Translating the Learning Factory model to a Danish Vocational Education Setting

Lindvig, Katrine; Mathiasen, Helle

Published in:
Procedia Manufacturing

DOI:
10.1016/j.promfg.2020.04.077

Publication date:
2020

Document version
Publisher's PDF, also known as Version of record

Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 45 (2020) 90–95

Procedia MANUFACTURING

www.elsevier.com/locate/procedia

10th Conference on Learning Factories, CLF2020

Translating the Learning Factory model to a Danish Vocational Education Setting

Katrine Lindvig[a,*], Helle Mathiasen[a]

[a]*University of Copenhagen, Department of Science Education, Oester Voldgade 3, 1350 Copenhagen K, Denmark*

Abstract

In 2018, the Center for the use of digital technologies in teaching (CIU) in the Vocational Education and Training (VET) sector was launched. The center is funded for three years by the Danish Ministry of Education. The main goals of CIU are to qualify the current use of digital technologies in teaching at the Danish vocational schools and furthermore to create a knowledge base on didactic aspects of technology enhanced teaching environments. The Danish VET sector currently face challenges in terms of recruitment, student retention, personalisation of teaching and learning, and in general to align with the demands of the labor market and industrial partners. The VET sector is characterised by a large degree of heterogeneity, both in terms of educational programmes, teaching practices and student population thus, there are no one-size-fits-all solutions. The Learning Factory model offers a lense to identify and hence solve these challenges while also meeting the goals of CIU. We therefore adopted the Learning Factory model and are now in the process of translating it to fit the Danish VET sector. In this paper, we first outline the process of translating the original Learning Factory model to a Danish VET sector. We then present the first round of Learning Factory established this fall. The five Learning Factories include participants from 21 schools and focus on various uses of IT including Virtual Reality, Augmented Reality, and Learning Management systems. We end with a discussion of how to develop a Learning Factory model that can produce solutions to local authentic problems meanwhile facilitating knowledge-sharing across a large, heterogeneous and complex setting such as the Danish VET sector.

Keywords: Vocational Education and Training; Digital Technologies in Teaching; Authentic Problems; Double Diamond Process; Transfer

* Corresponding author. Tel.: +45 29803849.
E-mail address: katrine.lindvig@ind.ku.dk

10.1016/j.promfg.2020.04.077

1. Background

The Danish VET system is divided into four main areas:

- Care, health and pedagogy
- Administration, commerce and business service
- Food, agriculture and hospitality
- Technology, construction and transportation

The four areas cover 109 different education programmes, and the programmes enrol a mixture of students respectively coming directly from lower secondary school, who completed lower secondary school more than two years ago with work experience, and students aged 25 or over. The individual programmes take between 3,5-4 years to complete and all programmes combine school- and work-based learning with differing emphasis on one or the other. Despite the increasing need for workers with a vocational background, the Danish VET sector have in recent years been faced with a range of challenges:

- Aligning with the demands of the labor market and industrial partners, including a need to digitise VET and to update the programmes to meet future demands from the subset of the fourth industrial revolution [1]
- Recruiting students for the more than 100 different programmes dispersed across the country [2]
- Cuts in financial support from the state, making it difficult to run to small and specialised education programmes.
- Difficulties in finding companies willing and able to offer apprenticeships. Instead, a large group of students is forced to complete their apprenticeship at the school [3].
- Personalisation of teaching and learning to accomodate for the diverse student population.
- Lack of transfer between theory and practice e.g. the school-based and work-based modules [3]

These challenges combined have resulted in high dropout rates and a loss in social inclusion and esteem for the VET sector [2], which again challenges the recruitment of a critical mass of talented students. The ten knowledge centers financed by the Ministry of Education are considered one way to solve these challenges. By looking into developments in digital technologies specifically for the four main areas (fx. healthcare technologies, chatbots for business, VR platforms for construction and farming etc.) the hope is to be able to update the education programmes and to prepare students for working with industry 4.0. Whereas solving the first challenge of implementing these area-specific technologies to meet the future demands of the industry has been the main focus of the first nine knowledge centers, CIU has - as the tenth and final center - been given the task to explore how the use of digital technologies in teaching can help solve the remaining five challenges. The purpose of this paper is to describe the Learning Factory model used, but also describe the basic research developmental approach which includes teachers' didactic competencies, hence the capability to develop teaching environments, which supports the individual student's knowledge construction in the broadest sense. This makes CIU somewhat different from the remaining centers and has thus required a different setup. For one, this setup includes follow-up research to help document and iterate the development processes and secondly, translating the original Learning Factory model in order to find tailor-made solutions to fit the local needs of the VET schools and education programmes.

