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DIGITAL TRANSFORMATION IN AUSTRIAN SECONDARY COLLEGES FOR AGRICULTIRE AND FORESTRY

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ABSTRACT

The process of digital transformation has been gaining momentum in secondary colleges for agriculture and forestry. Based on data from an online survey about the digital transformation of Austrian secondary colleges of agriculture and forestry this paper gives insights into the status quo. It focuses on three central questions. (I) What is the standard of digital equipment at the colleges in relation to its integration into the learning environment and the education offered? (II) What is the level of confidence of pupils in their own digital competence? (III) Who are the learners and teachers and what are the levels of acceptance of digital transformation among the latter? This paper looks at the above in the greater context of employability within today's global, political and administrative settings. The paper proposes the notion of a 'digital-generalist' who has a level of expertise and is able to act in an ethically responsible and sustainable way. Moreover, the results reveal that these colleges are undeniably in the process of digital transformation. Nevertheless, it is an ongoing process that should be based on a sustainable and smart integration of modern digital technologies and media into the teaching and learning environment. Suitable equipment, learning settings and teachers trained are crucial for digital transformation in secondary colleges, as is the support from appropriate governing and institutional structures. Furthermore, there are enormous potentials in digital transformation that demand research activities and networking as well as continuous information and awareness-raising.

Keywords: *agriculture and forestry, digital equipment, education in secondary colleges, pupils' digital competence, teachers' digital attitude, Austria.*

INTRODUCTION

Digital transformation is increasingly recognised as a crucial issue in the education for today's pupils and tomorrow's graduates of the secondary colleges for agriculture and forestry. These colleges, as well as primary schools and universities, have begun to implement digital technologies and media into their learning environment. However, it has been shown that colleges and pupils are not necessarily keeping up with the evolving needs derived from this rapid progress, i.e. maintaining the same educational standard or level of expertise. This

notwithstanding, it is not unreasonable, in our so called digitally-permeated society (cf. Martin, Grudziecki, 2006), to think of this ongoing process in education as doing the following. Digital transformation imparts the competences needed for 90% of the jobs in the near future (World Economic Forum, 2018), it contributes to the functioning of society (Gilster, 1997), it constitutes an essential requirement for life (Bawden, 2008), or functions as a tool to make life easier or improve life changes in a more sustainable way (Eshet-Alkalai, 2004).

At the same time, the concept of digital transformation is a multi-faceted moving target. It has been researched, interpreted and implemented in various ways in policy documents (Federal Ministry for Digital and Economic Affairs, n.d.; Federal Ministry of Education, Science and Research, 2018), academic literature (Bertelsmann Stiftung, 2016; BITKOM, 2015; EC, 2019; EC, 2014; Ferrari, 2013) as well as in teaching/learning and certification guides and practices (accenture 2015; EuropeanSchoolnet, n.d.; FAO, 2011; SchoolEducationGateway, o.J.).

Given its nature, any change to learning environments that digital transformation brings about entails new challenges and potential. Pupils of these secondary colleges must acquire the competence to apply, learn and work with digital technology and media; be it in class, free time activities or for professional purposes. This digital education begins before college and continues afterwards. It is essential in a world that has become increasingly challenged by interconnected economic, environmental, cultural and political problems (cf. Brundtland Report; United Nations, n.d.). The challenge for these colleges and their educators is to prepare their pupils to deal effectively with the digital transformation in order to raise a productive and flexible workforce. In this regard, digital competence becomes vitally important for both learners and teachers.

This paper, therefore, presents a framework for assessing the digital transformation of secondary colleges. This approach allows information to be obtained on: (I) the standard of the equipment (digital technology and media) and its integration into teaching, i.e. whether it should be a mixture of analogue and digital, (II) the level of pupils' confidence in their digital competence and (III) comparative mapping of the learners' confidence and the teachers' attitudes. The data for the analysis is taken from an online survey about 'Digital transformation in Austrian secondary colleges for agriculture and forestry'. The analysis of select survey data is based on the work by Bos et al. (2014), Calvani et al. (2016) and EC (2019, 2014). Moreover, the results of this mapping will clarify the existing needs of pupils and identify where measures for continuous information and awareness-raising, networking and research activities as well as political and social governance have to be taken.

