PARTICIPATORY DESIGN AS AN APPROACH FOR WORK-INTEGRATED LEARNING OF DIGITAL COMPETENCES: PUTTING THEORY INTO PRACTICE

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Abstract. *Technology is radically changing the healthcare sector. Introduction of technology demands new ways of providing healthcare services and the professionals will need new knowledge and competence to be able to do their job and to contribute to the continuous development of the sector. There is limited focus on digital competence and change-processes in the educations related to healthcare as well as in the workplaces. Applying work-integrated learning makes it possible for healthcare professionals to learn and develop their competence through practical work with examples from their own workplaces and empower them to maneuver the digitalization of the workplaces. Similar participatory design started as a movement to empower industrial workers to have a stronger voice during the introduction of new technologies at their workplace. As such participatory design is a design approach which promotes involvement of all stakeholders in the design of technologies that affects them. It provides a set of tools and techniques to enable active involvement in the design process. We use these tools and techniques to teach healthcare professionals digital competences needed in their workplaces, and we discuss opportunities of participatory design for work-integrated learning. Based on a set of three participatory design workshops, we present an approach that can empower healthcare professionals to maneuver the digital change at their workplace. We recommend continued investment in the development of work-integrated learning practices with a participatory mindset.*

Keywords: work-integrated learning, participatory design, experiential learning, lifelong learning, digital competences

1. INTRODUCTION

A crucial challenge in healthcare worldwide is the lack of compliance between people in need of healthcare and resources available to meet those needs (Blix, 2013; Chidzambwa, 2013; Hofmann, 2013; Nilsen et al, 2016). Propitious solutions to this challenge include eHealth related technologies as well as telecare (Lindberg et al., 2017; Marasinghe, 2016). Despite the possibilities of such technologies, they are not fully developed, and their potential is yet to be exploited (Gjestsen et al., 2017; Hoen et al., 2011; Modig, 2012). According to Cresswell and Sheikh (2013), there are many reasons for the limited dissemination of digitalization and the use of digital technology in healthcare service. Healthcare professionals' experiential skills, their training and knowledge, their expectations and means in technology use, as well as their habits and experiences in institutional context, established power relations and the technological artefacts at hand are pointed out as factors influencing the use of technology (Orlikowski, 2000). The digitalization of the healthcare sector requires changes in the workplace, workplace practices and a need for increased digital competences (Billett, 2015; Blix, 2013; Chidzambwa, 2013; Gjestsen et al., 2017; Hofmann, 2013; Länsisalmi et al., 2006). A survey conducted among municipal managers within the healthcare sector in Norway revealed that more than four out of five experienced a lack of relevant and needed technological and digital competence among their employees (Ipsos, 2018). The digital transformation of working life requires new further education and learning methods. There is a need to develop systems and tools that can promote lifelong learning in a

way that integrates work and education (NOU 2019:12, 2019) and to a greater extent adjusts to knowledge needs generated in society (Gellerstedt et al., 2015). The aim of this paper is to describe a set of tools and techniques for lifelong learning. Based on a participatory design mindset we present a case of three workshops that support the acquiring of digital competences for healthcare professionals as an approach to work-integrated learning. We explored the research question: **How can participatory design facilitate work-integrated learning of digital competences among healthcare professionals?** In chapter 2 we present a short summary of work-integrated learning as a pedagogy for lifelong learning, before discussing in chapter 3 how a participatory design mindset can be deployed for work-integrated learning. Chapter 4 presents a case study of three participatory design workshops for healthcare professionals to acquire digital competences, followed by a discussion of the approach in chapter 5, and a concluding summary in chapter 6.

2. WORK-INTEGRATED LEARNING AS A PEDAGOGY FOR LIFELONG LEARNING

Work-integrated learning (WIL) is described as "a combination of education and practice in the workplace" (Hattinger et al., 2014). According to Billett (2009), WIL is a pedagogical practice whereby students come to learn from the integration of experiences in educational and workplace settings. WIL appears in many forms, but the core is the expectation that integration of theoretical studies and work-experiences will create learning and employability (Gellerstedt et al., 2015). Sattler (2011, p. 29) points at the workplace as "the central piece of the learning" through, e.g. systematic training. So far much of the utilization of and concerns for WIL practices are directed towards students' initial preparation for their selected occupations. Ongoing learning across working life to acquire new competences has been somewhat neglected from the research community. Billett and Choy (2011) discuss how WIL can support ongoing development across working life. They describe how educational needs arising from changing occupational requirements are best addressed using augmented experiences in practice settings through pedagogic practices. Both the requirements for work are changing which necessitates for ongoing learning, and the kind of knowledge that needs to be adopted requires interventions and deliberate pedagogic support. Therefore, educational programs need to draw upon workplace experiences and augment the capacities of practitioners in ways that make particular and required contributions to their workplace learning.

