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ORGANIZATIONAL TRAINING AND PERFORMANCE

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Development and Implementation of a Maturity Model of Digital Transformation

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Abstract

The adoption and integration of digital technology in organizations are crucial not only for communication, administration and management, but also a meaningful asset to support learning and teaching as well as organizational change. However, existing models of educational technology adoption and integration predominantly focus on school settings as well as on individual factors explaining the assimilation processes. Therefore, this research intents to fill the gap of a holistic model of technology adoption in educational organizations through developing a theoretically grounded maturity model. In a case study, the maturity model of technology adoption was implemented in an European educational organization. The study included $N = 222$ employees in two waves of data collection. Findings indicate a positive attitude towards IT and digital media within the respective organization. Overall, the educational organization was classified as digitally pragmatist. It is suggested that maturity model development should be highly transparent, following a clear methodology. Model evaluation and validation should be carried out before transfer and generalization can take place. Factors mediating digital maturity and organizational performance on individual (i.e., motives, attitudes) and on organizational level (i.e., organizational culture) should be taken into consideration. For successful technology adoption processes, organizational and human resource development ought to go hand in hand, supported by a sound communication strategy.

Keywords Technology adoption · Maturity model · Digital transformation · Educational organization · Organizational change

Introduction

Digital technology integration is an important mission for every business, organization or institution. The adoption and integration of digital technology is crucial not only for communication, administration and management, but also a meaningful asset to support learning and teaching (Ifenthaler 2018). However, existing models of educational technology adoption and integration predominantly focus on school settings as well as on individual factors explaining the assimilation process (Niederhauser and Lindstrom 2018). Evaluation models, likewise, mostly emphasize the individual perspective and draw on concepts like media literacy (Holma et al. 2014). Accordingly,

there is a lack of models for integrating the individual and the organizational perspective. These models could allow for performance analysis as a baseline for human resource development and organizational change (Foshay et al. 2014).

This research intents to fill the gap of a holistic model of technology adoption in educational organizations through developing a theoretically grounded maturity model. First, an overview on maturity models measuring organizational capabilities is provided. Then, the development of a maturity model of technology adoption for educational organizations is presented. In the following, a case study investigates the implementation of the maturity model of technology adoption in the context of an European organization. The article concludes with a discussion of implications, limitations, and future research suggestions.

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Maturity Models Assessing Organizational Capabilities

Maturity models are an "established means to identify strengths and weaknesses of certain domains of an organization" (Lahrmann and Marx 2010, p. 522) that serve to identify

discrepancies between the actual and the intended organizational design which subsequently can be overcome by development activities. Maturity thus implies an evolutionary progress in the accomplishment of a desired state (Mettler and Rohner 2009). Following Mettler (2011), subjects of maturity assessments in socio-technical systems are either (a) processes/structures (i.e., to which extent a specific process is explicitly defined, managed, measured, controlled, and effective), (b) objects/technology (i.e., to which extent a particular object like a software product reaches a predefined level of sophistication) or (c) people/culture (i.e., to which extent the workforce is able to enable knowledge creation and develop competencies).

Maturity models have been widely used in information systems research (Proença and Borbinha 2018; Proença et al. 2016; Schweigert et al. 2012) and have been developed with a special focus on the conditions and implications of digital transformation (Remane et al. 2017). 'Digital Maturity', is understood as the state of an organization's digital transformation, that is: what the organization has already achieved in terms of performing transformation efforts (Chanias and Hess 2016). Applications in educational contexts, however, are scarce. The models at hand are mostly limited to the management of information systems within an educational organization, and they are still at an early stage of development (Carvalho et al. 2019).

Maturity models consist of major components (Fraser et al. 2002) such as (a) maturity level or stage (typically three to six levels), (b) descriptor for each maturity level (e.g., initial, managed, etc.), (c) a generic description of each level, (d) dimensions, (e) elements linked to corresponding dimensions, and (f) a description of each element for each level of maturity. De Bruin and colleagues (De Bruin et al. 2005) distinguish descriptive, prescriptive, or comparative maturity models. A descriptive maturity model is suitable for assessing the current situation. A prescriptive maturity model supports the definition and implementation of a development plan. A comparative maturity model allows for comparisons across industries or regions as well as facilitating benchmarking (De Bruin et al. 2005).