Digital transformation framework of secondary colleges

Educational interactions are increasingly mediated by digital transformation. Digital transformation is both a requirement and a right. And that, not only for learners! As the pace and extent of digital transformation have increased, so have the literature about and discussion within educational institutions (cf. Bertelsmann

Stiftung, 2016; BITKOM, 2015). Different concepts and frameworks for the development of digital transformation are available (e.g. Ala-Mutka, 2011; Calvani et al., 2016; EC, 2014; Ferrari, 2013). In this respect, the digital transformation framework broadly describes the level of digital performance, integration and excellence within a secondary college. This digital transformation framework includes the following aspects. (I) Multidimensionality covers the intersection between environment, people and confidence in competence that contributes to educating a 'digital-generalist' fit for the modern world (cf. Brundtland Report). (II) Complexity refers to the holistic nature of the framework which cannot currently be simplified into quantifiable indicators. The speed of the change adds to the challenge. (cf. Luhmann, 2006). (III) Interconnectedness means that the framework is not independent from the key infrastructure, social milieu and general key competences with which it overlaps (cf. Ala-Mutka, 2011; Luhmann, 2006). In this context, the design of the classroom and architecture of the college, the social relationships, the common general competences (for instance, reading, problem solving, numeracy, logical, inferential and metacognitive) are also part of the learning system. (IV) Sensitivity to the socio-cultural context: it would be unreasonable to think of a unique model as adequate at all times and in all contexts (cf. Street, 1984). The significance of this digital transformation framework will also change partly depending on the various educational settings (e.g. basic training, professional training, specialised training, virtual learning).

Among the various dimensions addressed within the digital transformation of these colleges, the emphasise in this framework is on the co-existence of three dimensions. These are the technology and media environment, the people and their levels of confidence, and also the intersection:

- Environment, as the general basic equipment is given, focuses on modern digital technology and media and their technical implementation in an integrated, flexible and sustainable way.
- People refers to the digital expertise of pupils and the teachers' acceptance of digital technology and media where it makes sense.
- The idea of confidence concerns the belief in one's own capability and competence in the digital world, which is both needed and essential for learners within the learning environment and for their future employability.
- The intersection between the three dimensions represents the ability to use digital technology and media to perform tasks, manage information, communicate and collaborate, create and share content, solve problems in an ethically, responsible and sustainable way (Ferrari, 2013), i.e. a 'digital-generalist'.

