Universidade Europeia

Universidade Europeia

Proceedings of the 20th European Conference on Knowledge Management

Universidade Europeia de Lisboa

Lisbon, Portugal

5–6 September 2019

Edited by
Dr Eduardo Tomé, Dr Francisco Cesário
Dr Raquel Reis Soares

VOLUME 1

acpi

A conference managed by ACPI, UK

Proceedings of the

20th European Conference on Knowledge Management
ECKM 2019

Hosted By
Universidade Europeia de Lisboa
Lisbon, Portugal

Edited by
Dr. Eduardo Tomé, Dr. Francisco Cesário
Dr. Raquel Reis Soares

5–6 September 2019

VOLUME 1

Review Process
Papers submitted to this conference have been double-blind peer reviewed before final acceptance to the conference. Initially, abstracts were reviewed for relevance and accessibility and successful authors were invited to submit full papers. Many thanks to the reviewers who helped ensure the quality of all the submissions.

Ethics and Publication Malpractice Policy
ACPIL adheres to a strict ethics and publication malpractice policy for all publications – details of which can be found here:
http://www.academic-conferences.org/policies/ethics-policy-for-publishing-in-the-conference-proceedings-of-academic-conferences-and-publishing-international-limited/

Conference Proceedings
The Conference Proceedings is a book published with an ISBN and ISSN. The proceedings have been submitted to a number of accreditation, citation and indexing bodies including Thomson ISI Web of Science and Elsevier Scopus.

Author affiliation details in these proceedings have been reproduced as supplied by the authors themselves.

The Electronic version of the Conference Proceedings is available to download from DROPBOX http://tinyurl.com/ECKM19 Select Download and then Direct Download to access the Pdf file. Free download is available for conference participants for a period of 2 weeks after the conference.
The Conference Proceedings for this year and previous years can be purchased from http://academic-bookshop.com

E-Book ISBN: 978-1-912764-33-4
E-Book ISSN: 2048-8971
Book version ISBN: 978-1-912764-32-7
Book Version ISSN: 2048-8963

Published by Academic Conferences and Publishing International Limited
Reading
UK
44-118-972-4148
www.academic-conferences.org

Designing a Tool to Assess Professional Competences: Theoretical Foundations and Potential Applications

Florian Fahrenbach, Alexander Kaiser, Florian Kragulj and Clemens Kerschbaum
Institute for Information Business, Vienna University of Economics and Business, Vienna, Austria
florian.fahrenbach@wu.ac.at
alexander.kaiser@wu.ac.at
florian.kragulj@wu.ac.at
clemens.kerschbaum@wu.ac.at
DOI: 10.34190/KM.19.103
Abstract: This conceptual paper outlines the descriptive theoretical foundations or kernel theories for designing an information and communication technology (ICT) tool to assess professional competences in the Austrian trade and craft sector. Upon completion, the ICT-tool serves as a boundary object in which applicants and assessors can interact. While this paper consists of a literature review and conceptual discussion, the overall project is methodologically placed within a multidisciplinary design-science paradigm. Design science scaffolds and structures the development of a theoretical model, the generation of assessment-items and the ICT-tool itself. This paper discusses the necessary descriptive knowledge or kernel theories on which the design of the ICT-tool rests. First, we describe the validation of prior learning – a process advocated by the European Union to make professional competences visible. Second, we describe the process how professional competences come about: through formal, non-formal and informal learning. Subsequently, we outline a knowledge-driven discourse on professional competences and discuss how different definitions of professional competence afford different approaches for its assessment. By presenting a use-case, we outline how the ICT-tool may guide applicants and assessors through this process.

Keywords: professional competences, assessment of competences, learning outcomes, validation of prior learning, design science, ICT-tool

1. Introduction

Professional competences are crucial for succeeding in any profession, ranging from hair-dressers to medical doctors. A large body of literature deals with the conceptualization (Le Deist and Winterton, 2005; Mulder, 2018) and assessment of professional competences in several research areas such as human resource management (Wright, 2001), medical education (van der Vleuten and Schuwirth, 2005), or nursing (Benner, 1984). Also in European Union (EU) policy-making, there is a focus on the conceptualization and assessment of professional competence (European Union, 2012, 2017, 2006). Professional competences are often acquired through informal and non-formal learning, i.e. learning that occurs outside institutions or formal environments. As a result, they "are partly tacit [...] in their character" (Bjørnåvold, 2000b, p. 13; also see Polanyi, 1966) which makes them difficult to assess. And, while policies are in place, we lack specific methods to assess (partly tacit) professional competences. In this paper, we address this lack and lay out the theoretical foundations or kernel theories for designing a tool to assess professional competences (Gregor and Hevner, 2013). Consequently, the research question is: *What are fundamental theoretical concepts for designing an assessment tool for professional competences?* As design science research requires making explicit the "knowledge base" or kernel, i.e. what we know about a phenomenon, answering this question is crucial for our endeavor to design an assessment tool for the trade and craft sector in Austria. Designing such a tool should be driven by thorough theoretical reasoning. Practically, our paper can serve researchers and practitioners alike that aim to work on similar strands.

