PD.

In this paper, we discuss different challenges with using PD in a healthcare network and elaborate on how practice-oriented approaches can contribute to mitigating these challenges.

The rest of this paper is organized as follows. Section II describes methods and results from the brief literature search. Section III starts with a description of PD and practice-oriented approaches, and ends with a discussion of how practice-oriented approaches can help mitigate PD's challenges. Finally, Section IV gives a summary of the research and highlight its contribution and future work.

II. METHODS AND RESULT

We conducted a search in Scopus, without any limit on year of publication, with the query string: TITLE-ABS-KEY ("participatory design" AND practice AND (healthcare OR "health care") AND ("information system" OR "electronic health record system" OR telemedicine)), limited to title, abstract, and keywords. To verify our search, we used the same search terms in Google Scholar.

The search in Scopus identified 33 papers. We screened the papers based on their abstracts, and we decided not to include any of them since the abstracts did not indicate any use of practice-oriented approaches in PD.

The search in Google Scholar identified 19 papers. We screened the papers based on their abstracts, and we decided to include one paper. This paper introduces a practice-oriented approach to bridge ethnography with design research, including PD, for the healthcare domain [20].

Because of the limited results from the search, we did not consider any inclusion or exclusion criteria necessary.

III. DISCUSSION

The brief literature search conducted for this study did not show any significant use of practice-oriented approaches combined with PD. However, there are chances that we could have identified more papers by using other search terms. Searching for "participatory design" or "practice" would have resulted in more papers. However, we assume that such an approach would not have helped us identify more papers intersecting the two research fields.

This section discusses some challenges with using PD in a healthcare network and elaborates on how practice-oriented approaches can mitigate some of these challenges.

A. Participatory Design

PD emerged as a political protest movement in Norway [12], advocating active user involvement in design as means to increased empowerment [12], build competencies and stimulate meaningful work [13]. This design approach views knowledge as being created through the interaction among people, practitioners and artifacts [12]. It is pragmatic in that the design should also contribute to improvements for the research subjects [12]. Thus, PD is action oriented. In order to design for change, envisioning and enacting possible futures are necessary. As PD has evolved, techniques and tools are developed, such as stakeholder analysis, to find relevant stakeholders influencing the design or influenced by the design [13]. Tools and techniques such as personas, scenarios, mock-ups, simulations, future workshops and cooperative prototyping are commonly used in PD to help participants substantiate future possibilities with practical discussions [21].

Three basic steps for mutual learning and design are usually present in PD. First is the initial exploration of work, where practitioners and designers meet and explore workflows, routines and how technologies can support practitioners in their practice. Second is the discovery process, envisioning the future workplace and prioritizing tasks. The last step is prototyping an envisioned solution, involving several iterations of sketches, drawings, and descriptions, gradually evolving the prototype in a lab or at the workplace. The iterations allow participants to examine, reflect and discuss incremental redesigns at each iteration [12].

While PD can positively affect design outcomes, it can also introduce some challenges. Democratization of work, for instance, entails that each participant's voice is equally valued, even those that offend others or argue out of self-interest [13]. There is also a risk that certain practitioners

 ISBN: 978-1-61208-984-3

use power to influence design decisions, and such challenges can cause tension and conflicts with not necessarily an optimal design result.

Another challenge is to establish an environment for mutual learning. In PD, the activities that directly engage participants in the design are in the foreground, while understanding and learning becomes a natural part of the design work [22]. In contrast, ethnography starts with understanding work practices, which involves detailed workplace studies. As PD has evolved, designers have started to use techniques from ethnography to learn about current problems and work practices before they meet participants. However, it is not always clear when ethnography stops and design starts, and how designers can benefit from the contributions of ethnography [22].

The third challenge with PD is to involve the suitable candidates as participants and co-designers to ensure that the information system to be designed is well integrated into practitioners' work practices [21], thus more likely to be accepted as valuable.

The fourth challenge with PD is how to broaden the learning from one particular site to a design of HIS that is perceived valuable and accepted by practitioners in broader areas [21]. With the growth in providers and practitioners, variances in work practices and needs are likely to increase. The same applies to the risk of conflicts and tension among practitioners and providers. Finding participants that can look beyond their work are essential [21]. However, this also calls for attention to differences in organizational structures [23], such as roles, regulations, hierarchies and power relations, internally and across providers.