2. Translating the Learning Factory Model

"A learning factory is defined by processes that are authentic, include multiple stations, and comprise technical as well as organizational aspects, a setting that is changeable resembles a real value chain, a physical product being manufactured, and a didactical concept that comprises formal, informal and non-formal learning, enabled by own actions of the trainees in an on-site learning approach". This definition by Abele et al. [4] has worked as the backbone and checklist for setting up the first five CIU Learning Factories in fall 2019. Below is an overview of how the various components translate in a CIU Learning Factory.

Table 1. Components in a Learning Factory

Components of the Learning Factory definition	Components in a CIU Learning Factory
Authentic processes	The participants work to find solutions to authentic problems from their home school e.g. personlisation of teaching and learning, student dropout, misalignent between theory and practice, lack of a digital strategy etc.
Multiple stations	A combination of 'factory days', work phases and workshops tailor-made to fit the needs of the participants.
Technical/organisational aspects	The participants work with topics such as Virtual Reality, knowledge sharing, implementing a digital strategy, transfer of knowledge between school and apprenticeship.
Changeable setting	The factory days take place at the participant's schools and the workphases in between are adjusted to fit the individual participants.
Resembles a real value chain	In the process of developing their solutions (products), the participants involve colleguaes and management at their schools.
A physical product being manufactured	A product can span from implementing a digital strategy, developing an 'ICT-drivers license', adding plugins to the local LMS system of formulating intended learnings outcomes for using a digital technology in teaching. The product is physical in the sense that it has to leave a visible mark on the school and for the benefit of the students.
Didactical concept comprising formal, informal and non-formal learning	Participatory action learning/research as the foundation combined with a work process heavily inspired by design thinking and research circles.
Enabled by own actions of the trainees in an on-site learning approach	The participants carry out the main work at the individual VET schools.

2.1. The didactical concept

The didactical foundation for the CIU Learning Factories is participatory action learning [5] [6]. Participatory action learning is an approach wellsuited to rethink and develop teaching and learning environments, focusing on both participation of teachers, management and students. All three categories are essential for ensuring motivation and transfer of knowledge [7]. In the CIU Learning factories, the participants (e.g. the teachers, students and management) actively take part in identifying and solving authentic problems at their schools. Together with the researchers affiliated to CIU, the participants also partake in developing and iterating the Learning Factory concept as well as communicating the results to the wider sector. This is crucial in terms of solving the challenges in the VET sector, in order to develop a knowledge-sharing infrastructure across the sector, and finally in order to anchor the knowledge and solutions created in the research literature.

2.2. Design based thinking and research circles

The programme and process for the CIU Learning factory is structured around the double diamond innovation model [8] and inspired by the research circle process [9]. As illustrated in Fig.1. a CIU Learning Factory process takes a year, includes four factory days and three workphases, and spans across the four distinct phases of the double diamond design process. The phases are illustrated in Fig.1. and include problem analyses (Discover and Define) as point of departure for design of solutions and products (Develop and Deliver), that can be used in a concrete teaching and learning environment. The point is that the concrete solutions and products are developed in a user involved design process (workphase 1-3).

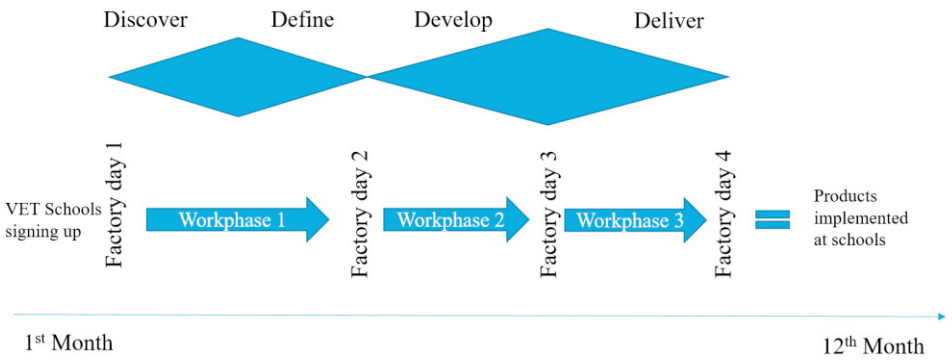

Fig. 1. CIU Learning Factory prototype.

