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Adapting Apprenticeships to the Digital Transformation of Education and Work from the Perspective of In-company Trainers

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Abstract

In a current research project, the aim was to identify how VET programmes are adapted to what is required of human labour in the fourth industrial revolution (4IR). Since the digitalisation trend and its implications are contested, this paper focuses on already observable digitalisation effects from the perspective of in-company trainers. It combines a document analysis of apprenticeship curricula, semi-structured interviews and two focus group interviews. The document analysis shows that vocational curricula are mainly competence-based, giving trainers freedom to adapt their apprenticeship programmes within the given framework. Data based on interview with 16 trainers gives detailed insight into their perceptions and adaptation procedures at micro- and macro-didactical levels. Strategies used by trainers to adapt their apprenticeships were identified as stabilisation, integration and academisation. These findings reveal that adaptation activities are either reactive to the demands of the digitalised world of work or proactive, enabling learners to shape the implementation of digital technology. This confirms that the adaption processes linked to the 4IR should involve setting educational goals and designing curricula and didactics in a holistic sense.

Keywords

apprenticeships; didactics; in-company trainers; digital transformation; qualitative research

1 Introduction

The availability and application of digital technology, including embedded systems, artificial intelligence and smart factories, is thought to have a sweeping effect on societies and economies in Europe (Bloem et al., 2014) and elsewhere (Hajkowicz et al., 2016). This megatrend is usually discussed using the umbrella term of the fourth industrial revolution (4IR) (e. g. Schwab, 2017)

Since vocational education and training (VET) is linked to the specific competence and qualification requirements of digitally transformed work environments, the 4IR impact is expected to be particularly relevant for apprenticeships and other forms of VET (e. g. Pfeiffer, 2015). However, the direction of recognized or expected 4IR effects is disputed and

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contradictory. Some suggest that digitalization will substitute for human labour and polarise the labour market (Frey & Osborne, 2013, Alhammadi, Brynjolfsson, MacCrory, & Westermann, 2014). Others predict labour shortages (Pew Research Centre, 2017) or doubt a reduced demand for intermediate qualifications (Esser, 2017). On one hand, the 4IR is seen as a disruptive quantum leap (Schultz-Wild & Lutz, 1997), on the other as a long lasting, incremental process of change (Kodama, 2018) that might help liberate humans from work that is dirty, dangerous and difficult (3Ds; Esmailian, Behdad, & Wang, 2016).

In the wake of these contradictory trends, our research interest is focused on the effects of the fourth industrial revolution as already perceived by in-company trainers in different enterprises and sectors in Germany. The research questions can be summarized as:

1. How are implications of the fourth industrial revolution (4IR) perceived by in-company trainers responsible for corporate apprenticeships?
2. What type of strategies do in-company trainers use to adapt apprenticeships to the effects of the fourth industrial revolution?

This paper seeks to answer these questions from a didactical perspective (Heimann, Otto, & Schulz, 1965; Klafki, 1994, Sloane, 2010), i. e. by exploring the ways in which trainers (re-)define the educational goals they set for the apprentices, which (new) content is addressed in their training and which teaching and learning methods are used. A holistic model of didactics is applied, to include not only the design of teaching and learning environments within a given institutional context (micro-didactics), but also the design of these institutional contexts (macro-didactics). Within this expanded model, we also take into account, for example, curriculum development, further training of trainers, alignment of training and workplaces, cooperation with the managers of the apprentices (if this role is separated from the trainer role), and partnerships with schools and training providers.

2 Research Methods

The research presented in this paper is a sub-project under a wider project, which focuses on the changing qualification needs of professionals involved in VET at schools, enterprises, chambers of commerce and elsewhere, preparing learners for the digitalised world of work (Project Q4.0¹).

The present paper combines the results of three related strands of work. Firstly, it draws on a document analysis of apprenticeship curricula as they are today. Here, the current range of curricular activities susceptible to adaptation was reviewed and used as input for the research process that followed. Secondly, it uses semi-structured problem-centred interviews (Witzel & Reiter 2012) with four individual in-company trainers. Thirdly, two focus group interviews were conducted (Vaughn, Schumm, & Sinagub, 1996) with 12 in-company trainers, categorised by trade. Details can be found in Table 1.