The major benefits of maturity models include an objective performance assessment (i.e., maturity level) and indications on how possible deviations toward expected performance can be overcome (De Bruin et al. 2005; Lahrmann and Marx 2010). Accordingly, maturity models are accepted tools for determining the status of organization and for illustrating activities for achieving a more mature level of the organization (Mettler and Rohner 2009). In addition, comparisons and benchmarking with other organizations are possible (Berghaus and Back 2016). Still, maturity models can be criticized with regard to their lack of suggestions and actions to be taken for improving organizations towards more mature levels (Mettler and Rohner 2009). Further, while the maturity models have a strong focus on organizational processes,

personnel capacities and individual aspects are often disregarded (Poeppelbuss et al. 2011).

Developing a Maturity Model of Technology Adoption in Educational Organizations

As suggested by De Bruin et al. (2005), the development of a maturity model of technology adoption in educational organizations needs to be theoretically sound and rigorously tested. As a first step, we conducted an extensive literature review on current maturity models of technology integration in organizations with regard to digital transformation. A minimum requirement for further consideration of existing maturity models was that they included information about different maturity levels, explicit dimensions, elements linked to corresponding dimensions, and a description of each element for each level of maturity (Fraser et al. 2002). Figure 1 provides an overview of the final selection of six existing maturity models. Clearly, the six maturity models differ widely in the descriptors of maturity levels, the number of levels and dimensions. However, the assessment of most maturity models is realized through quantitative surveys and a corresponding scale based on points assigned for a specific maturity level. Despite the overwhelming number of existing models (Wendler 2012), none of these approaches focusses on the digital maturity of educational organizations.
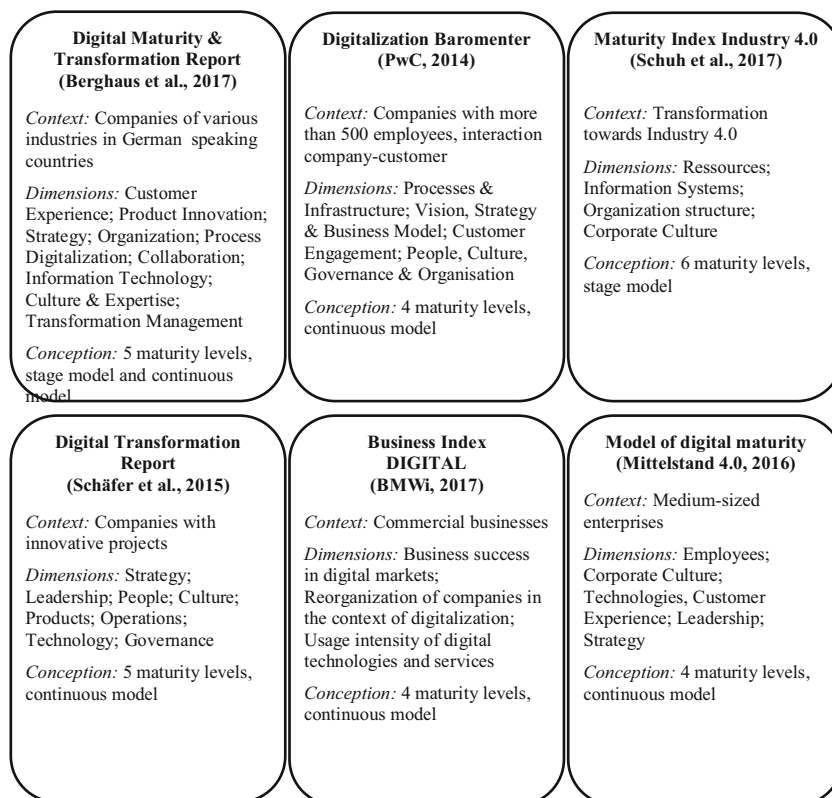
From a synopsis of the six maturity models (see Fig. 1), we developed the maturity model of technology adoption for educational organizations (MMEO) including the following characteristics (Lahrmann and Marx 2010):

- MMEO is designed as a hierarchical model with six dimensions: infrastructure, strategy and leadership, organization, employees, culture, and educational technology.
- MMEO is a continuous model with five maturity levels and corresponding descriptors: digitally minimalist (0–30 points), digitally conservative (31–50 points), digitally pragmatist (51–70 points), digitally advanced (71–90 points), digitally trailblazing (91–100 points).
- MMEO allows for multiple configurations in different contexts.
- MMEO's assessment approach is mainly quantitative.

