Herausgeber von *bwp@* : Karin Büchter, Martin Fischer, Franz Gramlinger, H.-Hugo Kremer und Tade Tramm

Berufs- und Wirtschaftspädagogik - *online*

Alberto CATTANEO & Antje BARABASCH
(Swiss Federal Institute for Vocational Education and Training)

Technologien in der Berufsbildung zur Verknüpfung des Lernens zwischen Schule und Arbeitsplatz: Das Erfahrraum Modell

Online unter:
http://www.bwpat.de/ausgabe33/cattaneo_barabasch_bwpat33.pdf

in

bwp@ Ausgabe Nr. **33** | Dezember 2017

Entwicklungsbezogene (Praxis-)Forschung

Hrsg. v. **Tade Tramm, H.-Hugo Kremer & Gabi Reinmann**

www.bwpat.de I ISSN 1618-8543 I *bwp@* 2001–2017

bwp@

www.bwpat.de

ABSTRACT (CATTANEO/BARABASCH 2017 in Ausgabe 33 von ***bwp@***)

Online: http://www.bwpat.de/ausgabe33/cattaneo_barabasch_bwpat33.pdf

In the beginning of the new Millennium, the Swiss Federal Council promoted a funding strategy to support vocational education oriented research. To this aim, some leading houses have been created, one of which – born in 2006 – was devoted to investigate the role of technologies for vocational education. The umbrella project was named "Dual-T", meaning that the focus has been on investigating how technologies could help bridging the gap between learning at school and in the workplace. Coordinated by EPFL and including the university of Fribourg, the University of Geneva (until 2013), and the Swiss Federal Institute for Vocational Education and Training, Dual-T adopted a design-based research approach and over the years developed a pedagogical model (the 'Erfahrraum') for the effective use of technologies in dual VET. We present in detail the example of one of the 12 research projects included so far in the framework of Dual-T, explaining how it enacts the Erfahrraum, exemplifying and elaborating about the relationships between research and practice. In addition our reflection on research praxis and research impact on practice are presented. Finally, we will show how different projects led us to further research- and practice-oriented questions, and how we are actually dealing with them.

Technologien in der Berufsbildung zur Verknüpfung des Lernens zwischen Schule und Arbeitsplatz: Das Erfahrraum Modell

Zu Beginn der Jahrtausendwende hat der Schweizer Bundesrat beschlossen verstärkt die Berufsbildungsforschung zu unterstützen. Aufgrund dieser Initiative wurden die Schweizer Leadinghouses gegründet, wovon sich eines seit 2006 dem Themengebiet Technologien in der Berufsbildung widmet. Das Projekt "Dual-T" setzt sich speziell mit der Frage wie Technologien die Diskrepanz zwischen Lernen im Betrieb und Lernen in der Schule überwinden könnten auseinander. Koordiniert wird das Großprojekt von der EPFL, den Universitäten Fribourg und Genf (bis 2013) und dem Schweizer Bundesinstitut für Berufsbildung (EHB, IFFP, IUFFP). Dual-T verfolgt einen Design-based-Research Ansatz und hat im Verlaufe der Jahre aufgrund der Forschungsarbeiten ein pädagogisches Modell entwickeln können (den 'Erfahrraum'), welches der Beurteilung einer effektiven Nutzung von Technologien in der Berufsbildung zugrunde gelegt wird. Wir stellen beispielhaft für die symbiotische Beziehung von Wissenschaft und Praxis ein Beispiel aus dem Dual-T Projekt detailliert vor und erklären wie der Ansatz des 'Erfahrraumes' eingesetzt wird. Weiterhin wird aufgezeigt wie uns die bisherige Forschungsarbeit in den Projekten zu neuen Forschungs- und Praxisfragen führt und wie diese behandelt werden können.

ALBERTO CATTANEO & ANTJE BARABASCH
(Swiss Federal Institute for Vocational Education and Training)

Technologies in VET: Bridging learning between school and workplace – the "Erfahrraum Model"

Technologien in der Berufsbildung zur Verknüpfung des Lernens zwischen Schule und Arbeitsplatz: Das Erfahrraum Modell

1 Introduction

Digitalization is nowadays a urgent and daily discussed topic at scientific and political level (ecoplan 2017). Investigating the development and use of technology has become important for the preparation of the future workforce. Many scholars pointed out the consequences of the digital revolution on both manual and – above all – mental work over the past decade (Brynjolfsson/McAfee 2014; OECD 2016). The Swiss Federal Council recently highlighted the need to prepare up-to-date skilled workers to face several challenges in production and distribution processes (Swiss Confederation 2017a) and furtherly identified eight priority actions to pursue in order to deal with the challenges of digitalization concerning education and training – e.g. to increase the use of technology within teaching and learning – and research and innovation – e.g. to encourage innovation and accelerate the knowledge transfer (Swiss Confederation 2017b).

Within this framework, the topic of exploiting at its best the potential of digital technologies strongly applies in particular to vocational education and training (VET), where the question is placed at the crossroads between education and economy. In fact, dual VET systems are considered to prepare workers adequately for new demands at the labour market, which includes the adaptation to technology-driven changes. The dual character of training also allows innovations at the workplace to inform VET at school (Pfeiffer 2015).