¹ Details at: <https://wiwi.uni-paderborn.de/dep5/sloane/forschung/q-40/>

Table 1 Description of trainers

	occupations in which apprentices are educated (examples)	job description	gender	interview type	type of company (sector)
Trainer 1	commercial clerks, mechanics, IT specialists	full-time trainer, head of training division	male	individual interview	large enterprise (industrial sector)
Trainer 2	commercial clerks, IT specialists, business computing (dual study programme)	full-time trainer, head of training division	male	individual interview	large enterprise (media)
Trainer 3	management assistant for retail services, textile management expert (dual study programme)	full-time trainer, head of training division	female	individual interview	mid-sized enterprise (retail)
Trainer 4	commercial clerks, mechanics, IT specialists, business engineers (dual study programme)	full-time trainer, head of training division	male	individual interview	large enterprise (industrial sector)
Trainer 5	industrial mechanic	full-time trainer, head of apprentice workshop	male	focus group interview	mid-sized public service (state sector)
Trainer 6	commercial clerks, mechanics	full-time trainer, head of apprentice workshop	male	focus group interview	large enterprise (industrial sector)
Trainer 7	motor vehicle mechatronics technician	mechatronic master and part-time trainer	male	focus group interview	small enterprise (crafts sector)
Trainer 8	management assistant for retail services, office manager	full-time trainer, head of training division	male	focus group interview	large enterprise (retail)
Trainer 9	office manager, IT specialists	CEO and part-time trainer	male	focus group interview	small enterprise (consulting)
Trainer 10	office manager	project manager and part-time trainer	female	focus group interview	small enterprise (private training provider)
Trainer 11	office manager, IT specialists	CEO and part-time trainer	male	focus group interview	small enterprise (industrial sector)
Trainer 12	office manager	head of financial division, part-time trainer	male	focus group interview	small public service institution (state sector)
Trainer 13	commercial clerks, mechanics	full-time trainer, head of training division	male	focus group interview	mid-sized power supplier (industrial sector)
Trainer 14	commercial clerks, mechanics	full-time trainer, head of apprentice workshop	male	focus group interview	mid-sized power supplier (industrial sector)
Trainer 15	industrial mechanic	full-time trainer, head of apprentice workshop	male	focus group interview	mid-sized enterprise (industrial sector)
Trainer 16	industrial mechanic	full-time trainer	male	focus group interview	mid-sized enterprise (industrial sector)

Both types of interview aimed at understanding the trainers' perspectives in four areas:

1. Their understanding of digitalisation and what it looks like in their companies
2. Perceived changes at the apprentices' workplaces and resulting new demands for competences and qualifications
3. Their views on the potential requirement for skill sets to be redesigned for specific trades or professions ('vision of the skilled worker in the future')
4. Implications of the fourth industrial revolution on their teaching and training and on how they organise their apprenticeships programs.

First, all interviews were transcribed. Consistent with qualitative methodology, the interview data was analysed using deductive coding based on the two guiding research questions. In addition, a holistic model of didactics was used in combination with inductive coding so as to draw on the richness of data rooted in the everyday practices of the trainers (Mayring, 2014).

3 Findings

On this basis, three main findings were generated: Classification of the curricular framework (3.1) categorisations of perceptions and adoption activities (3.2) and differentiations of three types of adapting strategies (3.3).

3.1 Classification of the curricular framework

When analysing how trainers dealing with the 4IR take steps to adapt their apprenticeships, a special feature of the German VET systems must be taken into consideration. Apprenticeships usually take place under the umbrella of a vocational occupation. This provision is regulated at a national level, where employer associations and trade unions are involved in the political decision-making process. That is, in-company trainers must comply with a skeleton curricula (German: *Ausbildungsordnung*) for each occupation. For this study, popular skilled occupations with particular relevance to the 4IR were selected for a comprehensive document analysis: plant mechanic for sanitary, heating and air conditioning systems, warehouse logistics operator, office manager, clerk in public administration, industrial mechanic, motor vehicle mechatronics technician, production technologist and nurses. The analysis shows that these curricula are mainly competence-based and situation-oriented. This is, they refer to actual workflows and business processes as the basic unit of the curriculum, not to compulsory subject content or topics. In general, these type of curricula give trainers a great deal of freedom to translate economic, social and technological changes into redefined curricula at company level, including meeting the changes demanded by the 4IR. For this, trainers need to undertake curriculum development and adaption activities at company level. These activities and their links to perception patterns are analysed in detail in the following sections.