B. Practice Theory

Practice theory is one way to study organizational phenomena. Practice theory views organizations as consisting of practices that produce an outcome. A healthcare organization, in this view, is both the physical place and the result of the practices' work activities [15]. Following this view, a hospital, for instance, consists of different practices. All perform necessary actions at the physical place for the outcome of a healthy patient, such as cleaning rooms and beds, diagnosing the patient, delivering food to the patient and so on. The actions are of particular interest in this research field since actions together constitute the practice [24].

Practice-oriented approaches do not follow a single, unified theory. However, they all have in common that practices, not individuals or practitioners, are the basic unit of analysis for understanding organizational phenomena [15]. New ways of understanding social and organizational phenomena are possible by studying the performance of actions by practices [15]. Another aspect that practice theories generally have in common is the recognition of materiality, communication, and symbols as essential parts of the practice composition [19].

Practice theories usually follow Schatzki's site ontology, stating that practices consist of language (sayings) and activities (doings), always situated within a site or sites [25]. Knowing is sustained and manifested in practice and through practices in the happening (situated) [26], which marks parallels to PD, with its focus on knowledge construction through the interaction among people and artifacts [12].

Sociomateriality is a practice-oriented notion that views the performance of activities that mutually shape and reshape materiality (physical and digital material) and social phenomena [23]. In this perspective, the boundaries between materiality and social phenomena are inseparable and not pre-defined [27]. Through sociomaterial practice, which is the space for human and material agencies, objects emerge as sociomaterial configurations [23]. Caused by differences in performance, the sociomaterial configurations can take different forms, with varying social and material consequences, intended or unintended [27]. Following the sociomaterial tradition, Nicolini studied the mutually shaping of practices and telemedicine [15]. Orlikowski found that organizational norms affect people's decisions on using information systems, but when in use, people start shaping the system and seek new possibilities [16][23].

While Sociomateriality often studies current relations, design is future-oriented [20]. By introducing Sociomaterial-Design, Bjørn and Østerlund are concerned with bringing Sociomateriality closer with practical design research, including PD, for the healthcare domain [20]. Their studies show how Sociomaterial-Design can bridge ethnography and design, which can be a valuable contribution to design research.

However, Sociomaterial-design and Sociomateriality, in general, suffer from treating organizational structures implicit. According to Leonardi [23], sociomaterial practice is similar to a technical subsystem from a socio-technical system perspective. Leonardi [23] reminds us that organizations are socio-technical systems consisting of a technical and social subsystem. The social subsystem consists of constructs such as roles, statuses, hierarchies, and power relations. While humans and materiality mutually shape each other in a technical subsystem, there is also an ongoing mutual shaping of the social and technical subsystems. In healthcare, the social subsystem is strong and affects knowledge sharing and collaboration between organizational and professional boundaries [28]. When designing a HIS for a health care network, it is crucial to understand both the social and the technical subsystems and how they affect each other.