However, the search for understanding how to effectively integrate the affordances provided by technology into education is not an unknown field of investigation. Over the last years scholars and institutions equipped us with more and more evidence-based awareness that the use of technology per se cannot make any difference on learning (inter alia Hattie 2009, 2015; Tamim et al. 2011; Higgins et al. 2012). Having classes equipped with all kinds of (new) digital devices is not at all a way to assure the enhancement of learning (OECD 2015). To sum it up: „Technology can amplify great teaching, but great technology cannot replace poor teaching" (ivi, 17). Therefore, rather than uncritically adopting whatever technology in our classes as soon as it appears on the market, we need to profoundly understand its instructional and pedagogical affordances; finally, we need experts able to effectively combine the simultaneous mastery of content knowledge, didactical and pedagogical knowledge, and only in addition to that technological knowledge (as it is proposed for example by the well-

established model by Mishra and Koehler (2006; see also Harris et al. 2009; Koehler et al. 2014). From a methodological point of view, this can be optimally investigated through an Educational Design Research approach (McKenney/Reeves 2014) – often also referenced to as "Design-Based Research" (e.g. Barab/Squire 2004; DBRC 2003) or "design experiments" (e.g. Brown 1992; Collins 1992) – which „in general distinguishes itself from other forms of inquiry by attending to both solving problems by putting knowledge to use, and through that process, generating new knowledge". (McKenney/Reeves 2014, 133).

About 10 years ago research within general education was already investigating how to effectively integrate technology in teaching-and-learning to have a positive impact on students learning outcomes, but within VET very little had been done. Hence, the Swiss leading house "Technology for vocational education" was created in 2006 to inquire about technological innovations in VET within various research projects, such as projects on collecting "meaningful experiences" from the workplace using portable ICT devices, on collaborative writing to learn procedures, or on fostering complex problem-solving with augmented tangibles. One of the outcomes of these projects was the development of a pedagogical model called "The Erfahrraum model" (see Schwendimann et al. 2015), which will be explained in this article. In addition one of the projects included in the Leading house research program –which was built on this model and is specifically concerned with mobile learning in the chefs' domain– will be presented. Based on our experience with inquiring practice as well as theory building and research we will elaborate on the perceived dichotomy between the two spheres and how we overcame it. Finally, an outlook on follow-up research goals and objectives will be provided.

2 The Dual-T leading house and the 'Erfahrraum'

2.1 How it all started: The Swiss Leading House on Technologies for VET – Dual-T

Not only research on learning with technologies in VET is sparsely developed, in most European countries there is still little research specifically focusing on VET overall. For Switzerland, a country in which about two thirds of young adults attend VET, researching this educational sector is of immanent importance. In order to steer the VET system effectively the Swiss national and cantonal authorities need research support to design a demand-oriented and up-to-date system that provides qualified workers for the Swiss labour market and an employable workforce willing to engage in further learning. Under this premise, at the beginning of the new Millennium the Swiss Federal Office for Professional Education and Technology (OPET, actually State Secretariat for Education, Research and Innovation, SERI), which is part of the Federal Department of Economic Affairs, identified six research priorities related to VET. Each priority was then assigned to one or more university leader in the field in order to develop a full research proposal, eventually shared with other professors. The resulting network of researchers around each priority constitutes a "leading house". Besides the general aim of conducting research, for each leading house „the aim is to fill conceptual gaps and meet the needs of VET policy and practice", as well as to „promote young researchers" and „to develop sustainable VET research and thus boost existing research

capabilities“ (Swiss Confederation 2007, 8). The ultimate goal was the establishment of VET-specific research domains within a time span of 10 to 15 years.

2.2 Dual-T

One of the priorities within the national research agenda concerned the role of technologies for learning in VET. The “Technologies for vocational education” leading house was attributed in 2006 to the Federal Technical University of Lausanne and also included the University of Fribourg, and the University of Geneva (until 2013). The Swiss Federal Institute for Vocational Education and Training (SFIVET) officially joined the project in 2008 (and had been involved from the beginning in the development of the research proposal).

Given the particular nature of the leading house, its focus on technology and the expectations on both research results and impact on the field, the consortium chose to adopt a Design-Based Research (DBR) (Brown 1992; Collins 1992; Design-Based Research Collective – DBRC 2003) approach. The reasons for choosing this approach are best summarized by Wang and Hannafin (2005). They argue that DBR is especially important when it comes to technology-enhanced learning. The authors summarize the following five distinctive characteristics of DBR: 1) it is pragmatic, aiming at refining both theory and practice; 2) it is grounded, as it unfolds in interventions which are theoretically grounded and are implemented in real-world settings; 3) it is interactive, iterative and flexible: it foresees the active involvement of the participants and practitioners in the design of the interventions; it is iterative, consisting in cycles of analysis, design, testing, redesign; 4) it is integrative, as it includes the use of multiple and mixed research methods; 5) it is contextual, leading to results which are connected with the specific design and context of the studies, and to design principles varying in content and depth. According to the DBR principles, each project in the leading house was then structured similarly, starting from an in-situ observation phase, from which to identify contextualized questions to address, and followed by a participatory design phase, an implementation phase for empirical validation, and continuing with redesign(s) and new empirical validation(s) before starting transfer to other training contexts and/or scaling up.

2.3 The development of a pedagogical model

Our preliminary observations in different professional fields revealed the existence of a shared background and the joint two-folded need of a. increasing the articulation across learning locations and at the same time b. supporting apprentices to reflect on their practice (see also Aprea/Cattaneo/Sappa 2015; Aprea et al. 2012).