3.2 Perceptions and adoption activities categorised

Based on our analysis of the interview material, approaches to the digitalised world of work can be categorised as:

1. Perceptions of digitalisation and its general implications
2. Adaptations on micro-didactical level
3. Adaptations on macro-didactical level
4. The role of in-company trainers in the context of the 4IR

Concerning the trainers' perceptions of digitalisation, the interview analysis confirmed the ambiguity of the digitalisation trend. On one hand, digitalisation is seen as a long-lasting development including the introduction of digital technology and automation efforts over decades, on the other, digitalisation is seen as a disruptive force. This category was further divided into four subcategories: 'definition of digitalisation', 'evaluation of digitalisation', 'anticipated effects' and 'effects realised at the trainers' workplaces'.

In defining digitalisation, the trainers highlight that the introduction of digital technology 'permeates all areas of life' (trainer 11). It is seen as an unstoppable force that will also affect those areas still to be digitised.

The evaluation of the digitalisation trend is ambivalent, too. Opportunities are emphasised alongside threats. Opportunities for digitalisation identified by the trainers include substitution of 'dull work', increased 'productivity' (trainer 1) and 'new training opportunities for people with disabilities' (trainer 13) with digital technology providing support in the work place. Digitalisation is evaluated as a threat, when it is 'not transparent from the point of view of individuals what happens with their data' (trainer 10), when automatisisation makes humans 'dependent on the technology' (trainer 15) and leads to the 'external determination' (trainer 8) of human workflows by machines. Placing the trainers' statements within this subcategory revealed stark differences between trainers with a positive evaluation (e. g. trainer 2, 3, 9, 11) and a predominantly negative evaluation (e. g. trainer 5, 10, 12, 15).

Concerning the effects of digitalisation, it is anticipated that those effects already realised will consolidate and strengthen. Even though a number of trainers interviewed confess that they themselves are not sure 'what will change' (trainer 1), and that the process of digital transformation 'will not be finished even 20 years from now' (trainer 2), a number of effects have already been identified, many of them pulling in opposing directions. While it is understood that the 'qualifications required' (trainer 2) for work have risen and will continue to rise, digitalisation will also make some occupational tasks 'less challenging' (trainer 2). This means qualification requirements will be reduced and working autonomy decline. Furthermore, the effects of digitalisation are not emerging equally. Some trainers report that their companies use 'fully digitalised billing' (trainer 11) and 'digital project management' (trainer 2), while others still document working hours with 'paper and pencil' (trainer 4) and 'excel files are filled manually' (trainer 12). While the digitalisation of tasks like these and extensive substitution of human labour are anticipated, the lag in the process of digitalisation is highlighted. According to the trainers' experiences, the effects of digitalised workplaces may lead to 'substitution', to a 'higher standardised and simplified' and 'flexibilised' type of work, while some type of already existing work will be 'maintained'. In their efforts to prepare apprentices for the flexibilised type of work in particular, a set of perceived skill requirements is discussed. These include 'basic IT competencies' (trainer 11), 'identifying potential for automatisisation' (trainer 8), 'social skills' (trainer 10) for collaborating in cross-professional teams, more 'creativity' (trainer 11), and ownership and self-management capabilities regarding their assigned tasks, perhaps including the ability to explain to suppliers how they need to comply with their 'digital interfaces' e. g. for automated billing and digital supply chain management. Some trainers also expect their apprentices to engage in social media for the benefit of the visibility of the company (trainer 3). It was also highlighted that some plant equipment has become too complex for humans to operate without digital display units as support measures, and these need to be mastered by skilled labour (trainer 6). Since the interview sample includes trainers from big enterprises as well as from small and medium-sized companies, the effects realised depend on the company. Big companies tend to show a higher level of digitalisation and automatisisation. However, in the sample, some small companies with just over 10 employees showed a remarkable level of digitalisation, involving fully state of the art IT security (trainer 11), and

sophisticated digital knowledge management, which the apprentices not only use, but also contribute to in accordance with the corporate culture of their company (trainer 9).