Compared to students' initial preparation, the goals for lifelong learning are more heterogeneous, because the practitioners are at different points in their development and have different goals, emphases and directions for the development related to competence in general as well as the more concrete digital competence. WIL techniques have to consider what practitioners already know, what they need to know, and how this learning best can be realised. The different starting points of the practitioners comply with a constructivist approach to learning, where WIL can be viewed as situated learning, meaning that the learning outcome for every individual depends on social and cultural interaction, where the learning takes place and what tools are available (Pennbrant and Svensson, 2018). Within WIL, development of learning happens through exchanging knowledge, collaborative reflection on actual situations or cases and a committed participation (Ibid.). These different pedagogic approaches cannot prescribe the intended outcome, but instead, negotiate it with the practitioners. Billett and Choy (2011) make a list of three requirements for WIL as a pedagogy for lifelong learning:

- Develop further the foundational knowledge upon which occupational practices are premised
- Access the kinds of knowledge which are hard to learn through practice because they are opaque
- Secure knowledge that is hard to learn because of its intricacy or complexity

Billett (2004, p.312) argues that the workplace is a field of knowledge or learning environment. Particular attention should be given to the dualism between what workplaces afford practitioners due to activities and interactions and how "individuals will engage in ways that best serve their purposes, such as how it

will assist their career trajectory, securing opportunities, or even locating easy work options". This dualism implies that both learning outcome and the way work-integrated learning can be facilitated depends upon how the individual participation is regulated through cultural practices, workplace affiliations (Billett, 2004) as well as tools, techniques and pedagogic that promotes the engagement of the individuals by utilizing their knowledge as a substantive pedagogic resource and providing opportunities for sharing and learning from that resource to create meaningful and valuable learning activities (Billett, 2001).

2.1. Experiential learning as a theoretical foundation of work-integrated learning

One of the learning theories, on which WIL is grounded, is Kolb (2014) experiential learning theory (Stirling et al., 2016). Experiential learning is based on the notion that knowledge acquisition occurs when an individual grasp and intentionally transforms his or her personal experiences. Kolb's theory has been formed by the work of Dewey (1933), Lewin (1951) and Piaget and Kamii (1978). Hence, in Kolb and Kolb (2005) they identify six core tenets upon which the experiential learning theory is founded: Learning is a process; Learning is grounded in experience; Learning involves mastery of all four learning modes; Learning is a holistic process of adaption; Learning occurs when an individual interacts with his or her environment; and Knowledge is created through learning. Building on these tenets Kolb (2014) describes four modes of learning within the experiential learning theory, such as:

- The *concrete experience (CE)* mode of learning emphasizes an individual's engagement with experience. It concentrates on the subjective feelings attached to an individual's present reality.
- *Reflective observation (RO)* focuses on descriptive observations of the experience. In this mode, the learner engages in reflection regarding an event occurred.
- *Abstract conceptualization (AC)* concentrates on applying logic, theory and concepts to experience. This learning mode means being able to use the theoretical background to further increase the knowledge originated from an experience.
- Finally, the *active experimentation (AE)* mode of learning emphasizes the use of experimentation to alter an environment or an experience. It focuses on creating practical, effective applications to solve pertinent issues (Stirling et al., 2016).

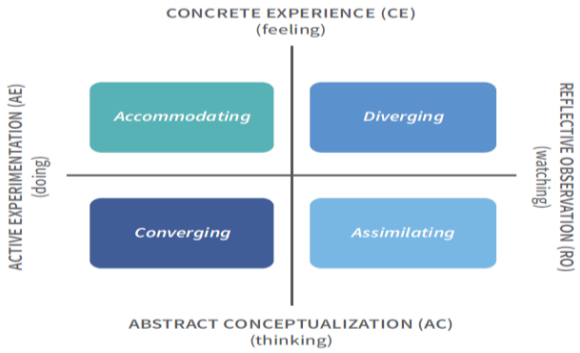


Figure 1: A representation of Kolb's model as presented in the WIL manual from the Higher Education Quality Council of Ontario.

To have a favorable learning process, all four modes should be integrated without any sequential limitation (Kolb et al., 2001, Evans et al., 2009). Furthermore, Kolb (2014) theory identifies four basic learning styles when acquiring new or building on existing knowledge. Adopting a particular learning style will be influenced by various factors in individuals' life (e.g., parents, peers, education, and employment. Each learning style favours an orientation toward two learning modes (Stirling et al., 2016) as illustrated in Figure 1.

- The *converging* learning style is associated with an orientation toward active experimentation and abstract conceptualization. Skills commonly associated with this learning style include problem solving, reasoning and practice (ibid) .
- The *diverging* learning style aims at a concrete experience and reflective observation. Skills commonly associated with this learning style include perspective-taking, observing one's feelings and possessing a creative imagination (ibid).
- The *assimilating* learning style is associated with an orientation towards abstract conceptualization and reflective observation. Skills commonly associated with this learning style include the generation of theoretical frameworks and interpreting abstract thoughts or ideas.
- The *accommodating* learning style is associated with concrete experience and active experimentation. This learning style is commonly associated with skills including engagement in activities, implementing designs, taking risks and adapting to new environments. Interestingly, a person's chosen vocation often aligns with and accentuates his or her learning style (Kolb, 1984).