As defined by Wahlgren & Aarkrog, the research circle is a specific way of organizing the meeting between practitioners and researchers, the aim being to develop practice as well as creating new knowledge for both practitioners and researchers. The work in research circles is organized as alternations between scheduled meetings (circle meetings) and the practitioners' developmental work at the schools. The researchers and the practitioners mainly meet at the meetings, where the practitioners will present their experiences and the researchers the results of their research [9].

The CIU Learning Factory process differs from the research circle in two respects: First, evaluations of the research circle approach suggest increasing the attention and support of the work and development in the local settings in between the circle meetings, as this is where the transfer and embedment of knowledge becomes possible [10]. Thus, in the CIU Learning Factory, more time is set aside for the workphases and the participants are given a certification kit, in which the participants commit themselves to involving colleagues, students and management in the product development. This ensures transfer and keeps the focus on the work in the local settings. The second difference is the use of experts and researchers in the CIU Learning Factory. Whereas the practitioners and researchers each present their experiences and results in the circle meetings, the factory days are much more focused on supporting the work processes of the participants, and providing just-in-time knowledge for them to proceed with their product development. Furthermore, during the Learning Factory the participants shift between a problem owning position and a qualifying position. While the individual participant may be in need of advice and assistance at some stages of the process, he or she might also be the expert on a certain topic or able to assist other participants in solving a problem of developing a product. Because the products should be solutions to local, authentic problems at the schools, the participants may very well be the experts in solving the problems, and the researchers and external experts merely be extra inspiration.

2.3. Setting and participants

While many of the first Learning Factories described in the literature [11] take place in actual factories or in other industrial settings, CIU's Learning Factories take place in classrooms or workshops at the local VET schools. Nevertheless, in order to stay with factory metaphor, the terminology from a factory setting is used to describe the different elements of the process. The first Factory day is kicked off at the VET school hosting CIU, but three of the 6-8 schools participating in a Learning Factory ideally hosts the following factory days.

The VET schools sign up for the Learning Factory and assign 2-3 participants (e.g. teachers, consultants or representatives from the school management) who then participate in the factory days and are responsible for filling out a certification kit during the workphases as well as leading the process of developing a solution/product. The certification kit, combined with webinars for the management is to ensure that, while only 2-3 participants from each

school are present at the factory days, the whole school sees itself as part of the Learning Factory and is engaged in defining, developing and implementing the final product/solution.

2.4. Authentic processes and problems

Each Learning Factory is based on an overall theme related to the identified challenges of the VET sector (cf. challenges listed in beginning of paper) and linked to a specific type or use of digital technologies in teaching (e.g. Learning Management Systems, Augmented Reality, Virtual Reality etc.). Examples of themes for the first round of Learning Factories are: 'Knowledgesharing amongst teacher by using LMS', 'bridging theory and practice using VR' 'visualisation of theory using AR', and 'increasing learning in online learning environments'. Although the overall Learning Factory theme provides a shared focus and supports networking between the participants, the individual participants are still free to tweak their own product and solution, as the main goal is to create a sustainable solution to an authentic problem at the local school. This authentic problem from the school is discovered and defined by the participants, in collaboration with their local management and colleagues, during the first two workphases (see Fig.1.) This means that, even if the outcome or product is a new VR platform or a simulation module, it must be solving an authentic problem at the schools, otherwise it will not be embedded or last [9]. Below are examples of authentic problems identified by participants in the first five Learning Factories:

- What design can succesfully support knowledgesharing at team level in the organisation, and how to integrate the asynchronous part of SharePoint Modern with implementation for the users?
- How to develop a learning process for the management team that enables them to motivate as well as facilitate knowledge sharing across the school?
- How to transform the mindset of 'superusers' from technicians to didactic thinkers – and how can we prepare them in terms of knowledge sharing?
- How to convey a realistic understanding to the students of how to work as a chef in a busy restaurant kitchen?

2.5. The product

One of the success criteria set by the Ministry in funding CIU was that the CIU Learning Factories should produce, if not physical products, then at least very visible outcomes in the shape of capacity building and competency development for the individual VET schools and not least the students. The final products are yet to be seen, as the first round of Learning Factories are only half way through. However, the participants in the five Learning Factories have all completed the two initial phases of the double diamond and are thus in the process of developing prototypes of their products. Amongst these are a 'VR Lesson in shop fitting for use in business service', 'a strategy for increased knowledge sharing across the school using LMS Moodle' and a 'podcast series for first year gastronomy students'.