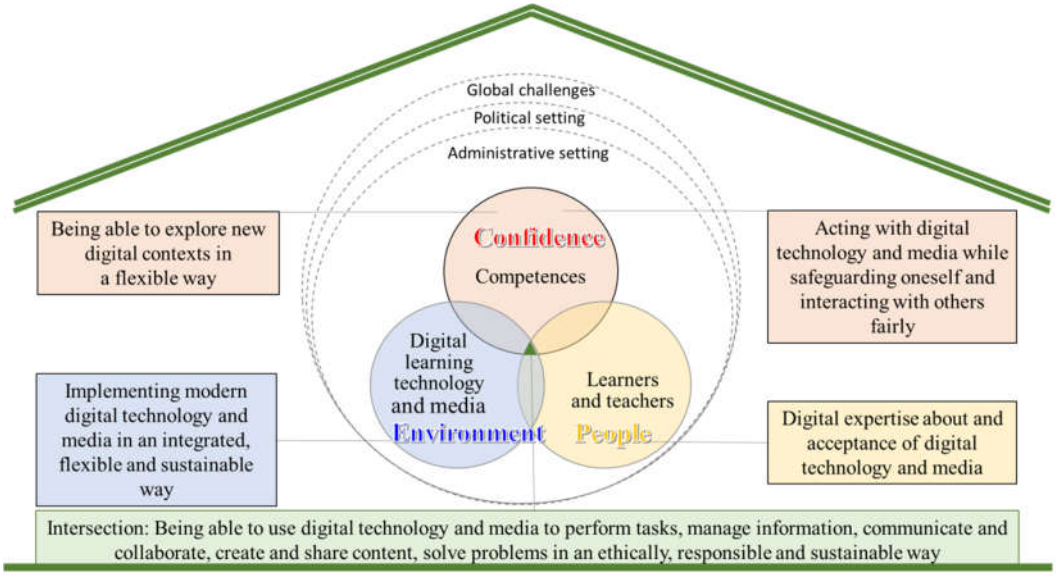

Figure 1. Digital transformation framework of secondary colleges (own visualisation in compliance with Bos et al., 2014 and according to Trible Bottom Line and Calvani et al., 2016).

It should not be forgotten that the dimensions also belong to different disciplines, for example computer science (ICT), media studies, psychology, pedagogy, etc. The implementation and assessment of this framework require an understanding of all these underlying conceptualisations. In literature, very often the majority of dimension issues are already foreseen, although the focus remains on equipment and technical operations. In this framework the approach is a balanced one, where each of these dimensions and its issues are equally developed. Figure 1 summarises the framework adopted.

MATERIAL AND METHODS

This framework proposed and the discussion above forms the basis for the forthcoming analysis. In a very simplified way the framework proposed provides the fundamental dimensions and indicators (Figure 1 and table 1) for any evaluation that assesses the digital transformation of colleges. The author does not suggest that the framework includes all elements of an evaluation plan needed for assessment.

Table 1. Description of the dimensions and indicators of the digital assessment framework.

Dimensions	Description of categories
Environment	Equipment including digital technology and media Mix of analogue and digital teaching
People	Pupils' level of confidence in their competence Attitude (digital acceptance) of the teacher towards digital technology and media
Confidence (competence areas)	Technical operation: Using digital means to perform tasks Information management: Being able to search, access, process, store and organise information Communication and sharing: Being able to communicate and cooperate using online tools Problem solving: Being able to analyse, reflect and discuss through digital means and identify digital needs Ethics and responsibility: Behaving in a digital milieu in an ethical and responsible way

*Source: adopted from BITKOM (2015), Bos et al. (2014) and EC (2014, 2019).

The data presented (cf. Table 1) in this research is drawn from a comprehensive survey 'Digital transformation in Austrian secondary colleges for agriculture and forestry' (Quendler et al., 2019). The survey was conducted as an online-questionnaire in March 2018. The survey link was randomly distributed to the pupils by the heads of the colleges. A total of 1,963 questionnaires were evaluated. This corresponds to 53% of the pupils attending these colleges.

For the data used in this analysis, the scale of answers was based on a 5-Likert scale and ranged from 5 = very good, 4= good, 3= average, 2= poor and 1= very poor (equipment), for competences from 1 = very good, 2= good, 3= average, 4= poor and 5= not at all. Those based on a 4-Likert scale ranged from 4= strongly agree, 3= agree, 2= disagree and 1= strongly disagree, 0= do not know (mix of analogue and digital teaching) and for teachers' attitude from 4 = a lot, 3= good, 2= moderate and 1= low. Since competence was not directly measured in this survey, the confidence level of pupils is used as an approximate measure of digital competence. Digital confidence, an index, is calculated as an equally weighted average of the six competence categories (Table 1): technical operation, information management, communication and sharing, knowledge creation, ethics and responsibility, problem solving and application.

The select data was compiled for analysis using RStudio Version 1.2.1335. The analysis includes statistical tools such as mean, standard deviation, frequency, chi-square test, mosaic plot, correlation (method Kendall) and the hierarchical agglomerative clustering technique (using squared Euclidean distance as the proximity measure and Ward's method as the clustering algorithm).