We apply the experiential learning model to emphasize the importance of the experience for work-integrated learning as a pedagogy for lifelong learning as argued for by Billett and Choy (2011). We built on experintal learning theory in creating our curricula for work-integrated learning. In our curriculum we present an example where the learning modes and styles of experiential learning are put into practice through a set of participatory design techniques that we will present in the following paragraphs.

3. TOWARDS A PARTICIPATORY DESIGN APPROACH FOR WIL

Participatory Design (PD) flourished among the various social, political and civil rights movements of the 1960s – 70's, when people in Western countries required more and stronger rights on the decision making in situations of shared interest and values (Simonsen and Robertson, 2012). PD has its roots in the democratization of the working place. It started in Scandinavia with Nygaard, who in the early 70's cooperated with the Norwegian Iron and Metal Workers Union (NJMF) to analyze problematics of new technologies in the working place and develop strategies to boost workers' power in relation to management technology initiatives (Simonsen and Robertson, 2012). The idea of giving power to workers in the digitalization process came as a consequence of an increased contradiction between management strategies, which were oriented toward de-skilling workers for increased efficiency and profits, and a change in legislation, where workers were given the right to access more information (Greenbaum and Kensing, 2012). The NJMF project was the first project in which workers and trade unions were involved in the technology immersion process at the working place. This new approach of system design, where the workers' voice was represented first, became a representative of the Scandinavian design tradition and later, it spread to other countries and disciplines (Van der Velden and Mörtberg, 2014). Action for change generated needs for new knowledge, which furthered new action. Thus, the outcomes of the NJMF project were a set of directives and activities that would sustain workers participation in the introduction of new technologies in their working places. The core of the project was to help workers to improve IT knowledge, so they could better represent themselves in discussions with the management. The idea of knowledge as important resource and the need to communicate across domains is central for our case.

Mutual learning is one of the main principles of PD (Greenbaum and Kensing, 2012). In a design context, this means, that stakeholders, involved in participatory design, share their knowledge and values in order to enhance common understanding by finding common ways of working. In the example above, workers are domain experts. They have first-hand knowledge of their workplace practices. The designers, on the other hand, have the technical expertise (Simonsen and Robertson, 2012). The two groups of stakeholders can enter into dialogue and mutual learning by sharing concrete exemplary knowledge. During the last thirty years the field of PD has improved due to tools and techniques which enhance mutual learning among different stakeholders in design projects (Greenbaum and Kensing, 2012, Brandt et al., 2012). In the same way, work-integrated learning aims to provide opportunities for practitioners to share their experiences and develop new competences together (Billett and Choy, 2011). Here we will explore if PD

tools and techniques can be used in the context of WIL. Participatory design is a design discipline, and the tools and techniques (Brandt et al., 2012) are meant to be used in design processes that aim at the design of new technologies, not related to the domain of learning and teaching. Previous work discusses how to teach participatory design, not taking a PD approach as pedagogical method.

We found scarce previous work, e.g. (D'Andrea and Teli, 2010), that describes and analyzes teaching experiences of using PD as a pedogeological method from a PD course involving students in all course activities, discussing details and structure. D'Andrea and Teli (2010) emphasize the importance of the teacher as facilitator, both assuring the didactic quality and contributing to the process of balancing the powers. They point out challenges regarding time and effort in guaranteeing the process. Moreover, they found that the number of students in the class influenced the process management. Furthermore, there are two studies that have incorporated PD in work-integrated learning. The Rabbit Hole, a capstone unit in the 4-year Bachelor of Design (Visual Communication) degree in the School of Humanities and Communication Arts, University of Western Sydney (Edwards-Vandenhoek and Sandbach, 2014), uses the design studio approach where design students work on real case studies, which are directly related to the industry. Zelenko & Bridgstock (2014) incorporated PD in work-integrated learning by defining an iterative design-based framework for work-integrated learning in developing agency in creative careers. They suggest framing internships as design projects, to teach students the need for flexibility, adaptation and critical and creative thinking while working in creative industries. Hence, there is evidence of projects that use PD as a teaching and learning approach, relevant for work-integrated learning. However, there seems to be a lack of PD techniques in work-integrated learning in domains outside the design field.

In our study, we explored how tools and techniques from participatory design can be used for the ongoing education of healthcare professionals. We describe a case of how we put experiental learning theory into practice through applying a set of PD techniques for each learning style and learning mode. Different from the previous examples, our students hold a bachelor's degree related to the healthcare sector, not in design. Moreover, the students' goal is to acquire digital competences needed in their working place to be able to be prepared for changes in their working practice as well as to better represent themselves in discussions with the management as described in the NJMF project.