Therefore, we progressively drafted and refined a pedagogical model, called “Erfahrraum”, to support reflective activities across learning locations . The model is inspired by experiential learning theories (e.g. Dewey1933, 1938/1963; Boud/Keogh/Walker 1985; Kolb 1984; Schön 1983; Engeström 1987), according to which you need to reflect on experience in order to facilitate learning; and by boundary crossing models (e.g. the expansive model by Fuller/ Unwin 2003; the connective model by Griffiths/Guile 2003; the integrative pedagogics model

by Tynjälä 2008), addressing „ongoing, two-sided actions and interactions between contexts“ (Akkerman/Bakker 2011, 136) and assuming the existence of boundary objects (introduced by Star 1989, the concept refers to objects that „both inhabit several intersecting worlds and satisfy the informational requirements of each of them“; see Star/Griesemer 1989, 393) which facilitate the crossing. Furthermore, as the Erfahrraum is a VET-specific model for technology-enhanced learning, it is also grounded on the integrated learning framework (Dillenbourg/Jermann 2007), which considers technologies as tools to support learning activities rather than for delivering or storing information. These learning activities can exploit multiple modes of interaction (with or without electronic devices, in presence or at distance), are built on social interactions (among students, with the teachers, with the in-company trainers), and produce emerging digital objects that can be used and reused to afford further learning activities.

Exploiting the use of technology, in the Erfahrraum knowledge elements flow from one context to the other back and forth, in an iterative way. For example, learners can collect experience from their daily activities at the workplace and store digital traces of experience when and where experience happens (e.g. taking pictures, capturing videos, recording audios, filling in online forms, and similar) for further reflection. Teachers can make use of a selection of the materials collected by the apprentices to get them to reflect upon, expand or give meaning to workplace experience, in individual as well as collaborative activities. This step can be conducted in the classroom by sharing, defining, contrasting, simulating, exploring, analyzing, solving problems, giving (and receiving) feedback, etc. These activities are supported by technologies such as digital portfolios. The teacher orchestrates them (Dillenbourg/Jermann 2010), foreseeing that the raw materials collected in the first step are adequate to become learning material. Finally, the learner should make sense of the knowledge constructed at school for further practice and assess its effectiveness back in the context in which it has been originally experienced. From this example one can notice, that the Erfahrraum is not physically located, it can be performed at the workplace or at school, under the supervision of colleagues, supervisors, teachers and/or peers. The phases are sequential, but the point of departure can vary.

3 An illustrative enactment of the Erfahrraum: The case of chefs

In this section we present one illustrative enactment of the Erfahrraum concerning apprentice chefs (for more detailed description please refer to Cattaneo/Motta/Gurtner 2015; Motta/Cattaneo/Gurtner 2014; see also Mauroux et al. 2013, 2016 for a comparable experience). As the other projects, also this one is embedded within the Swiss dual-track VET system. As a result, apprentices often experience gaps within their learning depending on where it takes place (Eteläpelto 2008; Taylor/Freeman 2011) and complain about the insufficient relationship between what they learn at school and what they experience at the workplace (de Bruijn/Leeman 2011). Based on this situation, the project aims at exploiting mobile devices for offering apprentice chefs original ways to build bridges over these gaps and to reassemble information and learning experiences made across locations into aggregated learning units.

Since transfer of learning is hardly spontaneous to happen and knowledge often remains context-specific, these aggregations have to be stimulated on both sides of the bridge, by apprentices' supervisors at the workplace and teachers at school.

On top of the general Erfahrraum framework, the chefs project also profited from a mobile learning framework. As Sharples (2009, 19) pointed out, mobile learning can be seen as „learning that happens across locations, or that takes advantage of learning opportunities offered by portable technologies". Thus, mobile devices seem to be particularly useful for our purpose: they have a high potential to support the integration of non-formal and informal learning (Pachler 2009), allow for just-in-time information retrieval whenever you need it and make note- or picture-taking easy wherever you are (Lai et al. 2007). The educational affordances (Kirschner 2002) offered by mobile devices can be exploited in order to support connectivity and stimulate real "seamless learning" (Chan et al. 2006).

During our observation phase, in our discussions with persons in charge of the training of chefs, we discovered that a boundary object was already foreseen, but hardly used, the so-called "learning documentation". In fact, chef apprentices are requested to write a journal in which they document and reflect upon their significant workplace experiences. This needs to be presented at their final exams. It includes two parts: a recipe book, and a section where the main professional processes are described and commented. Students do not receive a mark, but writing the journal is compulsory. Supervisors are supposed to regularly review the journal to be informed about the students' actions and reflections. It has been found, that often apprentices would develop the recipe book in the last minute before the exams. Based on our discussions with the teacher and the corporate association, we came to the conclusion that working more regularly on the receipt book could both have significant results on apprentices' learning and serve as a boundary crossing object, provided that it is exploited at school.

Starting with two classes (one used as the experimental, the other as the control group), we allowed apprentices to capture their experiences on the fly by using a smartphone or in some cases a headband camera. The collected material could be sent to a corresponding online environment that was designed for them to keep their recipe book in an electronic format. The recipe book was also provided with some reflective prompts (Kicken et al. 2009) to induce and foster reflection on practice. Apprentices were trained to exploit this environment, as well as to share their recipes, on request, with their teacher and schoolmates at the vocational school.

In parallel, in the construction of a lesson, the teacher decidedly took advantage of this online environment, by asking apprentices to collect and to share pictures or videos of a specific cooking method for a given lesson. The researchers and the teacher co-designed various learning scenarios (individual, group, plenary), all based on the use of that tool.

The activities throughout the project were continuously monitored and researched for the whole duration of the chefs' curriculum (3 years), both with qualitative and quantitative methods. Once the mobile and online tools have been available – the development of which was also a participatory design process – we progressively investigated the feasibility of the

approach, the usability of the tools and their perceived usefulness, the effectiveness of the learning scenarios in terms of learning (considered in both its cognitive and affective dimensions) and the teaching practices (see Hämäläinen/Cattaneo 2015). Moreover, specific investigations have been devoted to the use of prompts to support the development of metacognitive skills (e.g. Mauroux et al. 2014) and to the dynamics of co-regulation of learning within small-groups (Motta/Cattaneo/Gurtner 2017).