 ISBN: 978-1-61208-984-3

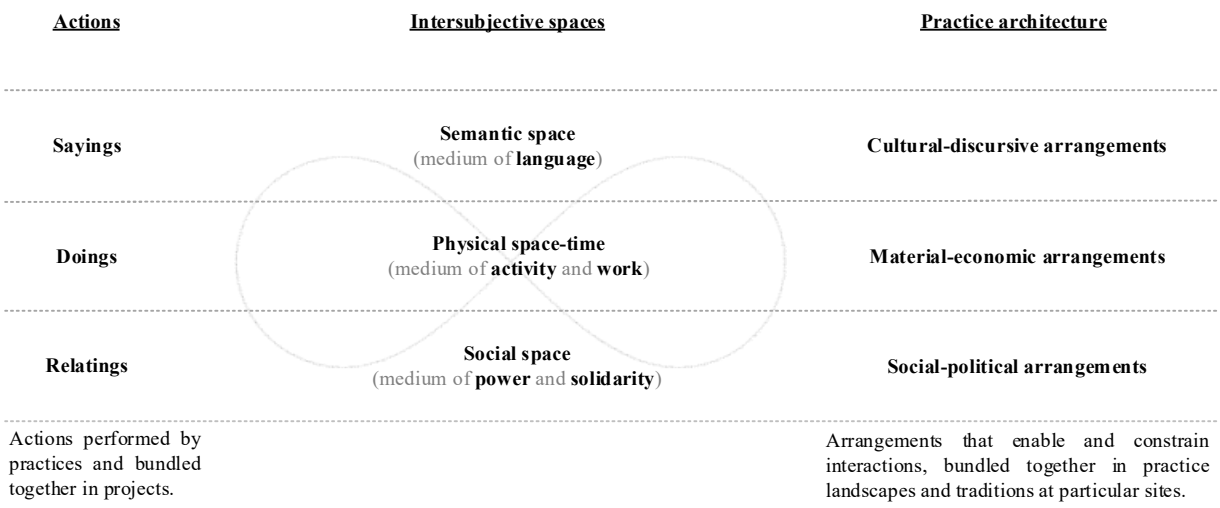

Figure 1. A simplified illustration of the theory of practice architectures [19]

In contrast to Sociomateriality, the theory of practice architecture expands on Schatzki's site ontology, making power and politics (Relatings) explicit, together with language (Sayings) and activities (Doings). Developed initially for studying educational practices, the theory of practice architecture has gradually evolved in other practice fields, such as nursing, teacher mentoring and professional learning at universities [19]. To our knowledge, no studies so far have used this theory in PD.

The theory of practice architecture (Figure 1) is domain-neutral and represents a view of what constitutes and shapes the practices. Practices in this theory, are human actions composed of what they say (Sayings), what they do (Doings) and how they relate (Relatings) [19][24]. These actions are interconnected and not reducible to one of these actions in isolation [29].

Projects bundle actions (left side in Figure 1) and contain the intentions that motivate the practice, the aims to achieve, and the practitioners' dispositions. When a nurse is engaged in nursing, one such project is to support the recovery of patients after surgery. The specific activity is justified through particular sayings and social relatings, with the intention and aims of the nursing practice. Through actions, aim, intention and disposition, practices can be examined and give insight into how and why others perform the practice differently.

There is also a continuous mutual shaping between the practices and the context. The context manifests itself in aspects of what is sayable, doable, relationships, rules, regulations and expectations. Through the theory of practice architecture, context emerges in the foreground. It becomes tangible through the practice architecture consisting of three interconnected arrangements, cultural-discursive, material-economic and social-political (right side in Figure 1) [19][24]. The practise architecture are the preconditions, traditions, constraints and enablement of the practices, by occurring in or brought to a particular site [19]. Transformation of practices' actions can also occur by bringing in new arrangements or creating new arrangements at the site [30]. For instance, rearranging the inside of a hospital building or creating a new information system can promote changes in the practices' actions.

The relations between practices and practice architecture emerge through three intersubjective spaces (Figure 1): interrelated semantic space, physical space-time, and social space. Through these spaces, practitioners come together in a shared language, material reality, power and solidarity [17] for mutual learning, acceptance and maintenance of the practice, and shaping and reshaping the practice [29].

The theory of practice architecture can be a valuable theoretical resource providing a concise language for interpretation and description [17]. It can explain situated dynamics and relations at one particular place, transferrable to study relations in other situations and contexts [16]. The theory can also serve as an analytical tool for identifying actual empirical connections between practices and the practice architecture, focusing attention on local variations in the mutual shaping of practices and the arrangements. Finally, it can be used as a resource for change, transforming the arrangements that keep the practices together [17].

C. How can practice-oriented approaches contribute to mitigate the challenges of participatory design in Valkyrie?

1) Equal voice and power relations

Democratization of work entails that every participant's voice is equally valued. Researchers have criticized this core value for letting those voices offend others and argue out of self-interest to be equally valued [13]. Since practice-oriented approaches use practices as the basic unit of analysis, they can help participants shift perspectives and view organizational phenomena from other angles. This shift in focus may help practitioners broaden their view,

thus reducing arguments out of self-interest. However, we should also remember that PD projects promote change that hypothetically leaves some better off while worsening the situation for others. Arguing out of self-interest is, therefore, not always a bad thing. Sometimes, such arguments can lead to new insight and new ways to approach the design.