4. THREE PARTICIPATORY DESIGN WORKSHOPS FOR HEALTHCARE PROFESSIONALS TO DEVELOP DIGITAL COMPETENCES

The presented learning curriculum is part of a further education program for healthcare professionals with a focus on empowerment, innovation and e-health. The target audiences for the part-time program are foremost nurses, physiotherapists, social educators, and occupational therapists. All participants work in different areas related to health and welfare services, and the majority of them have workplace experiences related to empowerment, innovation and e-health. The need for increased digital competences is the participants' main motivation for attending the program. We organized three participatory design workshops based on the experiential learning model. Participants' workplace experiences were used as foundation for development of digital competences, as proposed by Billett and Choy (2011). The workshops were composed by a set of activities, each with a specific goal. The activities were designed as single tasks or related sets of tasks corresponding to a specific PD technique. We started each workshop with a short presentation stating clearly the goal of the workshop, followed by the workshop plan. A workshop toolkit, given to each participant in a paper format, was provided for each workshop containing the necessary tools for individual and group tasks. In addition, we provided extra materials, that participants could use to add to their toolkit, e.g. sticky notes, color pens, magazines from healthcare to cut off, Play-doh. The third workshop included an additional digital toolkit per group. In the following we will present the workshops in detail. An overview of the different materials can be found at URL: "Materials for participants and facilitators"

4.1. 1st Workshop

In the first workshop, we aimed for two learning goals as presented below.

Goal: Raise awareness of working activities and technologies used in the working place

In order to raise participants' awareness toward their working activities and the kind of digital tools used in the workplace, we employed a *socio-technical walkthrough* (Prilla and Jahnke, 2011). The participants were invited to reflect on activities that they do as part of their work in relation to patients and colleagues within the same organization or in coordination across organizations. Additionally, they were asked to list all digital tools used in supporting these activities. They presented their findings as a *rich picture* (Monk and Howard, 1998), utilizing a prepared outline from the toolkit. We called the rich picture "Me, my patient and my team".

First task: The first task was to define a patient *persona* – "My Patient". A persona is a fictional character that designers create in design projects as a representative of a specific user group (Madsen and Nielsen, 2009). A persona has an identity which resembles realistic features of the user group. The user group in our case are patients. We asked the participants to create a persona for a typical patient that they work within their working place or could be working with in the future. They had to name their persona, describe her demographics, hobbies and feelings. Furthermore, they described the persona's illness, her symptoms, and how life had changed due to the illness, how hobbies and feelings had been influenced by the illness. The students were encouraged to find pictures for the persona to create empathy for the patients. We started the socio-technical rich picture from the patients' perspective inspired by patient-centered healthcare (Pelzang, 2010), where the healthcare professionals are trained to put the patient in the center of their services.

Second task: The second task was called "Me *and my patient*". We provided a prepared outline in the toolkit for the participants to fill in with information based on the following questions:

- How can/do you help this patient persona?
- What activities do you involve the patient persona?
- How do you coordinate/communicate these activities with the patient persona?
- What technologies do you use during these activities?

Third task: In the third task the participants mapped out the larger team around a patient, their activities and technologies used – "My team". Focused on the patient persona they tried to answer the following questions:

- Who do you collaborate with in order to assist the patient persona?
- In what types of activities do you collaborate with colleagues regarding the patient persona?
- In what types of activities do you collaborate with colleagues not focused on the patient (e.g. administration)?
- What types of digital tools do you use for coordinating: collaborative activities related to the patient as well as collaborative activities not related to the patient?

The collection of all the answers created a *rich picture* of the *socio-technical environment* for each individual participants' working place.

Goal: Enhance critical thinking skills regarding technologies used in the working place

The second learning goal was to enhance critical thinking skills related to technologies used in the working place.

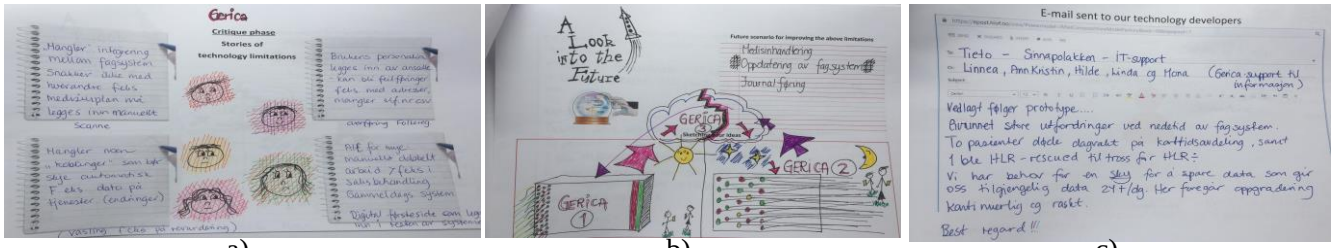
Fourth task: The participants were asked to select which digital tool from their rich picture was their favorite and why, as well as which digital tool they disliked the most and why? Each like and dislike and its reasons were noted down on color-coded sticky notes. While the fourth task was planned as a trigger for critical thinking individually, the fifth task aimed at creating knowledge by drawing on the shared cognition of the entire group.