Given the positive results obtained with these studies, we progressively scaled up, extending the experience to the whole sample of apprentice chefs in the Italian speaking part of Switzerland first, and then moving towards the French and German speaking regions.

4 Practice-oriented research: strengths and weaknesses

4.1 The interplay between research and practice, and its impact on both

Although they finally incorporated different technical solutions and run on different pedagogical scenarios, as all the Dual-T projects also this one started from a specific topic – for example how to calculate the price for a whole menu – described by practitioners of the field as either problematic or worth to be investigated within a quasi-experimental design.

Theory-based suggestions made by the researchers were then discussed with selected practitioners and (re-)designed to gain acceptance by the teachers and/or supervisors of the target profession. For example, theories on metacognition and on prompting to scaffold reflection were discussed to formulate adequate prompts in the online environment. When seeing the supervisors' difficulty in periodically accessing the platform, we re-design it so that it included a notification system.

Conversely, researchers profited from the expertise of teachers concerning the specific context and more generally teaching to apprentice chefs; the agreed-upon solution was then tested for feasibility and effectiveness in pilot groups. For example, the practice-related topics on which to develop some learning scenarios always came from the teacher, who was formerly a professional. Interviews, observations and tests were regularly run with the participants within pilot experiments to fine-tune the learning scenarios and the technical solution before enlarging the experiment to a wider sample.

In the specific case of the chefs, practitioners and researchers worked together in the spirit of Design-Based Research in order to design, implement and test new learning scenarios based on the use of the mobile and online tools. The supervision of the whole process was assured by a senior and a junior researcher as well as a teacher and profited from an international advisory board., . The junior researcher developed her PhD project within the project. The teacher involved developed his expertise in many ways: he could experience first-hand the research process and learn how research is conducted; he learned how to design learning scenarios and about the complexity of managing an action-based research design involving many stakeholders. He also obtained his teaching diploma with a thesis about the project.

At a more general level, the research team learned a lot about VET in practice, its functioning and its management, especially when dealing with supervisors, company directors and the professional association representatives, both at the regional as well as national level.

The network established in this project was progressively extended in many directions. The collaboration with the vocational school was nurtured from the beginning of the project for assuring its realization. Therefore, both the vocational school management team and the Cantonal office responsible for this vocational sector were constantly informed from the beginning and supported the intervention. Progressively, having seen the results of the pilot interventions, both the school principal and the Canton endorsed the widening of the experience to all the chef classes in the school.

Supervisors at the workplace were also invited to join the experience. First, the researchers together with the practitioners visited them and introduced the use of the platform. This was crucial to allow collaboration of the main VET stakeholders around it. Although most of the supervisors adopted the procedure quite quickly, convincing all of them sometimes requested additional efforts, especially with those fearing that training apprentices in such a way could interfere with realizing quality products. Cantonal inspectors and exam experts also asked to join the experience, thus allowing us to really involve all the main actors of the system around the same (boundary) object – namely the online platform with the apprentices' learning documentation.

The corporate associations in Switzerland have a strong say in VET. Therefore, we included the professional association in charge of chefs, first at regional, later at national level. The national association was supportive and funded an upgrade of the online platform.

In terms of products, we can report results at different levels and for different purposes.

For the research community, we produced several peer-reviewed contributions (both publications and congress presentations) on the experience. We also disseminated the information on the project within the VET practitioners community and transferred its results into teachers' training courses.

For practice, one of the main products is the technological solution itself, with its two components (the online environment and the smartphone apps); the learning scenarios (for a description of some of them see Motta/Cattaneo/Gurtner 2017; Hämäläinen/Cattaneo 2015) are also interesting products which the school can profit from, so that nowadays all the teachers willing to do it can use them in their classes. Concerning the interplay between research and practice, once a scenario proved to be effective for learning, it was simplified and undressed by many details needed for research aims, making it easier to be integrated and managed in teachers' everyday practice.

Additionally, the impact of using such kind of learning scenarios had also other consequences for the system: 1. Supervisors at the workplace were more engaged in supporting their apprentices with the realization of their recipe book and had more frequent contact with the teacher at school; 2. Motivation at school was much higher: having been put on stage as

protagonists, apprentices were willing to share and comment their own experiences while the teacher could better attach theory to practice; 3. The sharing of experiences happening in different workplaces also generated a stronger awareness of the profession and its procedures. The procedures can be slightly different depending on workplace characteristics. Most apprentices (about 82%) also reported to better perceive the connection between school and workplace; and 4. learning itself increased significantly, both in terms of declarative knowledge acquisition and reflective attitude, and finally in terms of better performance in practice (results reported e.g. in Motta/Cattaneo/Gurtner 2014; Cattaneo/Motta/Gurtner 2015; Mauroux et al 2016; Motta/Cattaneo 2016).

4.2 Lessons learned

This section provides some "lessons learned" on the DBR process, trying to make both the challenging and the straightforward part of each aspect explicit.

4.2.1 The subtle continuum between research and practice

Today, researchers are increasingly confronted with rising expectations regarding the societal utility of science. Research programs are increasingly application-oriented, often worked out among cooperative and transdisciplinary project teams, which have replaced the former university-centred basic research mode. The historic distinction or hierarchical order between basic and applied research which implies a moral superiority of academic research over benefit-oriented industrial research, even on the personal level of researchers came to an end (Elvehjem 1959, 94-96). The claim, that research as an intrinsic ideal of science for its own sake, with its simplified promise of scientific objectivity, denies the actual complexity of research (Schauz 2014). As a result, the boundaries between basic and applied research are blurring.