With regard to the theoretically grounded decision parameters during the development processes of a maturity assessment model (Mettler 2011), MMEO can be characterized as follows:

- Definition of scope: MMEO has a general focus, enabling analyses out of organizational and inter-organizational considerations. The subject-matter of the model 'digital transformation in educational organizations' is rather

Fig. 1 Synopsis of six models of digital maturity

Digital Maturity & Transformation Report (Berghaus et al., 2017)

Context: Companies of various industries in German speaking countries

Dimensions: Customer Experience; Product Innovation; Strategy; Organization; Process Digitalization; Collaboration; Information Technology; Culture & Expertise; Transformation Management

Conception: 5 maturity levels, stage model and continuous model

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Digitalization Barometer (PwC, 2014)

Context: Companies with more than 500 employees, interaction company-customer

Dimensions: Processes & Infrastructure; Vision, Strategy & Business Model; Customer Engagement; People, Culture, Governance & Organisation

Conception: 4 maturity levels, continuous model

Maturity Index Industry 4.0 (Schuh et al., 2017)

Context: Transformation towards Industry 4.0

Dimensions: Ressources; Information Systems; Organization structure; Corporate Culture

Conception: 6 maturity levels, stage model

Digital Transformation Report (Schäfer et al., 2015)

Context: Companies with innovative projects

Dimensions: Strategy; Leadership; People; Culture; Products; Operations; Technology; Governance

Conception: 5 maturity levels, continuous model

Business Index DIGITAL (BMWi, 2017)

Context: Commercial businesses

Dimensions: Business success in digital markets; Reorganization of companies in the context of digitalization; Usage intensity of digital technologies and services

Conception: 4 maturity levels, continuous model

Model of digital maturity (Mittelstand 4.0, 2016)

Context: Medium-sized enterprises

Dimensions: Employees; Corporate Culture; Technologies, Customer Experience; Leadership; Strategy

Conception: 4 maturity levels, continuous model

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emerging than disruptive. MMEO is management-oriented, and the general model will be openly disseminated.

- Model design: MMEO's maturity definition is people-focused, with a multi-dimensional target function. The design process is theory-driven, but evolves out of practical considerations. MMEO's product is a textual artifact as well as an assessment tool that enables a self-assessment for management and staff.

Table 1 provides an overview of the maturity model of technology adoption for educational organizations, its dimensions and respective indicators.

Case Study: Implementing a Maturity Model of Technology Adoption in an Educational Organization

Research Questions and Context

As a next step, we will present a case study for rigorously testing the maturity model of technology adoption in an educational organization (MMEO) (De Bruin et al. 2005). The goal of the application of the MMEO was to get an overview of existing individual competencies and organizational capabilities within an European organization and to set a benchmark for organizational change and human resource

development interventions. Therefore, the following research questions (RQ) were addressed:

RQ 1: What is employees' knowledge about digitalization?
RQ 2: How do employees use IT and digital media, and is there a difference between private and job-related usage?
RQ 3: What are employees' attitudes towards aspects of digitalization?
RQ 4: What is the maturity level of technology adoption within the educational organization?

The MMEO model dimensions (see Table 1) were operationalized and administered in a quantitative survey on digital transformation among the employees of a European vocational education training (VET) provider. This organization offers services in areas like adult/ongoing education, educational consulting, vocational training, inclusion/special education, training of refugees, or occupational rehabilitation. Within a holding structure, the organization employs include $N = 1700$ people in 25 geographically distributed subsidiaries. In 2017, the organization's overall course participation totaled up to $N = 22{,}391$ enrollments. This case study was carried out within a joint research project focusing on the development of evidence-based guidance for educational organizations in the process of digital transformation.