Fifth task: The PD technique applied for the fifth task is *mind map* (Willis and Miertschin, 2006). The mind mapping session is employed as a co-participative lecture where participants learn new digital concepts based on their situated knowledge from the workplace. The participants were asked to create a collaborative mind map by combining their reasons for digital tool likes and dislikes. The instructor acts as a mind map creation leader. As facilitator, the instructor gathered what the participants had written, synthesized the information in accordance to the literature, illustrate to the participants the translation process between what they said, the general technical term used in literature and the resulting mind map. In half of the whiteboard, we listed "Reasons to Like Technology" and in the other half the "Reasons to dislike Technology". The participants started enumerating the digital tools and their likes and dislikes. The instructor documented their reasons in keywords connected to the digital tool names on the whiteboard. The usage of keywords illustrated the translation process between what the students were saying, and the technical terms used in the literature, allowing the participants to technical vocabulary. Students were asked to reflect if their reasons were related to already available reasons on the whiteboard and how their reasons relate to their colleagues, creating clusters of technology advantages and disadvantages. We documented the digital tools as well to be used in the following workshops. The tasks supported situated learning and contextually valuable discussions for the participants.

Sixth task: The final task was planned to trigger constructive critiques and was used to connect the outcomes of the first workshop to the second workshop. Based on the "reasons to dislike technology" mind map, participants with similar arguments (in the same cluster) discussed how they currently handled technology disadvantages at their workplace. As a teamwork task, the participants shared best-practice and exchanged workplace experiences. Additionally, the participants were invited to think of how they would like to change the technology in order to facilitate their job. The task moved participants from passive technology users to active stakeholders, reflecting on improving digital tools.

4.2. 2nd Workshop

The second workshop started out with synthesized information created from the previously created mind maps. Participants' input from the first workshop was used in order to ground the second workshop including: a list of digital tools mentioned, a categorization of patient personas, a list of technical terms introduced during the mind mapping task. Grounding the workshop on participants' knowledge foundation and workplace experiences support participants' agency when acquiring further digital competences.



a) b) c)

Figure 2: Impressions from the 2nd workshop

Goal: Critically discussing existing technologies and acquisition of technological vocabulary for expressing needs in the working place

The participants worked in teams of four grouped by similar experiences of certain digital tools. Since the participants were from the same geographical area, they used common digital tools at the workplace. The

PD method used for the first part of the workshop is called *future workshop* (Jungk and Müllert, 1987), compounded of four activities: preparation, critique, fantasy, and realization phase. During the preparation phase, the method, its rules and the schedule are introduced. In the critique phase, the participants critique a specific phenomenon. In the fantasy phase, they think of possible solutions or dreams that could solve issues discussed in the critique phase. Finally, in the realization phase, participants reflect on which solution is feasible to implement with the resources at hand. Our future workshop was focused on improving digital tools that participants use in their workplace.

First task: In the critique phase, we combined two techniques *scenario-based* (Carrol, 1999) thinking and *storytelling* (Buskermolen & Terken, 2012). Each participant critiqued a digital tool using real scenarios from their own or their colleagues' experiences, avoiding general critiques and wrote down the problem as a story, defined as *co-constructing stories* (Buskermolen and Terken, 2012) technique. Participants discussed in which situations they have experienced that digital tools didn't provide them with the information they needed; where digital tools have failed to help them in their work; where digital tools were not enough to satisfy needs either for them as practitioner or for their patients, or when they thought of "what if" the digital tool could give me that information. They used technical terms from the mind mapping task to build their critique. The terms were visible on the whiteboard during the task and the following example was provided: *"In case it was difficult for you to understand a certain icon in an application, you could write a critique like: The interface was not user-friendly, so it was difficult for you to understand what the icon is used for."* The participants shared their stories in their teams and then grouped the stories based on similarities, creating themes of problems. Finally, the students selected one of the themes for the fantasy phase.

Second task: In the fantasy phase, the participants brainstormed solutions for the selected critique story. Each participant came up with one solution and wrote an alternative scenario-based story illustrating how the solution would improve the work process.

Third task: In the realization phase, the participants wrote a letter to the company that developed the digital tool proposing their improvements. They used arguments for good and bad technology they discovered in the first workshop. They started by explaining the problem as a story and then proposing the solution in the same way. The students revisited their reasons for linking and not liking technology and used that vocabulary to express to the developers their needs and requirements.

During all tasks, the instructor moved between groups and supported them if needed. This part of the workshop provided the participants the tools and techniques to communicate with the developers. Figure 2 shows an example from participants work in three tasks (respectively a, b, c).