Research on the introduction of new methods and tools in education are challenging the perception of foundational research as a normative category (Schauz 2014). Related distinctions, for instance, between discovery and invention or research and art are also fading. This paradigm is not new indeed. Scientists in applied botany for example declared the distinction between pure and applied science to be invalid: „All science is one. Pure science is often immensely practical, applied science is often very pure science, and between the two there is no dividing line" (Coulter 1917, 228).

Where applied research on practice regarding technologies seems to intersect with understandings of basis science, is at the intersection of understanding research as "fundamental research", a term used very early on in the context of technological and industrial research. Fundamental research means any scientific research revolving around basic technical problems with the goal of improving existing technology or, hopefully, developing new technologies (Nutting 1917, 250). This term emerged in research fields with an explicit application-orientation and conveyed the promise that science would produce, sooner or later, useful knowledge. With the growing expectation that scientific research must be able to offer

innovative approaches regarding technological developments as much as societal improvements, this semantic shift became in the late 19th century more and more accepted within the research community as much as outside of it. The epistemic notion of an asymmetry of knowledge and, by association, the scientific preference for research led by theoretical questions began to erode (Schauz 2014). However, practitioners as much as scientists remain to be sceptic and would often claim the concern that knowledge production as a source for innovation should not be solely aligned to immediate practical needs. In order to be sustainable sufficient time for experimentation and research is required to find lasting applications to practical challenges.

In the field of education this shift to applied research meant to achieve a higher social proximity between researchers, educators and students. It further required involving all stakeholders within the field of education as well as researchers from different disciplines, such as education, psychology, sociology, computer science, or linguistics. Bourdieu once talked about the dialectic between perceiving, understanding and acting that takes place in practice. According to him „practice always implies a cognitive function, a practical operation of construction which sets to work, by reference to practical functions, system of classification (taxonomies) which organize perception and structure practice“ (1977, 97). Just as Bourdieu said it, we realized that in a project like ours the relationship of thinking and acting is complementary. During the project questions, design proposals, experiences as well as research results were shared and discussed. Observation and analysis elicited and built a common frame of reference for follow-up investigations. Translating this further to the relationship between research and teaching, both have their own rules. Teachers are expected to use research-based findings for the instruction and at the same time they expect that researchers would understand their practice. It is not paradoxical in this sense to find nowadays contributions that try to reconcile the vision of teaching as “an art and science”, and specifically as a design science (e.g. Laurillard 2012; Maina/Craft/Mor 2015). In order for the research results to become meaningful for the educational context, notions of social worlds, the school as an organisation, practices, events and the actors involved need to be considered in a research design.

As we described above, the practical side of this project benefited from research – for example to structure in a specific way the online environment or to think about how to design the learning scenarios – and vice-versa, we built research on the basis of our practical intervention – for example investigating the reflective skills development or the apprentices’ perception of a link between learning locations. This interplay has consequences for the whole system, progressively making innovative interventions like the one described above to be fully integrated and become a routine. For example, when the research results supported the idea to extend the experience to all new apprentices, the school institutionalized the fact that at the beginning of the school-year all the in-company trainers would have been invited for a meeting where to present the project and the functioning of the digital tools.

At the same time, from a research perspective educational design research still suffers from some suspicion within the strictly experimental community; two common critical reactions by

reviewers of our papers have concerned for example the sample size (working with two or three classes can make a whole sample of 40 to 60 persons) and the non-random attribution of the subjects to the conditions (for ecologically validity, we used authentic classes, without splitting the participants over the conditions).

4.2.2 The complexity of a dual system and the time span for large-scale impact.

The dual mode for training apprentices is undoubtedly powerful, but it is also highly complex: involving teachers and supervisors only is not enough; to have an impact on the system other actors need to be involved, such as school authorities, cantonal inspectors, cantonal and national professional associations or exam experts, for instance. As a consequence, the time span needed to produce a large-scale impact when introducing an innovative solution is quite long, especially considering the complexity of the paths to be followed among the various VET stakeholders (see also Rodriguez/Nussbaum/Dombrovskaia 2012a; Margolis et al. 2006). Differently from other kinds of research projects, just one four-year period is too short to guarantee a meaningful impact on the system, at all levels. There are two major reasons for that: An intervention based on a technological innovation requires the innovation itself to be developed first, and this is part of the DBR process and project. Per se, it requires time and specific (user-centered) investigations – for example on usability, accessibility, and acceptance. Furthermore, given these characteristics, it is not possible to think about involving a large sample from the beginning. You have to start with a small sample, and then – when research results sustain the effectiveness of the intervention – you involve a larger number of people and scale up.

4.2.3 To practitioners through practitioners

In the text we mainly emphasized the privileged relationship of researchers with teachers; indeed, as showed, we also had relationships with in-company trainers; preferably, this second target group has been accessed through teachers. The reason is that within VET, teachers often come from practice, being professionals in a particular professional domain; this was the case for chefs too. Therefore, they have much higher chances to be recognized as "peers", member of the same community of practice – and therefore trusted – than researchers, who are usually perceived as detached from reality or practice. This dynamic at the individual level is also transferable to the institutional level as concerns our researchers and the teachers. At SFIVET, VET teacher training is conducted with a strong emphasis on practice. Strong ties to school principals and teachers support research that is designed collaboratively and built on reciprocal trust.