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Table 1 Dimensions of the maturity model for educational organizations (MMOE)

Dimension	Indicators/Content
Equipment and technology	Equipment with digital devices, software
	Up-to-date infrastructure
	Homogeneous technology landscape, standards
Strategy and leadership	Existence and implementation of a digital strategy
	Managers promote digitalization with priority
	Analysis of new technologies
	Democratic leadership style, creative freedom granted
Organization	Sufficient financial resources
	Technical Support (internal vs. external service providers)
	Efficient procurement and maintenance
	Pedagogical Support
Employees	Knowledge/Skills in dealing with digital technologies
	Usage of devices and services
	Attitudes
	Readiness for further training
Culture	Openness to new technologies
	Openness for change
	Open communication, mutual support
Digital learning and teaching	Digital platforms, e-Learning offerings
	Working with digital devices in classroom settings
	Digital Education as an overall goal
	Data driven teaching and learning

The digital transformation survey (DTS) covered five areas: conceptions of digitalization (8 items), use of information technology (IT) and digital media (10 items), evaluation of IT and digital media (2 items), digitalization in job-related contexts (8 items), and general attitudes toward digitalization (7 items). Most items were answered on a six-point Likert scale.

Sample and Procedure

The study was conducted between June and August 2018. In total, $N = 222$ employees (58% female, 34% male, 8% n/a) participated in the two waves using the DTS. The first wave was administered online, the second wave as a paper-pencil survey to reach additional employee groups. More than half of the participants were involved in teaching, while 30% worked in a leadership position. Participants' work experience ranged from 1 to 46 years, with an average of 18.5 years.

Results

Knowledge about Digitalization (RQ1)

Participants were asked to rate their familiarity with several concepts and technologies related to digitalization on a six-point Likert scale. As shown in Table 2, participants were very

familiar with 'Apps', and also with the concept of 'digital learning'. Concepts more closely related to digital transformation like 'big data' and 'wearables' were not as common among the employees.

Use of IT and Digital Media (RQ2)

Concerning the use of IT and digital media, participants were asked to differentiate between the private and the professional context. As highlighted in Table 3, there are highly significant differences between private and job-related usage for all the technologies and tools with medium to high effect sizes, except for 'Email'. Apparently, the use of conventional media seems to dominate within the professional context.

Table 2 Knowledge of digitalization

Technology	n	M (SD)
App	215	5.47 (1.062)
Digital Learning	217	4.88 (1.360)
Cloud	215	4.73 (1.572)
Cyber Security	215	4.63 (1.398)
Industry 4.0	214	3.26 (1.857)
Internet of Things	212	3.21 (1.886)
Big Data	211	2.86 (1.837)
Wearables	214	2.39 (1.663)

Table 3 Use of IT and digital media

Technology	Job-related		Private		Z	p	r
	n	M (SD)	n	M (SD)			
Computer, notebook	214	4.68 (1.050)	212	4.25 (1.042)	−4.955	0.000***	.34
Tablet/iPad	211	1.51 (1.228)	210	2.97 (1.778)	−8.940	0.000***	.62
Smartphone	209	3.19 (1.798)	210	4.84 (.705)	−9.169	0.000***	.64
Standard software	215	4.52 (1.199)	211	3.53 (1.228)	−8.458	0.000***	.58
Specialized software	212	3.90 (1.510)	205	1.69 (1.188)	−10.032	0.000***	.71
Email	214	4.61 (1.098)	212	4.59 (.733)	−1.245	0.213	.09
Messenger services	211	2.75 (1.723)	214	4.67 (.977)	−10.280	0.000***	.71
Cloud services	208	2.07 (1.487)	210	2.68 (1.592)	−5.022	0.000***	.35
Gaming software and apps	215	1.09 (.484)	215	2.45 (1.561)	−9.114	0.000***	.63
Streaming services, video	213	1.77 (1.081)	214	3.49 (1.328)	−10.676	0.000***	.73

*** $p < .001$

Concerning the evaluation of the use of IT and digital media, participants again were asked to differentiate between job-related and private contexts. As indicated in Table 4, participants positively evaluate the use of IT and digital media in private and in job-related contexts. However, participants indicate that they would like to use IT and digital media more extensively in job-related matters.

Attitudes towards Digitalization (RQ3)

Findings focusing on attitudes toward digitalization in general and in job-related context are shown in Tables 5 and 6. Participants report that IT and digital media already introduced changes in the work environment and that a further integration of IT and digital media could help to achieve further improvements of the work environment. However, participants also report issues with regard to support for technology integration, less autonomy in IT and digital media use, as well as a lack of IT and digital media for learning and teaching purposes (see Table 5).

General attitudes toward technology adoption are shown in Table 6. Participants expect IT and digital media to further support economic and societal growth as well as professional development. However, participants critically reflect dangers related to further adoption of IT and digital media.