Based on these perceived developments in digitalisation and their implications, the trainers initiate adoption processes. The category of ‘adaptations on micro-didactical level’ is further divided into four didactical parameters as subcategories: ‘learning objectives’, ‘learning content’, ‘teaching methods’, ‘media’. Concerning the adoption of learning objectives, the trainers relate to ‘basic vocational competences’ that remain the same and comprise traditional virtues such as ‘punctuality’ and ‘personal development’, combined with the ‘flexibility’ to acquire those skills needed in the digitalised future (trainer 1). Almost all trainers also mention ‘basic IT skills’ that ‘everybody needs’, even if not involved with software development and coding. When asked to elaborate on the type of IT skills developed during the apprenticeships, the following were mentioned: using ICT to connect with customers and co-workers, responsible and informed handling of own and corporate data, compliance with the data protection act and, referring to the threat of becoming dependent on digital technology, understanding that a machine may ‘malfunction’. Beyond that, ‘problem solving skills’ (trainer 1), were mentioned and ‘lifelong learning skills’ (trainer 10), ‘health competence’ (trainer 12), the ability to innovate in implementing new technology (trainer 9), as well as the ability to practice ‘self-management’ (trainer 2, 4, 9, 11) in an environment where digital technology takes over standard tasks and leaves complex, social, creative and poorly-defined tasks for skilled labour, sometimes carried out by apprentices working from home.

In line with the learning objectives, basic apprenticeship content remains the same. However, issues and tasks that lose their relevance in actual work processes, are more likely to be abandoned as content in an apprenticeship. This applies to ‘chiselling’ (trainer 1) or ‘daily cash accounting’ (trainer 13). Instead additional content is introduced, which is often interdisciplinary, that is electronics technician also learn ‘software development’ for ‘microcontroller’ and ‘surface-mount devices’ (trainer 4). Industrial occupations also learn about new technologies such as ‘additive manufacturing’ (trainer 6). For many occupations, including commercial clerks and office manager, content such as ‘tech for managers’, ‘data encryption’, ‘man-in-the-middle attacks’, ‘password management’, ‘copyright and legislation for data protection’, ‘Business Intelligence (BI) and big data’ and ‘social media’ is introduced as part of the apprenticeship (e. g. trainer 11).

Concerning the methods, the trainers state that their training will help apprentices to understand the ‘relevance and context of the tasks’, they are to perform (trainer 8). ‘Direct instruction’ is supposed to be of limited effect (trainer 12), instead the trainer should act as an ‘equal colleague’. With reference to the learning objectives, digital media is not seen as an end in itself. Rather, it is seen as a technical option that might be put to use in the apprenticeships alongside non-digital media. Therefore, educational ‘videos’ are regularly used (trainer 3), but ‘smartphones’ are usually banned as they are seen as a ‘hazard to the attention needed’ by the apprentices (trainer 2).

In the interviews all trainers were consistent in that adaptations on the macro-didactical level are necessary, that is curriculum, examinations, organisation/resources and qualifications of trainers. But the locus of control differs. Some trainers expect the ‘skeleton curricula on the national level to be changed first’ and the enterprise to ‘invest in digital devices’ for the training division (e. g. trainer 5, 7, 15, 16) as a prerequisite for them adapting their apprenticeship programmes. Others recognise the flexibility of competence-based curricula and use this as an opportunity to comply with the existing norms for apprenticeships, while at the same time introducing ‘supplementary modules and qualifications’ within the apprenticeship and additional measures to link up initial apprentice education with further education responding to demands for higher qualification (e. g. trainer 1, 2, 3, 4, 9, 11). Among the innovations on macro-level are ‘training projects’, in which apprentices of different trades work together (e. g.

trainer 4) and increased cooperation between the training companies and schools (e. g. trainer 6). The trainers insist that these changes are also to be reflected in the ‘trade examinations’, which are organised not by single enterprises, but on the level of chambers of commerce resp. chambers of trade as self-administration entities of companies in a certain sector (e. g. trainer 7, 11). The organisational capacity to provide suitable apprenticeships is also linked to the development of the company as a learning organisation, and having a ‘feedback culture’ (e. g. trainer 9).

Regarding the role of in-company trainers in the context of the 4IR, it is highlighted that trainers themselves need to be learning employees, particularly those full-time trainers in training divisions separate from the work processes (e. g. trainer 4, 5, 10). Due to apprentices, who use digital media and may be better informed in some vocational areas as their trainers, trainers are not seen as ‘dispensers of knowledge’ (trainer 11) any longer, but rather as models and moderators of the complex learning processes, the apprentices need to acquire competences relevant in a digitalised world of work.