RESULTS AND DISCUSSION

Digital transformation has been around for the last decades, first with computers and notebooks and most recently, the Internet (Web-Based learning). As equipment has been improving (cf. Moore's Laws) the evolution and the adoption of digital technology and media in classrooms, have increasingly shaped the pupils' learning environments – both the physical and the virtual. OECD (2015) suggested, however, that the simple provision of digital equipment and infrastructure is not sufficient, there should also be the influence of personal expertise and interest, i.e. attitude, in the process of digital transformation. Similarly, being born in a digital era does not necessarily imply having the confidence to use digital technology and media in a critical, creative and informative way (EC, 2014).

Digital technology and media and mixture of digital and analogue teaching

The digital transformation in learning has long been measured in terms of the actual digital technology and media equipment and their integration into learning. Not surprisingly, with reference to the equipment the majority (80%) still favour a mixture of analogue and digital forms of teaching. As illustrated by figure 2 there is a significant difference in terms of digital equipment and the mix of analogue and digital teaching [χ^2 is 35.23, P = 0.004]. It turns out that the lower the standard of digital equipment at the college is, the more a mixture of analogue and digital teaching [τ is -0.07, P = 0.001, z = -9.05] is seen as needed. It can be assumed that the better the school is equipped; the more digital teaching practise has already been implemented in the classroom. This notwithstanding, in many classrooms, the textbooks are still the linchpin of the lesson. Nevertheless, half of the pupils still hope that learning will take place more and more in virtual spaces in the future (Quendler et al., 2019). This development is also confirmed by EC (2019) and (Bennett, Maton, 2010). It is generally accepted, for instance, that current and recent students demand instant access to information and expect digital learning technology and media to be an integral part of their educational experience (e.g. Oblinger, Oblinger 2005; Barnes et al., 2007; Philip, 2007).

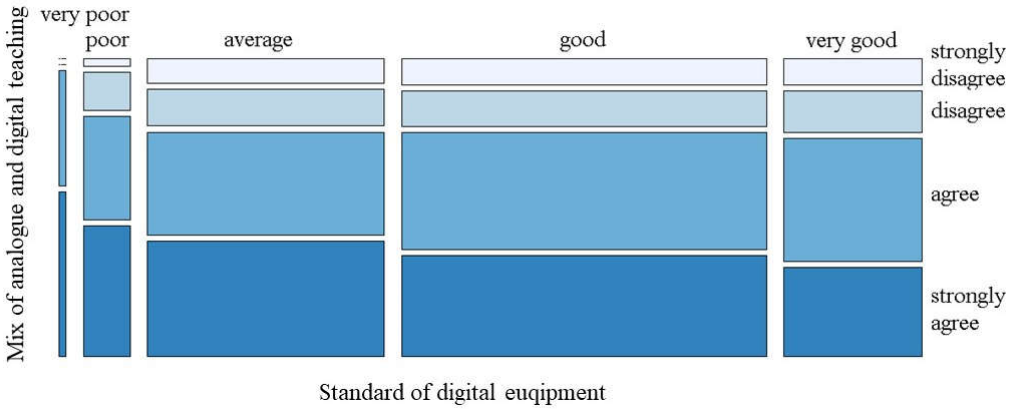

Figure 2. Digital equipment of the secondary colleges versus the mix of analogue and digital teaching, 2018.

*Source: own visualisation of survey data 'Digital transformation in Austrian secondary colleges for agriculture and forestry' (n=1,963).

Pupils' digital confidence in competences

As argued above, digital competence is fundamental for every path of life, therefore, there is a need to validate and recognise digital competences. Competence categories and the digital confidence level are given in table 2. The general average of digital confidence is 1.99. As shown in table 2, the highest level of confidence that the pupils have is in the competence category 'information management' with the general average of 1.85. The lowest one is 'problem solving' with a score of 2.41. This competence, one out of six, has the weakest result and shows the most room for improvement. In the case of secondary colleges for agriculture and forestry, the pupils' confidence in their digital competence scored better in every category than for Austria as a whole as well as Europe (EC, 2019).

Table 2. Descriptive statistics about the competence categories 2018.