Level of Technology Adoption Maturity (RQ4)

In order to determine the maturity level of technology adoption with the educational organization, the following computation rules have been applied: 1. The maturity level of technology adoption for each dimension was calculated. 2. A weighting for the dimensions was applied. 3. The overall maturity score of technology adoption was determined. 4. The semantic label for the maturity level was assigned.

As shown in Table 7, the highest sub-score was calculated for the dimension culture and the lowest sub-score was calculated for the dimension organization. With an overall maturity score of 59.51, the educational organization is classified on maturity level 3, labelled as 'digitally pragmatist'. MMEO also allows to calculate a distribution of different maturity levels among all employees which is shown in Fig. 2.

Discussion and Conclusion

The development and implementation of a maturity model of technology adoption in educational organizations needs to be theoretically sound, rigorously tested, and widely accepted (De Bruin et al. 2005). In line with Mettler's (2011) process steps in the research design of maturity assessment models, we identified the need for MMEO, defined the scope of the model, and

Table 4 Evaluation of IT and media usage

Evaluation	Job-related		Private		Z	p	r
	n	M (SD)	n	M (SD)			
I enjoy using IT and digital media.	215	4.47 (1.440)	217	4.88 (1.117)	−4.310	0.000***	.29
I would like to use IT and digital media more intensively.	214	4.11 (1.567)	216	3.96 (1.457)	−2.026	0.043*	.14

* $p < .005$ and *** $p < 0.001$

Table 5 Digitalization in job-related contexts

Item	n	M (SD)
In my work environment we are open for the usage of IT and digital media.	205	4.58 (1.354)
In my work environment there are already changes due to IT and digital media.	184	4.03 (1.577)
The increased use of IT and digital media in my work environment could help to achieve improvements	197	4.68 (1.304)
There is sufficient support for the use of IT and digital media in my work environment, e.g. IT support, didactical support.	199	3.29 (1.387)
Supervisors/Managers promote the use of IT and digital media in my work environment.	201	3.75 (1.513)
In my work environment, I can decide for myself to what extent I use IT and digital media.	199	3.62 (1.575)
In my work environment, IT and digital media are used for teaching and learning.	196	3.66 (1.546)

mapped out a model design. The next step within this methodology was to evaluate the design. Thus, an ex-post evaluation of both the model and the development process was mandatory before generalization and transfer could take place.

Findings of the presented case study indicate a positive attitude towards IT and digital media within the educational organization, but also significant differences between job-related and private aspects. Here, a general characteristic of people oriented maturity assessments becomes evident: The relationship between individual competencies and organizational capabilities is not always unequivocal. A high maturity level among employees does not automatically imply high organizational capabilities, let alone high organizational performance. Thus, maturity models should take mediating factors into account, like, for example, individual motives and attitudes or organizational culture. MMEO incorporates these factors from the employees' perspective, so that additional mediation analyses can take place. Concerning organizational culture, it could be worthwhile to extend the model with an additional perspective. An executive survey could provide valuable information on organizational conditions and cultural factors – 'digital leadership' (i.e., leadership that is in line with the affordances of digital transformation) is likely to play a crucial role here.

With regard to the MMEO, the organization of our case study can be classified on maturity level 3, labelled as 'digitally pragmatist'. The main goal of the MMEO development

for the organization could be achieved as follows: to describe the state of digital maturity within the target organization. However, in addition to the descriptive model purpose, additional comparative analyses can be carried out. Differences in digital maturity between different branches and subsidiaries as well as between different employee groups (i.e., executives, employees with teaching role) have a high practical relevance for the target organization.

MMEO was to set a benchmark for organizational and human resource development interventions. Here, the results of the DTS indeed indicate potential areas of improvement. Although the MMEO in its present format does not incorporate explicit design principles for a prescriptive purpose of use (Röglinger et al. 2012), the findings highlight technologies and processes that might become subject to training and development. Hence, organizational change and human resource development must go hand in hand.