Change can also affect current power relations. To empower workers means a distribution of power from others. Power relations, hierarchies, statuses and roles are embedded in healthcare practices [28]. Power is exercised between practitioners internally in a healthcare organization and between organizational boundaries, representing barriers to effective coordination and knowledge sharing [28]. Tension and conflicts may arise if the design implies changes to current balances. In Valkyrie, it is necessary to understand current power relations since we are working with different groups of healthcare professionals and with providers at different care levels. Likewise, it is crucial to understand how design changes might affect current power relations, hierarchies, statuses and roles. The theory of practice architecture can provide us with both a framework and a vocabulary to study the empirical relatings, sayings and doings at particular locations. Learning of these relations can move to broader areas to design a HIS to promote service coordination for a healthcare network. However, the theory of practice architecture will not solve this alone. After all, the willingness to design for change rests with the practitioners, which is why we want to involve them as active co-designers in Valkyrie.

2) Selection of practitioners as co-designers

It is crucial to involve suitable participants in the project since PD relies heavily on expert users as active co-designers. Ideally, participants should both represent their profession and be open-minded to learn from others to contribute to the design of their future work.

Stakeholder analysis, a method used in PD [13], supports the discovery of relevant stakeholders influencing or influenced by, directly or indirectly, the design project. Stakeholder analysis is relevant to Valkyrie, but finding relevant stakeholders in a healthcare network gets complicated since we also need to consider the organizational boundaries. We believe that the theory of practice architecture can contribute to the stakeholder analysis in at least two ways.

First, the focus on practices adds a layer to the stakeholder analysis, otherwise oriented towards individuals and organizational roles. This move introduces a domain-neutral perspective across boundaries, relevant for discovering stakeholders, especially those indirectly influenced by design.

Second, the practice layer is also a change tool to plan for future practices. The view of future practices can lead to the discovery of future users and stakeholders considered relevant to the project.

While the theory of practice architecture contributes to the stakeholder analysis to discover relevant stakeholders to Valkyrie, it does not provide any mechanism to choose individuals suitable as active co-designers in the project.

3) Establishing an environment for mutual learning

Both PD and the theory of practice architecture focus on *change* and *understanding*. However, they have different starting points. The theory of practice architecture starts with understanding the mutual shaping and reshaping of practices and the practice architecture and eventually uses this insight for possible future rearrangement and change. PD has the change as a starting point, while understanding becomes a natural part of mutual learning during the design process.

To understand participants' work practices and needs, designers must first learn their language and how they think and act, indicating that the initial exploration of work in PD may take up much time. However, time is often a limiting factor for clinicians, who otherwise would use their time on treating patients. In Valkyrie, we believe that an ethnographic workplace study with open-ended interviews and observations of clinicians in their natural work setting can contribute to a better environment for mutual learning later on in the PD project. Clinicians can benefit from this by reducing additional time, creating a more focused mutual learning process, and lowering the risk of frustration and tension.

However, how detailed the ethnographic study should be is a question to be explored further. This is also ongoing discussions in the PD research community. Ethnography and design research seem to overlap, which is why we find the Sociomaterial-Design approach appealing. This practice-oriented approach bridges ethnography with design research to incorporate understanding and learning with action and change. However, we miss the sensitivity towards organizational constructs such as roles, statuses, hierarchies, and power relations. We find this highly relevant in HIS-design for a healthcare network, such as for Valkyrie. The theory of practice architecture can provide us with such perspective at a particular site and in broader areas. However, the theory of practice architecture does not provide any intersection between understanding and design that Sociomaterial-Design provides. In Valkyrie, we will further explore how practice-oriented approaches can contribute to PD projects in the healthcare domain.

IV. CONCLUSION AND FUTURE WORK

In this paper, we have discussed some challenges related to Participatory Design (PD) when designing an information system for a health care network. Further, we have discussed how practice-oriented approaches can help mitigate these challenges.

Practice-oriented approaches do not mitigate all aspects of the recognized challenges. However, they can contribute with a vocabulary and a way of thinking that can help inform the design through different phases of the research project. They can also help to identify actual empirical connections between practices and materiality to interpret and explain practice variation.

One of the practice-oriented accounts, the theory of practice architecture, provides a framework to understand the practices' actions through language, activities, power, and politics. Power and politics are relevant in healthcare and

 ISBN: 978-1-61208-984-3

essential to move the design from local sites to broader healthcare networks.

This paper contributes to practice-oriented approaches in technology design by adding the dimension of power and politics. This paper also contributes to the ongoing discussions in the research community on how to evolve PD to meet the future needs of ubiquitous healthcare data in patient-centric healthcare.

In order to understand how practice-oriented approaches can contribute to mitigating the challenges of PD, we will explore this further as part of the Valkyrie project.

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 ISBN: 978-1-61208-984-3