Goal: Introducing patient-driven design thinking

The second part of the workshop prepared the participants to move from reflection on existing technologies to suggesting new digital tools that could improve the healthcare sector and their workplace. Here we used the *design thinking* approach (Brown and Katz, 2011). Design Thinking is a design methodology that provides a solution-based approach to solving problems. It has five phases: empathize, define, ideate, prototype and test. Here we employed the first three, focusing participants' attention on patients and patient-driven digital solutions.

Fourth task: In the empathize phase, the participants created an *empathy map* for a type of patient. Empathy map (Ferreira et al., 2015) is a design method used to empathize and synthesize observations from user studies and discover unexpected insights about users' needs. The task was collaborative and extended their previous work, the patient persona from the first workshop. The participants formed groups that had experiences with the same type of patients. They had to describe a patient type's struggles in daily life: How do the patients feel; What do they want to feel better about; What do they need to feel better.

Fifth task: In the define phase, the participants created a clear problem definition. They analyzed their empathy map and explored possible gaps between what a patient wants to do and what they do or discover possible causes for negative feelings. These gaps or causes were used to define the problem that the participants want to solve. They formulated their problem definition as: "Our patient group needs a better way to_____ because ___.____."

Sixth task: In the ideation phase, we employed the *Now-Wow-How* technique (Ericson and Törlind, 2013). This is a technique used in design thinking for sorting ideas. Now presents ideas that can be implemented immediately, but which lack novelty. Wow groups ideas that can be implemented and are innovative. How collects ideas that could possibly be implemented in the future. The participant groups were dividing into two sub-groups each. Half of each group ideated, how to solve the problem they just defined if they were granted a magical digital tool (How). The other half brainstormed, how they would solve the problem with current technologies (Now). They could search for existing solutions online. Each sub-group tried to generate as many solutions as possible. Next, the groups reunited and shared their solutions to see, if there are common ideas or if ideas could be combined into a single solution that is futuristic, but still possible to develop (Wow). The groups used scenario-based techniques and storytelling to describe their solution.

Seventh Task: Finally, they were invited to use different materials to visualize their idea as a first sketch, e.g. Play-doh, post-its, cardboard. Sketching and prototyping is a common technique in design defined as a materialization of ideas (Sanders and Stappers, 2014). Building their idea assisted students in visual thinking and reflections. Moreover, facilitated the sense-making of their abstract concepts. This task aimed familiarizing students with a hands-on experience where they use different materials to convey their ideas and prepare them for the next workshop.

4.3. 3rd Workshop

The previous workshops participants acquired digital competences, critiquing existing technologies, suggesting improvements, and designing new digital tools. However, technology was still experienced as a finished product, similar to a magic black box hiding its inner workings. The goal of the last workshop was to open that box and provide basic insights on how technology works and how computers think.

Goal: Introducing computational thinking and technology exploration

Figure 3: Impressions from the 3rd workshop

The PD techniques chosen in the third workshop are *Do-It-Yourself techniques* (Giraud and Jouffrais, 2016). Rapid prototyping tools such as simple microcontrollers (e.g. Touch Board® and Microbit®) enable non-programmers to build interactive physical objects and to design tangible user interfaces. These tools require no or little programming skills (Giraud and Jouffrais, 2016) suitable for our participants with no programming background. The touch board is a pre-programmed microcontroller based on the Arduino platform that provides 12 touch-sensitive electrodes that trigger sounds through a built-in MP3 player. It enables even non-programmers to create interactive audible interfaces. The micro:bit is a microcontroller developed by BBC including a large number of built-in sensors and actuators. Combined with the block-based programming environment Microsoft MakeCode it lowers the threshold for kids and

non-programmers to create digital artifacts. The use of these tools enables the participants to prototype their ideas and experience their solutions. This workshop was located at a Makerspace and was reinforced by one additional instructor. We gave a short introduction for each digital tool, and the participants had time to play and explore the tools on their own.

First task: Once the participants acquired an initial understanding of Touch Board's capabilities, they ideated how they could apply the tool to prototype an audible experience for dementia patient based on one of the proposed solutions from the second workshop.

Second task: For the second exercise, the participants used the micro:bit to create a prototype of a smart safety alarm. Safety alarms were one of the most criticized digital tools in the first workshop.

We provided example prototypes for both tools to lower the technology threshold and support their ideation process. In both tasks, participants followed the design thinking approach presented in the second workshop. They described a patient group, defined a problem and ideated different solutions using a prepared paper toolkit. Next, they prototyped their solution supported by the instructors using the digital tools and supplementary material from the makerspace. After each task, the groups demonstrated their prototypes for all participants using a *role-play* technique to test their prototype. *Role-play* (Svanaes and Seland, 2004) is the practice of creating physical performances to communicate developed ideas, issues, and scenarios to an audience, and to convey current ideas and issues in a rich way. During the feedback round, participants could reflect on both the prototypes and their designed scenarios.