This case study has obvious limitations that need to be addressed. The current development of the maturity model for technology adoption in educational organizations needs to be further validated. An expert validation approach would confirm the current dimensions and operationalized measures. As suggested by De Bruin et al. (2005), the validated MMEO could be tested in further educational organizations. Having

**Table 6** General attitudes towards digitalization

Item	n	M (SD)
Digitalization opens up great opportunities for the advancement of economy and society.	203	4.88 (1.010)
Digitalization creates great dangers.	204	4.52 (1.147)
Digitalization offers great potentials for my own professional development.	202	4.46 (1.214)
Digitalization offers great potentials for my own personal development.	204	4.25 (1.310)
Digitalization leads to additional strain in my job.	206	3.37 (1.580)
Digitalization means additional stress in my everyday life.	206	3.23 (1.599)

Table 7 Subscores in the MMEO dimensions and maturity score

Dimension	n[a]	M (SD)
Employees	209	62.11 (13.63)
Knowledge	215	59.19 (20.01)
Usage	215	56.66 (14.35)
Attitude	215	69.75 (18.64)
Equipment and technology	218	58.30 (22.13)
Strategy and leadership	190	53.42 (26.09)
Organization	199	45.73 (27.73)
Culture	209	70.87 (19.73)
Digital learning and teaching	196	53.16 (30.92)
Maturity score	**167**	**59.51 (14.50)**

[a] Deviations in the sample size n result from the evaluation procedure which provides for a minimum of answered items per dimension

Fig. 2 Distribution of participants over MMEO maturity levels
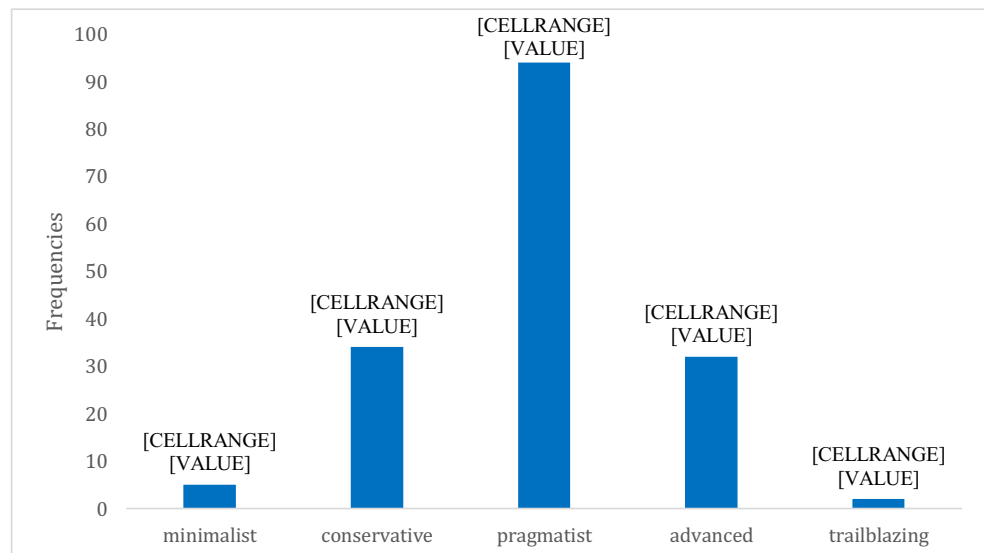
additional samples available, an in-depth cluster analysis could help to confirm the robustness of the MMEO dimensions. A further refinement of MMEO could include the inclusion of additional dimensions. Likewise, an elaborate advancement of MMEO could include a specific instrument for executives which is a common approach in adjacent research approaches (Sonntag and Stegmaier 2006).

As the maturity model for technology adoption in educational organizations helps to identify the current state of adoption and integration of digital technologies, understanding and managing continuous change helps to better facilitate organizational transformation toward technology adoption and integration (Ifenthaler 2017; Locke et al. 2011). According to Kotter (2007), trustful communication is the key for successful change management. Misconceptions among employees which may lead to active or passive resistance against changes in the educational organization may be a blocker toward technology adoption. Accordingly, having a clear vision of the target state is essential for adoption and integration of technology. To communicate the vision of all employees, the so-called guiding coalition should exemplify the behavior to reach the target state of the organization. Thus, it is an important role for learning and development professionals in times of digital transformation to act as change agents and peer-to-peer consultants in order to shape a culture of organizational change (Vey et al. 2017).

Compliance with Ethical Standards

Ethical Approval   All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This article does not contain any studies with animals performed by any of the authors.

Informed Consent   Informed consent was obtained from all individual participants included in the study.

Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

Conflict of Interest   Author Dirk Ifenthaler declares that he has no conflict of interest.

Author Marc Egloffstein declares that he has no conflict of interest.

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