4.2.4 Sustainability vs ongoing process

Sustainability is always an important issue for innovations developed within a research project (e.g. Rodriguez/Nussbaum/Dombrovskaia 2012b). For the partners of the chef's project this has been a highly relevant consideration from the beginning. From a technical point of view, two aspects needed careful reflection, the development and the maintenance of the

platform as well as the related apps. Keeping up the platform has been explicitly included in the specifications of the contracted developer. Based on the agreement passed with the corporate association, his contract has been signed for a minimum of 8 year for the maintenance of the platform. Given the rapid evolution of technologies nowadays, this timeframe provides sufficient time to take new developments into account. With respect to the apps, and given the experience made early in the project with existing apps, it was decided to build a specific app for the project. The school has taken over the challenge to develop it and to keep it up-to date as part of its duties.

However, sustainability has also to deal with dissemination and adoption. This is the most challenging part of an educational design research project. On one side, if you do not show that your project is sustainable, full adoption by professional associations will never take off. On the other side, political support is required as an essential component to guarantee sustainability: the credibility of the leading house in front of the corporate associations is surely more acknowledged as concerns its research competences than for the ones able to steer the vocational system. This is the reason why a strong political support is needed to interact with the practice stakeholder for the project's results to be durable.

4.2.5 Generalizability of results: Towards Realto and the idea of a community manager

The question about the generalization of results in practice-oriented research is a well known and debated issue (see Euler 2017; McKenney/Reeves 2014). Design principles are sometimes seen as the path through which to address generalization (Euler 2017). In our case, the explicit formulation and constant refinement of design principles has taken the form of their direct embodiment in an electronic learning environment. Having this been the case across sub-projects, our actual aim was the creation of a more generic, cross-profession platform which would be grounded on the ones that the leading house has previously developed. The name of this environment became "Realto", alluding to the famous bridge in Venice and so remiscending the idea of improving the relationships between learning locations.

Following up on our project the sustainability of the platform is an issue. Will we built it for research (for example exploiting the affordances provided by learning analytics) or is research embedded in the platform (e.g. embodying informed design choices, then monitored through research processes)? Potentially, it could fulfil both roles. Further research questions in this respect are about the business model for the platform management, what kind of change management model should be adopted, and similar.

With the various research projects developed so far, the leading house on technologies in VET has an impact on educational and professional practices. The nature of the actual research project is close to implementation studies. For this reason, in this last phase of the project we included a "community manager" in our team, who is now in charge of recruiting schools to adopt Realto. This transformation process could be considered the final indicator of the effectiveness of this large scale educational design research initiative that had started with the creation of the Dual-t leading house.

Literatur

Akkerman, S. F./Bakker, A. (2011). Boundary Crossing and Boundary Objects. In: Review of Educational Research, 81**,** 132-169.

Aprea, C./Arn, C./Boldrini, E./Cattaneo, A./Motta, E./Sroka, A. (2012): Digitale Technologien als Tools zur Förderung der Konnektivität des Lernens in Schule und Betrieb. In: Faßhauer, U./Fürstenau, B./Wuttke, E. (Hrsg.): Berufs- und wirtschaftspädagogische Analysen - aktuelle Forschungen zur beruflichen Bildung. Opladen-Berlin-Toronto, 61-73.

Aprea, C./Cattaneo, A./Sappa, V. (2015): Mind the Gap: Boundary-Crossing an den Übergängen von informelllem und formalem Lernen in der beruflichen Bildung. In: Niedermair, G. (Hrsg.): Informelles Lernen. Annäherungen – Problemlagen - Forscungsbefunde. Linz, 265-280.

Barab, S./Squire, K. (2004): Design-Based Research: Putting a Stake in the Ground. In: Journal of the Learning Sciences, 13**,** 1-14.

Boud, D./Keogh, M./Walker, D. (1985): Reflection: Turning Experience into Learning. London.

Bourdieu, P. (1977): Outline of a theory of practice. Cambridge.

Brown, A. (1992): Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. In: The Journal of the Learning Sciences, 2**,** 141-178.

Brynjolfsson, E./McAfee, A. (2014): The Second Machine Age. Work, Progress, and Prosperity in a Time of Brilliant Technologies. New York - London.

Cattaneo, A./Motta, E./Gurtner, J.-L. (2015): Evaluating a mobile and online system for apprentices' learning documentation in Vocational Education: Usability, effectiveness and satisfaction. In: International Journal of Mobile and Blended Learning, 7**,** 40-58.

Chan, T.-W./Roschelle, J./Hsi, S./Kinshuk/Sharples, M./Brown, T./Patton, C./Cherniavsky, J./Pea, R./Norris, C./Soloway, E./Balacheff, N./Scardamalia, M./Dillenbourg, P./Looi, C.-K./Milrad, M./Hoppe, U. (2006): One-to-one technology-enhanced learning: An opportunity for global research collaboration. In: Research and Practice in Technology Enhanced Learning Journal, 1**,** 3-29.

Collins, A. (1992): Towards a design science of education. In: Scanlon, E./O'Shea, T. (eds.): New directions in educational technology. Berlin, 15-22.

Coulter, J.M. (1917): Botany as a national asset. In: Science, 45**,** 225-231.

DBRC (2003): Design-based research: An emerging paradigm for educational inquiry. In: Educational Researcher, 32**,** 5-8.

DeBruijn, E./Leeman, Y. (2011): Authentic and self-directed learning in vocational education: Challenges to vocational educators. In: Teaching and Teacher Education, 27**,** 694-702.

Dewey, J. (1933): How We Think: A restatement of the relation of reflective thinking to the educative process. Boston.

Dewey, J. (1938/1963): Experience and Education. New York.

Dillenbourg, P./Jermann, P. (2007): Designing integrative scripts. In: Fischer, F./Mandl, H./Haake, J./Kollar, I. (eds.): Scripting Computer-Supported Collaborative Learning – Cognitive, Computational, and Educational Perspectives. New York, 275-301.