5. DISCUSSION

In the previous section, we presented an applied PD approach for work-integrated learning of digital competences for healthcare professionals. In this section, we discuss the workshops and the respective PD techniques through Kolb's experiential learning model as the theoretical foundation for work-integrated learning. We elaborate on how during workshops we drifted within the different parts of the model as a mean on reflecting on our process and how that contributed to learning and development of digital competence.

In the 1st workshop, we started by discussing participants' experiences in their workplaces. The situated visualization of the workplace activities was facilitated through the socio-technical walkthrough rich picture technique (first to third task). This is compatible with the concrete experience (CE) learning mode in Kolb's experiential learning model. Initiating the learning process by focusing on the participants' experiences will also lay a foundation for WIL by mapping out and raise the awareness about the participants' different starting points and the situations at their present workplaces. Kolb's model does not pose any sequential limitation regarding learning modes as long as the four modes are integrated for a favorable learning process (Kolb et al., 2001, Evans et al., 2009). However, in our case we pose CE as the starting point of our learning process. We argue that CE learning mode should be the start of a learning process for WIL for lifelong learning and make the basis even when the participants drift in other learning modes. This approach is compatible with Billett and Choy (2011)'s arguments about the necessity of the engagement of the individuals utilizing their knowledge as a substantive pedagogic resource and providing opportunities for sharing and learning from that resource in WIL for lifelong learning. Critical reflections of the situated experiences about technologies used in their workplaces (fourth and fifth task) followed. The mindmap technique spurred a reflective approach toward concrete experiences through challenging participants to critically think about the current work practices adapting in this way a reflective observation (RO) learning mode. The combination of CE and RO learning modes is associated with a *Diverging* learning style. Thus, in our case we have started the learning journey with *Diverging* learning style. An abstract conceptualization (AC) learning mode was applied in the last task of the 1st workshop were participants challenged previous reflections through brainstorming on possible future solutions regarding issues associated with technology. Thus, shifting toward an *Assimilating* learning style were abstract thoughts are interpreted vis a vis with situated experiences. Applying reflective brainstorming in groups facilitated the assimilation of knowledge. Throughout the workshop,

the *Diverging* learning style had precedence. The intention of the shift to an *Assimilating* learning style was only to make participants start thinking about abstract concepts, which would be explored in the next workshop. In Figure 4, the 1st workshops' drifting in Kolb's model among learning styles and learning modes is represented with the blue curved arrow.

In the 2nd workshop, we used the Future Workshop technique to obtain a better structured reflective brainstorming. Critique phase associates with a RO learning mode – reflection current practices in the working place and critiquing them. Fantasy and realization phase associate with AC learning mode – reflecting on abstract concepts for improving the current practices. Hence, Future Workshop is compatible with an *Assimilating* learning style where reflections and abstract conceptualizations are promoted. Future Workshop technique was enhanced with scenario-based thinking and storytelling. Both techniques support situated thinking rooted in experience contributing in this way in *Assimilating* learning style. The structured reflective brainstorming and discussions contributed to collaborative reflections where the participants could exchange experiences and knowledge, and thereby facilitate work-integrated learning. Billett and Choy (2011) discuss the importance of individualized learning paths coming from experience. Future workshop and co-constructing stories facilitate this individual approach of learning as the participants will deepen their knowledge and understanding on the case at hand which has emerged from individual experiences. However, the PD techniques supplement the individualized learning path with working in groups which share the same digital challenges, thus requires similar digital competences for their workplace. Reflective observations and abstract conceptualizations are boosted through the shared cognition and knowledge in the group, facilitating in this way the learning process. Design thinking is another design approach that facilitates abstracts conceptualization of possible solutions for problems rooted in concrete experiences. Moreover, design thinking involves a hands-on approach to experimentation with different solutions by creating different prototypes. While design thinking adopts an AC learning mode in ideation, it also adopts an active experimentation (AE) learning mode during sketching and prototyping (seventh task). This associates with a *Converging* learning style. Throughout the 2nd workshop the *Assimilating* learning style had precedence. Shifting in *Converging* learning style was to make participants start thinking about experimentation of their acquired knowledge through hands-on techniques, which would be the focus of the next workshop. In Figure 4, the 2nd workshop drifting in Kolb's model learning styles is represented with the green curved arrow.

The 3rd workshop aimed to give participants the possibility to experiment with technology so they could enhance learning by doing. The experimentation with technology would build both on the concrete experience of the participants and the abstract concepts discussed in previous workshops. Due to the widespread lack of digital competence among healthcare professionals, enhancing a pedagogical approach like learning by doing is in accordance with the requirements for WIL when aiming at knowledge that is hard to learn because of its complexity and related to healthcare professionals limited experiences with technology. Do-It-Yourself is a suitable technique in giving participants the possibility to experiment with technology by applying abstract concepts or concrete experiences discussed previously. Rapid prototyping tools, which do not require advanced programming knowledge, support lowering the barriers among users of technology. Hence, Do-It-Yourself technique is suitable for AE learning mode. Moreover, situating experimentation in abstract conceptualization and concrete experience represents a positioning in the 3rd workshop in both the *Accommodating* and *Converging* learning styles. In Figure 4, the 3rd workshop is drifting in Kolb's model of learning styles and represented with the orange curved arrow.