3. Current status

Five different Learning Factories are established focusing on VR, AR, knowledge sharing across levels and disciplines, implementing digital strategies as well as Learning Management systems, respectively. The upcoming factories are fully booked and there is currently a waiting list.

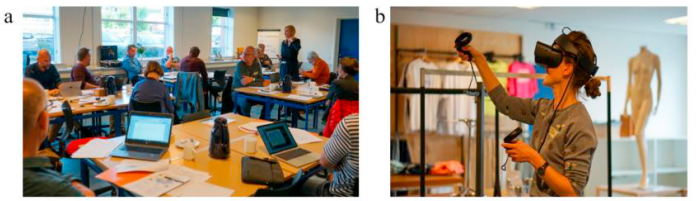

Fig. 2. (a) An example of a Factory day; (b) A CIU Learning Factory participant exploring a VR platform.

Drawing on experiences from the first round, the selected themes for the upcoming Learning Factories span from ‘visual guiding through augmented reality’, ‘navigating the jungle of digital technologies for teaching’, to ‘implementing digital strategies and developing the didactic side of digital technologies.

An additional new Learning Factory is also under development - a shorter version targeted larger schools who may want to work intensively with one specific problem. It is the ambition to continue iterating and adjusting the model to fit the needs of the VET schools, with the overall purpose of developing teachers' didactic competencies so that they can develop teaching environments that can support the individual student's knowledge construction in the broadest sense.

4. Challenges

While the CIU Learning Factory model so far has received a lot of positive attention from stakeholders and practitioners in the VET sector, a number of challenges persist that future iteration of the CIU Learning Factory model need to deal with. Amongst these challenges are:

- A lot of conservatism in the sector, and lack of previous research to draw on.
- Involving the industrial partners in order to create a stronger alignment between work-based and school-based learning.
- Aligning expectations between the Ministry of Education and CIU, between CIU and VET schools, and between the participating practitioners from the VET schools and their colleagues
- The economy of scale – how can the model be used to reach more schools, thus having a stronger impact on solving authentic problems and supporting the use of digital technology in teaching?

Acknowledgements

The study behind this paper was conducted by the authors as part of follow-up research linked to CIU. We gratefully acknowledge the assistance of the employees at CIU and of the individual respondents who contributed to the research.

References

[1] B. Marr, Why Everyone Must Get Ready For The 4th Industrial Revolution. Forbes, 2016.
[2] G. Bøndergaard, Nord-VET - the Future of VET in the Nordic Countries, In The historical emergence of the key challenges for the future of VET in Denmark, Nord-VET, 2014.
[3] C. Helms Jørgensen, The Current State of the Challenges for VET in Denmark, In Nord-VET - the future of VET in the Nordic Countries; Nord-VET, 2014.
[4] E. Abele, Learning Factory, In CIRP Encyclopedia of Production Engineering, Berlin: Springer, 2016 1–5.
[5] K. Lewin, Action Research and Minority Problems. J. Soc. Issues 1946, 2 (4), 34–46.
[6] P. Freire, D. Macedo, Pedagogy of the Oppressed, 30th Anniversary Edition, 30th Anniversary edition.; Ramos, M. B., Translator; Continuum: New York, 2000.
[7] V. Aarkrog, The Coherence between Practice Situations and Ways of Transfer: Examples from the Danish Vocational Training Programmes. Educ. –Line, 2003.
[8] Design Council UK. The Double Diamond: A universally accepted depiction of the design process https://www.designcouncil.org.uk/news-opinion/double-diamond-universally-accepted-depiction-design-process, accessed Dec 26, 2019.
[9] V. Aarkrog, B. Wahlgren, Teacher Training through Research Circles, in Trends in vocational education and training research, VETNET Proceedings, 2019, Vol. II, 1–7.
[10] B. Wahlgren, V. Aarkrog, Developing a Culture for Change in VET, in Trends in Vocational Education and Training Research, VETNET Proceedings, 2019, Vol. II, 438–444.
[11] E. Abele, J. Metternich, M. Tisch, Learning Factories: Concepts, Guidelines, Best-Practice Examples, Springer International Publishing, 2019.