Dillenbourg, P./Jermann, P. (2010): Technology for Classroom Orchestration. In: Khine, M.S./Saleh, I.M. (eds.): New Science of Learning: Cognition, Computers and Collaboration in Education. New York, 525-552.

ecoplan (2017): Berufsbildung2030.ch – Auswertung des Forums Megatrends. Online: http://berufsbildung2030.ch/wsp/site/assets/files/1/bb2030_ch_ergebnisse-forum-megatrends_170116.pdf (09.09.2017).

Elvehjem, C.A. (1959): Basic research and the state university. In: Wolfle, D. (eds.): Symposium on basic research. Washington, DC: American Assoc. for the Advancement of Science, 87-105.

Engeström, Y. (1987): Learning by Expanding: An Activity-Theoretical Approach to Developmental Research. Helsinki.

Eteläpelto, A. (2008): Perspectives, prospects and progress in work-related learning. In: Billett, S./Harteis, C./Eteläpelto, A. (eds.): Emerging perspectives of workplace learning. Rotterdam, 233-247.

Euler, D. (2017): Design principles as bridge between scientific knowledge production and practice design. In: EDeR - Educational Design Research, 1**,** 1-15.

Fuller, A./Unwin, L. (2003): Learning as Apprentices in the Contemporary UK Workplace: creating and managing expansive and restrictive participation. In: Journal of Education and Work, 16**,** 407-426.

Griffiths, T./Guile, D. (2003): A connective model of learning: The implications for work process knowledge. In: European Educational Research Journal, 2**,** 56–73.

Hämäläinen, R./Cattaneo, A. (2015): New TEL Environments for Vocational Education – Teachers' Instructional Perspective. In: Vocations and learning, 8**,** 135-157.

Harris, J./Mishra, P./Koehler, M. (2009): Teachers' Technological Pedagogical Content Knowledge and Learning Activity Types: Curriculum-based Technology Integration Reframed. In: Journal of Research on Technology in Education, 41**,** 393-416.

Hattie, J. A. C. (2009): Visible Learning. A synthesis of over 800 meta-analysis relating to achievement, London and New York.

Hattie, J. A. C. (2015): The Applicability of Visible Learning to Higher Education. Scholarship of Teaching and Learning in Psychology, 1**,** 79-91.

Higgins, S./Xiao, Z./Katsipataki, M. (2012): The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation. Durham, UK: Durham University and Education Endowment Foundation.

Kicken, W./Brand-Gruwel, S./vanMerrienboer, J.J.G./Slot, W. (2009): The effects of portfolio-based advice on the development of self-directed learning skills in secondary vocational education. In: Educational technology research and development, 57**,** 439–460.

Kirschner, P.A. (2002): Can we support CSCL? Educational, social and technological affordances for learning. In: Kirschner, P.A. (eds.): Three Worlds of CSCL: Can We Support CSCL? Heerlen, 7-47.

Koehler, M.J./Mishra, P./Kereluik, K./Shin, T.S./Graham, C.R. (2014): The Technological Pedagogical Content Knowledge Framework. In: Spector, J.M./Merrill, M.D./Elen, J./Bishop, M.J. (eds.): Handbook of Research on Educational Communications and Technology. New York, 101-112.

Kolb, D. (1984): Experiential learning. Experience as the source of learning and development. Englewood Cliffs, NJ.

Lai, C.-H./Yang, J.-C./Chen, F.-C./Ho, C.-W./Chan, T.-W. (2007): Affordances of mobile technologies for experiential learning: the interplay of technology and pedagogical practices. In: Journal of Computer Assisted Learning, 23**,** 326-337.

Laurillard, D. (2012): Teaching as a design science: Building pedagogical patterns for learning and technology. New York - London.

Maina, M./Craft, B./Mor, Y. (2015): The Art & Science of Learning Design. Rotterdam.

Margolis, J.L./Nussbaum, M./Rodriguez, P./Rosas, R. (2006): Methodology for Evaluating a Novel Education Technology: A Case Study of Handheld Video Games in Chile. In: Computers and Education, 46, 174-191.

Mauroux, L./Dehler-Zufferey, J./Jimenez, F./Wehren, R./Cattaneo, A./Gurtner, J.-L. (2013): Autorégulation des apprentissages et dossiers de formation en formation professionnelle. In: Berger, J.-L./Büchel, F. (Hrsg.): L'apprentissage autorégulé : perspectives théoriques et recherches empiriques. Nice, 195-227.

Mauroux, L./Dehler-Zufferey, J./Rodondi, E./Cattaneo, A./Motta, E./Gurtner, J.-L. (2016): Writing Reflective Learning Journals: Promoting the Use of Learning Strategies and Supporting the Development of Professional Skills. In: Ortoleva, G./Bétrancourt, M./Billett, S. (eds.): Writing for Professional Development. Leiden, 107-128.

Mauroux, L./Könings, K.D./Dehler-Zufferey, J./Gurtner, J.-L. (2014): Mobile and Online Learning Journal: Effects on Apprentices' Reflection in Vocational Education and Training. Vocations and Learning, 7**,** 215-239.

McKenney, S./Reeves, T.C. (2014): Educational Design Research. In: Spector, J.M./Merrill, M.D./Elen, J./Bishop, M.J. (eds.): Handbook of Research on Educational Communications and Technology. New York, NY: Springer New York, 131-140.

Mishra, P./Koehler, M.J. (2006): Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. In: Teachers College Record, 108**,** 1017-1054.

Motta, E./Cattaneo, A. (2016): Reflection on and in action in initial vocational education: any improvement of metacognitive processes and professional performance? EARLI SIG14 Learning and Professional Development International Conference. Regensburg, 24th-26th August 2016.