Competence categories	Level of confidence (%)					Mean	SD
	not at all	poor	average	good	very good		
Technical operation	0.27	2.23	13.83	50.46	33.21	1.86	0.75
Information	0.44	1.91	13.06	50.95	33.64	1.85	0.76
Communication and	0.54	2.34	16.98	46.71	33.64	1.90	0.80
Knowledge creation	0.33	2.78	17.31	49.43	30.16	1.94	0.78
Problem solving	2.72	9.53	30.92	39.25	17.58	2.41	0.97
Ethics and responsibility	1.20	2.29	14.21	46.05	36.25	1.86	0.83
Colleges	0.16	0.65	5.81	48.94	44.44	1.99	0.62

*Source: Source: own visualisation of survey data 'Digital transformation in Austrian secondary colleges for agriculture and forestry' (n=1,963).

A further analysis, as to whether there is a connection between the level confidence of pupils in their digital competence and the standard of equipment, the mixture of analogue and digital teaching and the digital acceptance of teachers, is shown in table 3.

Table 3. Digital confidence levels of pupils and descriptive statistics according to standard of equipment, mixture of analogue and digital teaching as well as digital acceptance of teachers, 2018.

	Level of confidence							
	Mean	SD	not at all	poor	average	good	very good	Sum
			Count (%)					
Digital equipment [τ is 0.01, P = 0.502, z = 0.58]								
very poor	1.84	0.78	0.00	0.05	0.16	0.27	0.43	0.92
poor	1.98	0.72	0.05	0.16	1.09	3.04	1.63	5.97
average	2.02	0.63	0.11	0.16	6.19	16.60	6.73	29.79
good	1.97	0.59	0.05	0.16	3.15	10.04	3.96	17.36
very good	1.99	0.61	0.05	0.54	7.27	27.84	10.26	45.96
Mix of digital and analogue teaching [τ is 0.18, P < 0.000, z = 8.88]								
strongly disagree	2.25	0.78	0.11	0.29	1.17	2.71	0.83	5.12
disagree	2.14	0.63	0.06	0.17	3.32	7.91	2.20	13.67
agree	2.05	0.58	0.06	0.46	8.01	21.23	7.57	37.33
strongly agree	1.84	0.59	0.00	0.17	5.35	25.92	12.42	43.88
Digital acceptance of teachers [τ is 0.68, P < 0.000, z = 31.74]								
low	2.18	0.80	0.16	0.16	1.52	2.93	1.47	6.24
moderate	2.04	0.63	0.27	0.05	4.99	13.78	5.32	24.42
good	2.01	0.60	0.16	0.05	2.82	15.08	6.78	24.91
a lot	1.86	0.56	0.49	0.00	8.52	25.99	9.44	44.44

*Source: own visualisation of survey data 'Digital transformation in Austrian secondary colleges for agriculture and forestry' (n=1,963).

According to table 3, there is no significant relationship between the level of digital confidence of pupils and the equipment of the colleges. Anyway, more than half (53%) of the pupils with a digital confidence level from 'good' to 'very good' attend a college equipped to a standard of 'good' to 'very good'. Not surprisingly, 67% of the pupils having a confidence level from 'good' to 'very good' agree with a mixture of teaching. The connection is significant and it turns out that the higher the level of digital confidence, the more the pupils are in favour of a mixture of analogue and digital teaching. For the indicator teachers' digital acceptance, 57% of the pupils with a confidence level from good to very good see the former as 'good' to 'a lot'. Also there is a significant positive connection between the digital confidence

level of pupils and the acceptance of teachers: The more teachers are open towards digital media, the better the digital confidence level of the pupils is.

