Collaborating with Collaborative robots

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KomDigital
- Styrk de digitale kompetencer og skab værdi

About us

- Jacob Nørbjerg, Associate Professor, cand.scient. PhD
  - Information Systems Development: theory, method, and practice
  - Agility
  - Technochange
- Torkil Clemmensen, professor in IT Management, MA and PhD in psychology (University of Copenhagen)
  - Psychology as a science of design
  - Usability and UX
  - Human Work Interaction Design

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CBS is by national and international standards a strong institution with a distinctive 'business university' profile

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CBS in totals

20,422
Student population

3,928
International students

192
PhD students

44
PhD degrees conferred

633
Full-time academic staff

884
Part-time academic staff

884
Administrative staff

297
Exchange and coorporation agreements worldwide

Funding

179.2 Million Euro

Campus figures

133,946 m²
campus area

Six central locations

Four on-campus Metro stops

High-tech facilities and Wi-Fi

800+ study seats at CBS Library

Learning resource center

Bookstore

Cafés and canteens

SMEs and Industry 4.0

- SMEs
  - Depend on their workers' knowledge and innovative capabilities to create new ways of working with technology
  - Lack the capability and capacity for comprehensive digital transformation

Collaborative robots

- Collaborative robots can be integrated into the production without radical reconfiguration or automation of established workflows
- A human worker can program a collaborative robot to perform tasks such as lift, pick and place, move, or otherwise process physical objects
- Worker designed interaction with collaborative robots and other assistive technologies is a useful first step towards digitalization in an SME
- But, even 'simplified programming' of collaborative robots is not that simple, and robots may be underutilized

Digital Peer-Tutoring

- What it is?
- Can we use EU-money to further develop the ideas?

CASE

‘Digital Peer-Tutoring’ with human workers interacting with collaborative robots on the shop floor

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Research questions

- *Can a 'Digital Peer-Tutoring' learning format enable shop floor workers to design positive UXs for themselves and their colleagues?*
- *What kind of ethical stance does the use of 'Digital Peer-Tutoring' imply?*

- We aim to develop capabilities among shop floor workers to use short videos to design solutions to interaction and collaboration with collaborative industrial robots

Related work

- ‘peer tutoring’ and similar notions of informal technical help giving between colleagues:
  - over-the-shoulder-learning
  - over-the-shoulder guidance
  - peer-assisted learning and teaching
  - over-the-shoulder appropriation
  - peer interaction
- ’digital peer-tutoring’ builds entirely on the use of video

- From video-sketching to video-based design thinking as a method for ’digital peer-tutoring’

Case setting

- 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
- 100,000€ collaborative robot in order to explore if and how it could be used in their production, but robot idle much of the time


WATER JET
EASY CUT

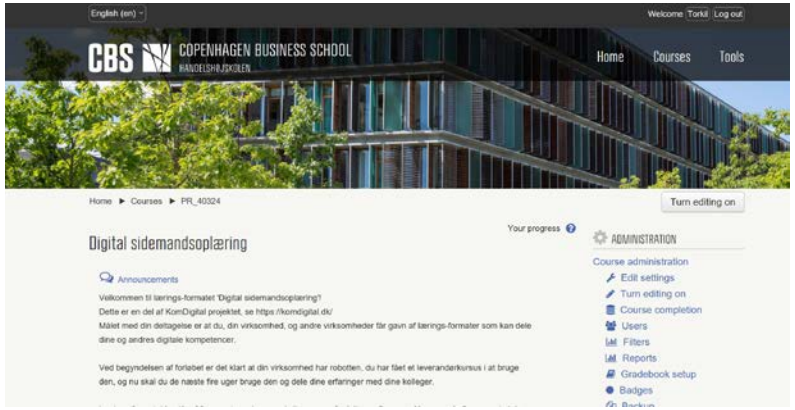

MIRIT

Method

- Key important for HWID?
- Action Design Research argues that IT artifacts are ‘ensembles’ formed by the socio-technical context during development and use

Prototype: the digital peer-tutoring learning format

- Ensemble of instruction-videos, quizzes, example solution-videos, and worker-created-how-to-videos, facilitated by a digital competence facilitator
- We designed and implemented four online 15 minutes training sessions together with selected shop-floor workers:
  - 1. Describe an interaction and a collaboration problem
  - 2. Sketch solutions
  - 3. Design a prototype
  - 4. Test the prototype
- We hired a 'digital competence facilitator'
  - travelled to the factory for each session
  - facilitated workers to produce their own 'employee-videos'
  - uploaded employee-videos to a shared (secure) site for later download and knowledge sharing within the company



Discussion and ethical issues

- '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 Peertutoring how-to videos and found them useful
  - The videos helped workers create ideas about robot use, identify problems not formulated before, sketch alternatives, test solutions, and demonstrate them to colleagues.
  - These results support [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 ethical stance built into the 'Digital Peer-Tutoring' learning format could be characterized as
  - 'apathetic' when too long and complex instructional videos led the workers to give up
  - 'empathetic' as workers produced their own videos and evaluated solutions together, effectively co-designing work procedures