Motta, E./Cattaneo, A./Gurtner, J.-L. (2014): Mobile devices to bridge the gap in VET: ease of use and usefulness as indicators for their acceptance. Journal of Education and Training Studies, 2**,** 165-179.

Motta, E./Cattaneo, A./Gurtner, J.-L. (2017): Co-regulations of Learning in small groups of chef apprentices. When do they appear and what influences them? In: Empirical Research in Vocational Education and Training, 9:15.

Nutting, P.G. (1917): Organized knowledge and national welfare. In: Science, 46**,** 247–252.

OECD (2015): Students, Computers and Learning: Making the Connection, PISA, OECD Publishing. Online: http://dx.doi.org/10.1787/9789264239555-en (09.09.2017).

OECD (2016): Enabling the next production revolution: The future of manufacturing and services-interim report. Online: https://www.oecd.org/mcm/documents/Enabling-the-next-production-revolution-the-future-of-manufacturing-and-services-interim-report.pdf (09.09.2017).

Pachler, N. (2009): Research Methods in Mobile and Informal Learning: Some Issues. In: Vavoula, G./Pachler, N./Kukulska-Hulme, A. ((09.09.2017)..): Researching Mobile Learning. Frameworks, Tools and Research Designs. Bern, 1-15.

Pfeiffer, S. (2015): Effects of Industry 4.0 on vocational education and training. Vienna: Institute of Technology Assessment. Online: http://epub.oeaw.ac.at/ita/ita-manuscript/ita_15_04.pdf (09.09.2017).

Rodriguez, P./Nussbaum, M./Dombrovskaia, L. (2012a): ICT for Education: A Conceptual Framework for the Sustainable Adoption of Technology-Enhanced Learning Environments in Schools. In: Technology, Pedagogy and Education, 21, 291-315.

Rodriguez, P./Nussbaum, M./Dombrovskaia, L. (2012b): Evolutionary Development: A Model for the Design, Implementation, and Evaluation of ICT for Education Programmes. Journal Of Computer Assisted Learning, 28, 81-98.

Schauz, D. (2014): What is basic research? Insights from historical semantics. In: Minerva, 52**,** 273-328.

Schön, D.A. (1983): The Reflective Practitioner. How Professionals Think in Action. New York.

Schwendimann, B./Cattaneo, A./Dehler-Zufferey, J./Bétrancourt, M./Gurtner, J.-L./Dillenbourg, P. (2015): The 'Erfahrraum': A model for exploiting educational technologies in dual vocational systems. In: Journal of Vocational Education and Training, 67**,** 367-396.

Sharples, M. (2009): Methods for Evaluating Mobile Learning. In: Vavoula, G./Pachler, N./Kukulska-Hulme, A. (Hrsg.): Researching Mobile Learning. Frameworks, Tools and Research Designs. Oxford, 17-39.

Star, S.L. (1989): The structure of ill-structured solutions: Boundary objects and heterogeneous distributed problem solving. In: Gasser, L. & Huhns, M. (eds.): Distributed artfficial intelligence. San Mateo, CA, 37-54.

Star, S. L./Griesemer, J. R. (1989): Institutional ecology, "translations" and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. In: Social Studies of Science, 19**,** 387-420.

Swiss Confederation (2007): Vocational Education and Training Research in Switzerland. An OPET programme to promote VET research. Bern: Swiss Confederation, Federal Office for Professional Education and Technology OPET.

Swiss Confederation. (2017a): Rapport sur les principales conditions-cadre pour l'économie numérique. Bern.

Swiss Confederation. (2017b): Défis de la numérisation pour la formation et la recherche en Suisse. Bern.

Tamim, R. M./Bernard, R. M./Borokhovski, E./Abrami, P. C./Schmid, R. F. (2011): What Forty Years of Research Says about the Impact of Technology on Learning: A Second-Order Meta-Analysis and Validation Study. In: Review Of Educational Research, 81**,** 4-28.

Taylor, A./Freeman, S. (2011): 'Made in the trade': youth attitudes toward apprenticeship certification. In: Journal of Vocational Education & Training, 63**,** 345-362.

Tynjälä, P. (2008): Perspectives into learning at the workplace. In: Educational Research Review, 3**,** 130-154.

Dieser Beitrag wurde dem ***bwp@*-Format:** ☑ **FORSCHUNGSBEITRÄGE** zugeordnet.

Schlüsselwörter: *Schweizer Leadinghouse Technologien, Design-based Research, Erfahrraum Modell, Technologien, School-Workplace Connectivity*

Zitieren dieses Beitrages

Cattaneo, A./Barabasch, A. (2017): Technologies in VET: Bridging learning between school and workplace – the "Erfahrraum Model". In: *bwp@* Berufs- und Wirtschaftspädagogik – online, Ausgabe 33, 1-17. Online: http://www.bwpat.de/ausgabe33/cattaneo_barabasch_bwpat33.pdf (14-12-2017).

Die AutorInnen

Dr. ALBERTO CATTANEO

Swiss Federal Institute for Vocational Education and Training
(SFIVET EHB IFFP IUFFP)

Via Besso, 84/86, CH-6900 Lugano

alberto.cattaneo@iuffp.swiss

http://www.sfivet.swiss/person/cattaneo-alberto

Dr. ANTJE BARABASCH

Swiss Federal Institute for Vocational Education and Training
(SFIVET EHB IFFP IUFFP)

Kirchlindachstr. 79, CH-3052 Zollikofen

Antje.Barabasch@ehb.swiss

http://www.sfivet.swiss/person/barabasch-antje