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New paths in teacher training

University course "Industry 4.0 - Vocational Education 4.0"

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Abstract

The changes in the professional world are being driven forward by digitalization. Occupational fields and job descriptions are changing more and more rapidly, so that the school and tertiary education institutions in the education of children, adolescents and young adults as well as continuing professional education institutions are constantly challenged to respond to these changes and adapt their offers very quickly. In order to provide the teachers of Vocational Schools in Austria with tools for this purpose, the university course for vocational education at PH NÖ in cooperation with the Federal Ministry of Education, Science and Research has developed the university course "Industry 4.0 - Vocational Training 4.0" and already in 2 rounds carried out. So far, 98 teachers and school principals took part in the university course, working on 20 cross-school projects in cooperation with businesses and tertiary educational institutions. These all showed a high future potential. It has often been a combination of environmental and social issues with technical solutions that made visible that digitalization can be of great help in solving our burning problems. Attendent the course, 47 course participants took part in a survey on the "Ideas for the term" Industry 4.0 "and which competences should be passed on to pupils".

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Schlüsselwörter:
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1 Introduction

Beginning with the development of the steam engine in the 18th century, industrialization began around 1800 – sort of "Industry 1.0" - which eminently influenced working life and, of course, our social development. With the introduction of electricity at the end of the 19th century and the introduction of the automobile at the beginning of the 20th century, the second major change took place, the 2nd Industrial Revolution - "Industry 2.0". In this phase not only the production and the transport were changed strongly, but by the introduction of telephone calls and telegrams it came also in the office to large changes in the work processes.
As early as the 1970s, with implementation of computers in employment, the 3rd Industrial Revolution - Industry 3.0 began. This development led to ever faster development cycles and thus began the automation in the industrial halls. The ever faster development led to the seamless transition to the 4th Industrial Revolution or Digital Revolution - Industry 4.0. Due to

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the rapid digitalization of all areas of life, not only working life but also private life is changing. One of this is the permanent accessibility of the individual in many parts of the world and the permanent access to innumerable information up to control possibilities of the own household from far distances or the rapid change of nearly all job profiles by the modern communication and control techniques. Nobody can escape this change, which is progressing in the shortest possible time. This not only leads to relief in our (communal)life, for example, through networking, but also to ever greater risks such as disinformation (fake news), fraud in financial transactions (pishing mails, and so on) to the vulnerability of high-tech areas such as the energy sector, military installations or the financial sector, which are permanently threatened by hacker attacks. Our children and adolescents, both parents and educational institutions, must be prepared for these complex challenges in the best possible way. This presents a particular challenge, as parents and teachers themselves are sometimes not well equipped to handle these tasks. The digitally driven developments are so fast that ordinary consumers can barely keep up and thus on the one hand enough security vulnerabilities that can be used by criminals, and on the other hand great pressure in the working life, with different aspects, occurs (see Holler, 2017).
Therefore, it is not only necessary to convey the knowledge of digital methods and tools in our educational institutions, but also to make the thinking patterns and working methods of both teachers and students viable in the context of digitalization.
Based on these considerations, a continuing education course for teachers of vocational schools in Austria has been developed jointly by the Pädagogische Hochschule NÖ and the Federal Ministry of Education, Science and Research on the initiative of the Ministry of Education, Science and Research.

2 THE UNIVERSITY COURSE AND THE IMPLEMENTATION:

The university course program to be developed should fulfill the following objectives:
• Creating a common understanding of the needs of Industry 4.0 - VET 4.0 and raising awareness of the topic
• Identify the driving and critical factors of digitalization of the economy and Industry 4.0 practices and related training needs
• Implementing the mindset of how digitalization can be harnessed to humans, facilitated and perceived as an opportunity, and how to be aware of fears or threats of job loss, and how to create a sense of risk, and how to protect yourself from abuse
• Implementation of a joint Industry 4.0 networking project with technical, economic, occupational and socio-scientific aspects involving various types of schools as well as economic and research partners
• Initiation of school development at the school location under the aspect of Vocational Training 4.0 and the new forms of communication
• Opening the topic of digitalization in the direction of diploma theses in the higher vocational schools or theses in the middle vocational schools
(see Kraker, Schrack, Koliander, 2019)

An intensive development process resulted in a three-part university course with the diploma "Vocational Training 4.0 Coordinator" and 5 ECTS credits.

To get the graduation of the university course it is required:
• Active participation in all three course blocks.
• Development, documentation and presentation of a common 4.0 pilot project in the 4.0 cluster.
• Further development of the 4.0 pilot projects as well as the holding of at least two regional meetings in the 4.0 clusters between the course parts
• Participation in the common exchange platform (PH-Moodle)

• Submission of a joint project report of the project group as well as a personal reflection of each individual

In the planning, care was taken to ensure that the inputs were given by high-caliber lecturers from the business or public sector (administration, research). Examples include the General Manager Strategy Group of Audi AG, 2 Product Manager of LinkedIn, the Head of the Public Employment Service Austria and the Head of Cyber Security of the Austrian Armed Forces.

For the development of the cluster project "Industry 4.0", the University Alliance - Director of SAP was won, who developed project ideas and subsequent implementation with an SAP training team with the course participants in school clusters by means of design thinking.

According to Tim Brown, Design Thinking is based on the assumption that people from different disciplines can better solve problems by working together in an environment that encourages creativity. Motivations and needs of people are taken into account and developed from these concepts, which are tested in several stages (see Brown 2008).