Comparative mapping the learners and teachers

Pupils' confidence level and teachers' attitudes to digital transformation are naturally linked with each other. Their relationships may, however, not be so obvious. Based on the cluster analysis, six categories of relationship covering three basic possibilities are proposed. Either the pupils have the upper hand (superior) compared to the teachers in their values, both groups are on equal footing or the teachers have the upper hand. These relationships are depicted in figure 3, as follows: (1) 'Pupils superior' (high) representing 15% of the sample (cluster 1). These pupils claimed a high level of digital confidence although the level of digital acceptance of their teachers is seen as very low. (2) 'Pupils superior' (average) representing 20% of the sample (cluster 2). In this cluster the relationship between the digital confidence level of pupils and the digital acceptance of teachers is 'on a par'. (3) 'Equal footing' (high) representing 18% of the sample (cluster 3). These pupils and teachers are those with a high level of confidence and digital acceptance. (4) 'Equal footing' (average) representing 29% of the sample (cluster 4). This cluster is similar to the 'equal footing' (high) but both the interest of pupils and teachers are on an average level. (5) 'Equal footing' (low) representing 11% of the sample (cluster 5). This cluster is categorised by pupils and teachers with a low interest in digital issues. (6) 'Teacher superior' (high) representing 7% of the sample (cluster 6). In this cluster the teachers have an excellent acceptance of digital media but this has not positively affected the pupils' confidence. Clear differences in their patterns of confidence level and teachers' attitude towards digital media can be established, permitting the formation of different clusters. Given these clusters, secondary college pupils and teachers are far from homogeneous. Taken together, these findings provide further impetus to move beyond debates about 'digital transformation' by seeking more sophisticated understanding of how pupils' digital confidence and teachers' digital acceptance can be harmonised and benefit learning and teaching.

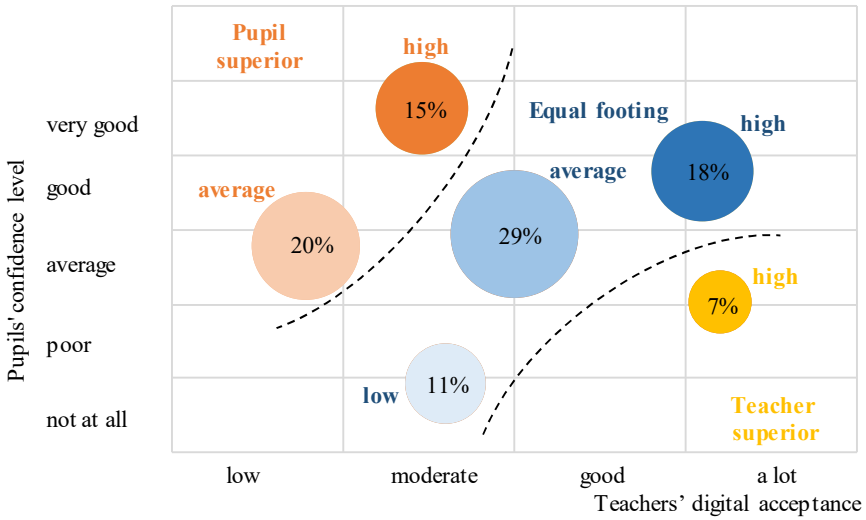

Figure 3. Categories of relationship between pupils' level of confidence and teachers' digital acceptance in secondary colleges, 2018.
*Source: own visualisation of survey data 'Digital transformation in Austrian secondary colleges for agriculture and forestry' (n=1,963).

Discussion of the intersection

The intersection, see figure 1, between the three dimensions is based firstly on the available digital technology and media (including infrastructure). This digital technology and media (including infrastructure) should be comprehensively expanded and continuously upgraded in order to promote digital innovation and solutions for learning. The appropriate equipment (including infrastructure), a reliable technical functionality and the availability of high-quality software are indispensable when digital technology and media are increasingly being used for learning in colleges. With this in mind it must also be possible to use an up-to-date digital technology and media (including infrastructure) without being exposed to a latent fear of failure. WLAN, wireless beaming, procurement of hardware, etc. have to meet professional demands and allow pedagogy to re-prioritise technology (Fullan, Langworthy, 2014, 5; Quendler et al., 2019). Furthermore, digital technology and media available should be used to transform instructional pedagogy and transcend traditional learning environments to make teaching, more pupil-friendly, diverse and modern (Quendler et al., 2019). At the same time, the expansion of knowledge associated with the digital technology and media requires an intensified focus on competence-oriented learning (cf. Albrecht, Revermann, 2016, Sauter, 2018). The integration of digital technology and media into the pupils' learning environment should serve to impart professional, general, holistic and expansive competences, i.e. with a view to becoming a 'digital-generalist' who sees the big picture. In this context, the influence of teachers' acceptance of digital media is crucial. Teachers can exploit the didactic potential of digital technology and media in a learning environment to enrich the education offered. This

