

‘Digital Peer-Tutoring’. Early results from a field evaluation of a ‘UX at work’ enhancing learning format

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Abstract. This paper describes a learning format that enables workers to co-design their work with collaborative robots. The video-based digital peer tutoring format, enables shop floor workers to create their own peer-tutoring videos to share how-to knowledge with colleagues. Early field evaluation results indicate that workers benefit from the learning format and produced how-to videos for their colleagues. Furthermore, the learning format was also found useful by the company management and ownership as means of documentation and customer communication.

Keywords: collaborative robots, assistive technologies, UX at work

1 Introduction

Peer tutoring has been put forward as a way to help students of all kinds deal with design problems [8]. Design, understood here as design thinking [3], is typically applied to solve non-routine, wicked problems. It is an iterative process that consists of generative and evaluative stages, which eventually converge on a solution to the design problem. Creating novel how-to knowledge requires hands-on experience, which is where peer tutoring becomes very helpful. We propose a new learning format, ‘Digital Peer tutoring’, that can help workers share their experience with collaborative robot interaction. We ask the questions: *How can a ‘Digital Peer-Tutoring’ learning format enable shop floor workers design positive UXs for themselves and their colleagues? What kind of ethical stance does the use of ‘Digital Peer-Tutoring’ imply?*

We report from the initial part of a research project aiming to develop Digital peer tutoring for shop floor workers. We aim to develop capabilities among shop floor workers to use short videos to design and document solutions to operational and collaboration issues related to assistive technologies (collaborative robots).

The research is situated within the KomDigital regional development project, which brings together 18 of the Copenhagen Capital Region's companies, unions, employer associations, and educational institutions. The partnership aims to improve digital competencies among employers and employees in SMEs (companies with fewer than 250 employees) thereby enabling them to adopt and implement digital technologies.

KomDigital achieves its goals through the development of digital learning formats, tailored to the working conditions and needs of companies and employees.

2 Related work

Peer tutoring [4,8] overlaps somewhat with other notions of informal technical help giving between colleagues, such as over-the-shoulder-learning [11], over-the-shoulder-guidance in tertiary education [2], and peer-assisted learning [5] and teaching [9] in the medical domain, and over-the-shoulder appropriation [1], and peer interaction [6] in software development.

We build primarily on the approach from Twidale [11] in that we aim to support informal technical help between colleagues, and follow Schleyer et al. [8] in that we acknowledge the role of peer tutors at various levels to the benefit of developing problem solving skills among colleagues. Specifically, we introduce a new role of digital competence facilitator, a ‘Digital Coach’, as we explain below.

What distinguishes ‘digital peer-tutoring’ from traditional peer-tutoring is that the concept builds entirely on the use of video. The idea is that workers learn from creating and redesigning videos while sketching [7] as part of applying design thinking to design their own and their colleagues’ work flow and interactions with collaborative robots. Ørngreen et al. [7] suggested to link various sketching techniques and creative reflection processes to video productions, and we extend this proposal to cover linking all parts of design thinking (problem definition and user needs finding, sketching, prototyping hypotheses, and evaluation) to workers’ video production. Secondly, we propose that video-based reasoning, instead of simply paper or verbal exchange, empower workers to explore and take ownership of their work. Vistisen et al. [12] proposed to support ethical user stances during the design process of products and services, and proposes using animation-based sketching as a design method. We follow that line of thought, though we are less interested in professional designers, and more interested in workers’ own production (and consumption) of videos-as-digital-peer-tutoring.

3 Case setting and method

The ABC company is a European SME specializing in glass processing. The company produces individual pieces and small batches with special specifications as well as entire series of several thousand units.

About a year prior to our visit, the ABC company purchased and installed a 100,000€ collaborative robot in order to explore if and how it could be used in their production. At the time of our visit, the robot was used only during the final polishing steps of one large scale order, and it was idle much of the time. Workers and management agreed, however, that the robot could be used for other purposes as well, and thus enable the company to accept more large batch orders, but no initiatives had been implemented for several months due to lack of time to experiment with the robot. Furthermore, the initial design decision had been a stationary installation, that is, the robot could not be moved to other positions on the floor where it could interact with other machines or workers.

The initial design decisions seemed to be related to a limited initial understanding of the robot’s capability and a lack of strategic intent. In any case, it was clear that there

was an unexplored potential (and risks) for enhancing the factory's capacity while empowering workers and help them design their own user experiences with the robot.

Our approach to building new digital competences is inspired by action design research (ADR). ADR argues that IT artifacts are 'ensembles' formed by the organizational context during development and use. Research in this tradition interweaves constructing the IT artifact, intervention in the organization, and evaluating outcomes [10].