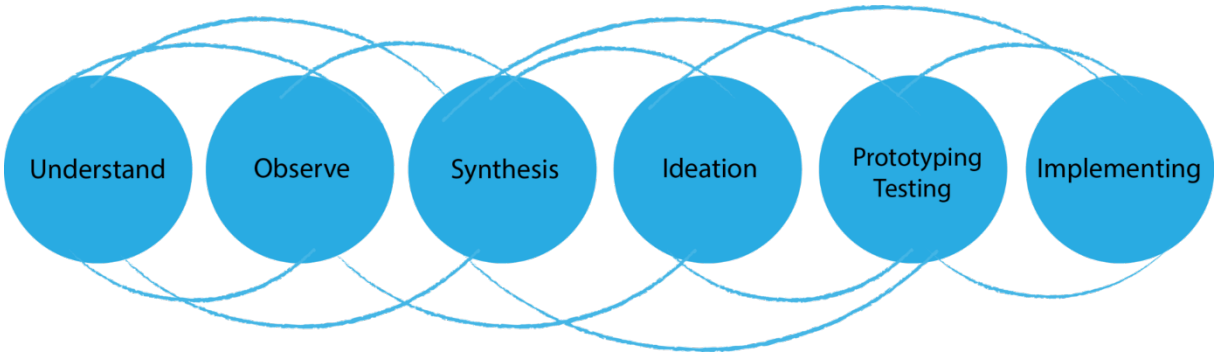

Illustration 1: The Design Thinking process, referring to Anja Wölbling, Kira Krämer, Clemens N. Buss, Katrin Dribbisch, Peter LoBue, and Abraham Taherivand 2012. "Design Thinking: An Innovative Concept for Developing User-Centered Software", in Software for People, Mädche, Alexander (eds.), Berlin: Springer, p. 121ff.

The Design Thinking approach was chosen as teachers from different types of schools – so to say faculties - should work together to develop and implement a project, including the involvement of business and tertiary education institutions. During the development phase we tried to create the most creative environment possible.
As a result of the project groups, the Design Thinking approach was also used in part in the further work with pupils.

In the planning and implementation of the projects, care was taken to ensure that as much as possible of the joint work was used by means of collaborative working techniques. The documentation took place via the Moodle platform of PH Lower Austria.

2.1 RESULTS:

Projects:
In the previous two rounds of the university course, 20 projects have been planned and some of them have already been completed. The unfinished projects are projects that are larger in scope and still have to be financed by the business partners or have to be negotiated with other partners.

Here is a short overview of some selected projects:

Project name	Project content	Participating school types*)	External Partners
Bee Maya	Development and sale of a cost-effective, online readable beehive scale	AC HTL HES	Teaching business of the agricultural college
Ruthnerturm 4.0	Further development of the Ruthnerturm - energy-self-sufficient and smart - as a possibility of "Urban Gardening"	2 HTLs AC	Garden centre Research office
Life Care	Combination of a house alarm system with a person monitoring for those in need of care	HTL HES PS	Producer of alarm systems UAS
Information tool for climate-adapted tree species	Online information for farmers and interested parties about tree species that can resist climate change	HAFS HTL HES	University of agriculture
Intelligent mobility	Development of a low-cost, digitized wheelchair	PS HETS	IT - Company
Dörrex	Development of a mobile and energy self-sufficient fruit-drying plant	HTL PS	Plant engineering company
Clever together	Development of a common learning room for practical applications	HETS HES HTL	
PV-School	Concept of a school with photovoltaic system and metrological monitoring as well as a "photovoltaic case" for schools	PS HETS HES HTL	Technical university Vienna

Tab. 1: Overview of selected projects of the 1st and 2nd university courses

*) Abbreviations:
PS: professional school
UAS: university of applied sciences
HES: higher economic school
HAFS: higher agriculture and forestry school
HETS: higher economic and tourism school
HTL: higher technical school
AC: agricultural college

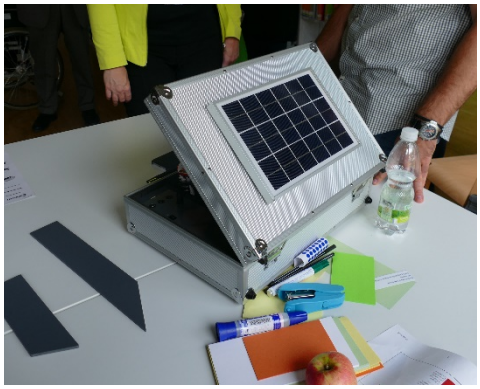

Illustration 2: Example of a project result: photovoltaic case, which has already been used successfully in schools

Illustration 3: Example of a project result: digitized wheelchair

Diploma theses:
From these projects diploma theses, which were presented in the context of the final and diploma examinations, developed in almost all participating secondary schools. The teachers and headmasters were very satisfied with these results.

Accompanying research
Before the start of the course, course participants were asked what they associate with the term "Industry 4.0".
Subsequently, the course participants were asked which competencies they would like to convey to their students, so that they can find their place in the future world of work.
The results of the survey show that the term "Industry 4.0" is associated with networking and digitalization, especially in the area of production and manufacturing. The willingness to innovate as well as social and communicative skills in dealing with digital media and means are seen as important competencies that students should acquire (see Koliander, 2019).

2.2 CONCLUSION

According to Dreher and Koliander, it is no longer enough for students in a time of rapid change through digitalization and networking to acquire professional skills and abilities. Dreher and Koliander write in their article "Skills? Even better: design competence" that, in addition to good professional training, there is an increasing need to face complex problems, to search for new solutions creatively and in exchange with other people and to act under uncertainty, including possible mistakes." (see Dreher and Koliander 2019).

These design skills have been intensively familiarized and experienced by the participants of the university course and have developed and carried out great, future-oriented projects. All school clusters have been assured that they will continue the collaboration that has begun.

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