comprises the meta-learning output of the learning process and is associated with (a) agency and communicative initiative, (b) digital dialogue and collaborative knowledge construction, (c) open educational resources (OERs) and (d) interdisciplinary as well as social learning projects in the form of action or process learning (Sorensen, 2008). Furthermore, teachers' training is fundamental to the success of digital transformation in these colleges. It needs prepared teachers who feel empowered by the use of digital tools and want to use them in the most efficient and fullest way. In this respect, the results of the pupils' survey, as well as the final report of Steele et al. (2014) on the Mastery Learning project, like many others before him, suggest that teachers should be given the opportunity to acquire digital competence through continuing education and shared teaching development.

CONCLUSION

Digital transformation seeks to embrace a broad, complex, interacting set of core dimensions. This paper provides a comparative analysis and gives the following insights into the digital status quo of the 11 secondary colleges for agriculture and forestry:

- The results show the diversity in the standard of the digital equipment in relation to the mixture of analogue and digital teaching. The contemporary model desired is a very well equipped college with a mixture of both analogue and digital forms of teaching. Although pupils are in favour of a mix, a further area of research should identify the benefits and shortcomings of either form and mix with the view to establishing the best balance.
- The focus on digital competence and the pupils' levels of digital confidence in secondary colleges is recent and necessary. Generally, the current levels are far from uniform.
- Ideally the aim should be a 'digital-generalist' with an appropriate level of digital confidence who sees the bigger picture and how a mix of all the (digital) specialties can contribute to sustainable careers and (digital) social change. The importance of learning about digital competence is becoming a central aspect of any education with an employability perspective. As a further area of research it is nowadays necessary to adopt a transversal model which takes stock of the diversity of digital competence. It is time to develop the digital component of '(new) competences, skills, aptitudes and attitudes for new jobs' on the labour market.
- Clear similarities and differences in the relationship between digital confidence levels of pupils and the digital acceptance of teachers can be established. These allow clusters of levels of affinity within the digital transformation process. The diversity of the cluster results shows that (i) there is a digital gap, (ii) a systematic transfer in and between the clusters is desirable and (iii) that it is important to maintain a digital transformation culture that is built on the pupils' expertise and teachers' interests as well as on their needs. This implies a further field of research regarding the motivation for digital transformation and the training in digital confidence and competence. This should focus on learning

from each other in a way that combines digital knowledge transfer, competence acquisition, and practical application. Furthermore, in order to drive the digital transformation of teaching and learning within these Austrian colleges, it is paramount to understand the digital needs both teachers and pupils have with respect to future employability.

- The intersection (see figure 1) shows the link between the three dimensions from the perspective of the 'digital-generalist'. It also infers that, a sustainable and smart digital transformation can only succeed if is grounded within the current context of the Austrian education system. In that context, it can be supported and guided by administration and policy. General areas are standards in learning settings, teacher training and equipment of digital technology (including infrastructure) and media.

The focus in this paper is the survey of pupils. However, we know little of the perspective on digital transformation of teachers, the administration, curriculum designers and political decision makers. Secondly, there are a number of demographic variables that may predict the preference for digital technology and media in learning, pupils' digital confidence and teachers' attitude to the 'digital'; these include age, gender, college location, and cultural background. This may also be an area for future research, together with looking at the benefits, drawbacks, professional requirements and challenges. Finally, it should be noted that these colleges have already faced major transformations, but it is an ongoing process caused by the continued integration of modern digital technology and media into teaching and learning.

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