3.3 Types of adapting strategies

By focussing on the differences in dealing with the digitalisation trend, three types of strategies for adapting apprentices could be distinguished: stabilisation, integration and academisation strategies.

Trainers applying a stabilisation strategy maintain established apprenticeship practices by at least partially shielding them from the impact of digitalisation on their work (e. g. trainers 5, 7, 10, 14, 16). It is noteworthy that those who apply this strategy usually share a predominantly negative evaluation of digitalisation and see it as a threat. From this perspective, shielding can be legitimated. From an educational perspective, the benefit of this strategy is that traditional training measures such as manual demonstration can be more instructive than abstract digitalized operations. Due to this way of dealing with digitalisation, adapting processes are mainly limited to micro-level, macro-didactical changes are rare.

The integration strategy is in stark contrast to this and is applied by a different group of trainers (e. g. trainers 1, 2, 3, 4, 6, 8, 9, 11). This group shares a predominantly positive evaluation of digitalisation and sees it more as an opportunity. Threats such as ‘external determination’ or ‘substitution’ of human labour by machines are also identified by these trainers, but they believe they will be overcome by developing those skills and competences that future workforces will need in the digitalised world. Hence, the curricular freedom allows new competences and content to be integrated into the apprenticeship and to be organised in a way that gives young learners the chance to acquire them. These include the learning competence to continue development after the apprenticeship (and also to integrate initial training and professional development).

The academisation strategy is applied by a sub-group of the second group of trainers and limited to trainers from large or mid-sized enterprises (trainers 1, 2, 3, 4). The argument is that in some areas the monitoring and controlling of complex operations is so demanding for employees, that the training requires additional studies. Here the training divisions have introduced dual study programs that integrate the apprentices in the working and learning processes within the company, but also send them to a higher education institution instead of school. The admission requirements for dual study programmes are usually higher than for regular apprenticeship programmes. Some companies have cut some apprenticeship positions in favour of new dual study positions (trainers 2 and 4).

4 Conclusions

The study has shown that in-company trainers develop different strategies to deal with the 4IR and its impact on VET. The cross-case analysis of 16 trainers also indicates that those maintaining a negative and concerned view on digitalisation tend to react more passively, applying a stabilising strategy which has educational value but may fail not only to enable vocational learners to work in a digitalised environment, but to take responsibility for the use and effects of the technology implemented that will shape their own work environment. Trainers who take a more balanced perspective on digitalisation, recognising both opportunities and threats, adopt apprenticeships more actively, applying integration and academisation strategies. They don't limit their efforts to the micro-didactical level, such as introducing new digital devices to the practical guidance at the training workshop or workplace, but take management decisions on the macro-level, too, adapting learning objectives, curricula and didactics in a holistic sense. Therefore, this study points to the importance of a comprehensive understanding of the 4IR for trainers to be able to adapt apprenticeship programmes.

Beyond the apparent link between adapting strategies and perceptions of digitalisation, the study has also shed some light on how training conditions depend on the size of the enterprise. Usually, the apprenticeship programmes of large enterprises are considered to be more sophisticated and innovative, since there are sufficient resources to allocate to training, while apprenticeships at small and medium-sized enterprises are more closely linked to actual work processes. This is not necessarily a disadvantage. The sample of trainers interviewed showed that, by virtue of their size, small enterprises may be more flexible and take advantage of new technologies faster than some established large companies. Two trainers (trainer 9 and 11) were also CEOs of their own companies and while acting only part-time as trainers, in board decisions they recognised the training needs of their workforce, and this also benefited the apprenticeships by establishing a corporate culture supporting learning and feedback. In bigger companies however, full-time trainers leading training divisions may be external to day to day business decisions. This independence of work processes may be useful for educational purposes, such as setting up innovative training projects, but also implies the need for further training of the full-time trainers to keep them updated about changes to work processes and business flows. When adapting apprenticeships to the digital transformation, these specific corporate needs must be considered. In this regard, one of the things that may do most to strengthen the attractiveness of apprenticeships would be to link them up with work processes at the company which are innovative, in the sense that they take advantage of new technological opportunities while deploying innovation in a way that ensures meaningful and enriching tasks for human labour that provide learning opportunities in themselves. Those graduating from well adapted apprenticeships may be the very ones to help bring forth this human version of a new digital world of work.

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