Figure 4 shows a representation of Kolb's model enhanced with PD techniques that we applied for each learning styles. Moreover, we have visualized how each of the workshops associate with two learning styles starting in a specific learning style and changing in the last task as a way to prepare the participants and contribute to a gradual transition to the next session. The combination of PD techniques facilitated the adaptation of all the learning modes. Kolb and Kolb (2005) suggest the integration of all learning mode as a favorable learning process without any sequential limitations. Our case starts with a CE learning mode rooting the learning process in individual experiences. This is suitable for WIL in lifelong learning and

the participants' experience as a pedogeological resource (Billett and Choy, 2011). However, we have explored through PD more cooperative learning, where participants with similar experiences follow a common learning path. This facilitates the learning process through teamwork and knowledge sharing and creating in groups. We made sense of our case through experiential learning theory. Thus, we conclude that the three workshops with PD approach contribute to Work-Integrated Learning.

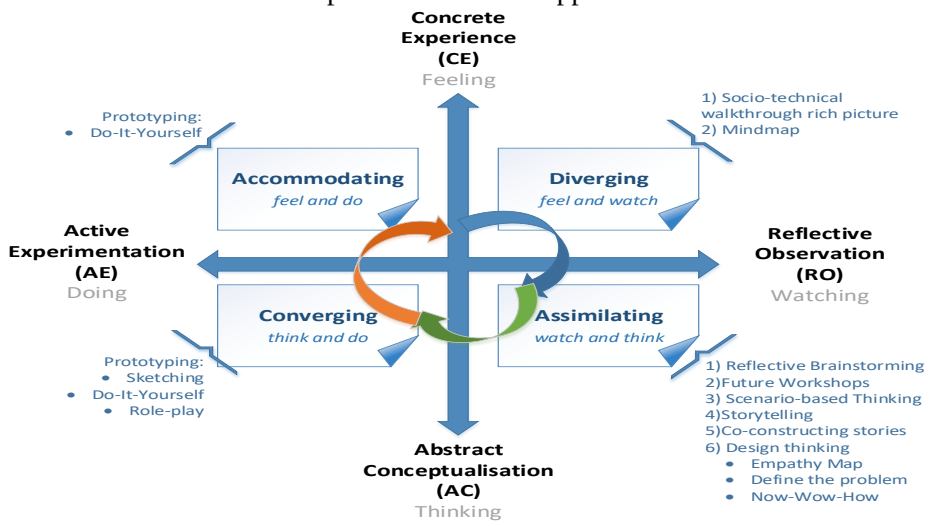


Figure 4: Kolb's experiential model in our case -enhanced with a set of PD techniques for each learning style

6. CONCLUSION

We live in an era of technical revolutions that pervades the whole society. The technological development has, is and will continue to influence our workplaces. This is associated with a change in competences needed in different job positions. The necessity for digital competences, along with the main competences needed in the workplace, has brought many practitioners back to school in search of new knowledge. This category of students possesses relevant experiential knowledge that needs to be in the core of the new knowledge building. Thus, new ways of learning should be applied for them. Laying a foundation for work-integrated learning demand a new approach when planning further education. Instead of focusing on a predetermined curriculum, it is necessary to negotiate the process, adaptation of tools and techniques with the participants due to their starting point and their need for digital competence.

Billett and Choy (2011) discuss WIL for lifelong learning for those people that continue their education throughout their lifetime. However, their analysis is speculative and do not suggest how to apply WIL for lifelong learning. We presented a case where we applied PD as an approach to work-integrated learning. PD stems in the democratization of the workplace and the involvement of workers in the decision-making regarding systems that will be used by them (Simonsen and Robertson, 2012). Even though PD is a design discipline it has as a main principle mutual-learning and the sharing of knowledge that would support users to build more digital competences so they can seat together with developers and management and better express their needs.

We have described a case of using PD tools and techniques for work-integrated learning of digital competences. Our PD approach consists of three workshops. In each workshop, a set of PD techniques has been applied. The PD techniques are compatible with specific learning styles in the experiential learning theory (Kolb and Kolb, 2005). Hence, we conclude that the PD approach does contribute to the learning process.

Through this paper we want to bring forward our case, so other researchers can adopt and test the presented approach in their curricula, either with healthcare practitioners or in another context. We argue,

that teaching IT competences for cross-disciplinary purposes is highly relevant for the IT education research community. The digitalization of all aspects of our society, requires IT education for everyone, especially as continuing education. As part of our future work, spring 2020, we will repeat the model with our new participants, introducing a set of evaluation mechanisms to measure the impact of our approach in their digital competences.

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