We visited the company 6 times over a six-week period during the spring 2019. During first visit we gained insights into the company, the motivation for purchasing the robot, and challenges with its current as well as potential future uses. We observed the robot's current (very limited) use, interviewed and discussed with robot vendors, managers and shop-floor workers, and observed work and demonstrations of the robot.

The digital peer-tutoring learning format (see section 4) was implemented in four sessions over the next four visits, followed by a final evaluation on the sixth visit. We documented all observation, interviews, and learning sessions with video and audio recordings, and photos.

The learning format was evaluated after each session and at a final one-day meeting with participation from all key stakeholders.

4 The digital peer-tutoring learning format

The digital peer-tutoring learning format consisted of an ensemble of instruction-videos, quizzes, example solution-videos, and worker-created-how-to-videos. Together with the case company, we designed and implemented four training sessions with selected shop-floor workers. The themes of the sessions were:

1. Describe an interaction and a collaboration problem
2. Sketch solutions
3. Design a prototype
4. Test the prototype

Each session included short (3-5 minutes) instruction videos that explained the theme, introduced techniques that the participants could use to investigate problems and describe solutions, and an exercise where the participants should develop a short video (3-5 minutes). We also produced short example videos with our 'answers' to the assignment for each of the four session.

A 'digital competence facilitator' (student assistant) travelled to the factory for each session and discussed the material with the participants, and helped them produce their own 'employee-videos'. These were subsequently uploaded to a shared (secure) site for later download and knowledge sharing within the company.

5 Field evaluation results

The initial results from the final evaluation reveal both short- and long-term benefits and challenges of Digital peer tutoring. Regarding short-term benefits, the workers

liked the learning format: "...worker-video on iPad [could be useful]...", [Worker Br]. This confirms previous findings on the usefulness of video [7], and extends it to the shop floor workers

However, the 'instruction videos' were too long and complicated. "[They should be cut down on a list of four points]" [Worker Br]. Too long videos can be an expression of an 'apathetic ethical stance', a stance that reduces the worker-user to be a mean of input for the intended final design [12].

On the other hand, the workers expressed that they could use video to both think about the problem, sketch different solutions, and evaluate their use: "Sketches I had read up on it, go and think about it..." [Worker Br], and "the worker should be able to pause the video ..." [Worker Bi]. Thus, there were indications that the format helped workers explore new technologies from an emphatic ethical user perspective, that is, from their own perspective [12]. The Company manager K supported this: "We, as a business must spend more time on [workers' use of video to innovate]". The management perspective adds a new layer to understand short term benefits of video-sketching and ethical design, and thus center our focus on the multi-layered essence of user experiences at work.

The stakeholders also commented on the long-term benefits of the learning format:

- Help videos could be used to tackle issues in manufacturing, [Worker Bi], and retain knowledge even long after they were produced [Manager J].
- Introduce new employees to the job through [Manager J].
- Videos can replace manuals for dyslexic employees.
- Document supplier shop floor supplier courses [Consultant F] [Manager K]
- Introducing new production processes, for example "recording the results from the company's informal and formal experiments on the shop floor" [Manager J and K] and "recording order-specific ideas for how-to, so next time this order comes in, the video shows what to do" [Worker Bi], and retain good ideas [Teacher T].
- Producing videos for marketing purposes and quality documentation.

These benefits allude to a diversity of user experiences in work situations, and perhaps also tells us that the ethical stances taken by workers-as-designers-of-their-own-work may be confounded by management's strategic interest in how-to knowledge.

6 Discussion and conclusion

'Digital Peer-Tutoring' enabled shop floor workers design positive UXs for themselves and their colleagues, also beyond what we expected. The workers liked the Digital Peer-tutoring how-to videos and found them useful. This is in line with [11] saying that it is possible to use peer tutoring to give informal technical help between colleagues, and with [7] that suggests to link various sketching techniques and creative reflection processes to video productions. The videos helped workers create ideas about robot use, identify problems not formulated before, sketch alternatives, test solutions, and demonstrate them to colleagues.

Company owners, management, and workers had unexpected ideas about how to use the peer-tutoring videos within and outside the company, in for example internal quality control and customer communication. Thus, similar to the point made about peer tutoring [8], we should acknowledge the role of Digital peer tutoring in developing problem solving skills at various organizational levels.

Finally we conclude, using the categories proposed in [12], that the ethical stance built into the ‘Digital Peer-Tutoring’ learning format could be characterized as ‘apathetic’ when too long and complex instructional videos lead the workers to give up. However, the learning format also showed to be ‘empathetic’ as workers produced their own videos and evaluated solutions together, effectively co-designing work procedures.

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