Our paper departs by outlining the problem of measuring and comparing competences against standards that the trade and craft sector in Austria is facing. To address this problem, we have been developing a theoretical framework for assessing professional competences and an ICT-tool that puts the framework into practice (Fahrenbach *et al.*, 2019). Particularly focusing on the ICT-tool in this paper, we introduce design science as an overall methodology that scaffolds our research and motivates the research question. Afterwards, we describe fundamental theoretical concepts or kernel theories to design an ICT-tool for the assessment of professional competences. First, we introduce the validation of prior learning, i.e. a process promoted in the EU to identify, document, assess, and recognize professional competences. Second, we outline how professional competences come about: formal, non-formal and informal learning. Subsequently, we take a knowledge perspective on how professional competences are conceptualized in management and organization studies. After reviewing what

professional competences are and how they come about, we discuss what that means for their assessment. We conclude the main part by presenting a use-case - the net of competences - a prototype that embodies the theoretical foundations outlined in the main part. Upon completion, this artefact can be used for design science research, and, thus, increases our descriptive knowledge base on professional competences.

2. Problem statement

After the EU has agreed on the European Qualification Framework, i.e. a set of common principles that put lifelong learning into practice (European Union, 2006) by fostering the validation of prior learning (European Union, 2012), it is now important to design innovative and standardized tools for the validation of learning outcomes (European Commission *et al.*, 2014). While the EU acknowledges that the validation of competences is a complex endeavor, they call to develop standardised tools, as these can "mainstream processes and increase awareness of validation" (Cedefop *et al.*, 2017, p. 75). Within standardized ICT-tools, different methods of assessment can be supported – a multimethod assessment is seen as "gold standard" in assessment procedures as it is "based on the triangulation of results from different assessment methods [...] frequently used in validation" (Cedefop *et al.*, 2017, p. 74). Policy-makers recently concluded conclude: "more can be done in the standardisation of tools and the use of ICT" (Cedefop *et al.*, 2017, p. 20) for the validation of prior learning.

To address this issue, we are currently running a research project with the Austrian Federal Economic Chamber (WKO). This projects aims at developing the theoretical framework and concrete ICT-tool to assess individual professional competences against given professional standards in the trade and craft sector (82 vocational professions, for example hair-cutters, butchers, builders, painters, electricians). These standards are documents for each profession that contain roughly 50 learning outcomes. Learning outcomes are "statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competence" (Council of the European Union, 2008). Comparing an individual competence profile against learning outcomes shall enable an informed decision on whether a person has developed proven professional competences to exercise a profession and start a business. This ensures that professionals adhere to high standards.

In Austria, there are about 180 professions that require a formal and effective proof of competences. Therefore, the aim of our project is to develop a competence-based model and, subsequently, an ICT-tool that scaffolds the assessment of professional competences. The project's emphasis lies on the assessment of a person's existing competences that she or he has been developing in formal, non-formal, and informal learning processes (i.e. prior learning). In sum, the resulting ICT-tool should scaffold the whole process of the validation of prior learning.

3. Methodological framework of the project

We employ a design science paradigm (Gregor and Hevner, 2013; Hevner *et al.*, 2004; Peffers *et al.*, 2007) for developing the ICT-tool. Whereas natural sciences and social sciences try to *understand* the different facets of reality, "design science attempts to create things that serve human purposes" (Simon, 1996, p. 55). Thus, design science is "the creation and evaluation of an innovative, purposeful artifact for a specified, currently unresolved problem domain" (Hevner *et al.*, 2004, p. 82). With "utility as a goal in mind - design science addresses research through the *building* and *evaluation* of artifacts designed to meet the identified [...] need" (Hevner *et al.*, 2004, pp. 79–80). An artefact refers to "a thing that has, or can be transformed into, a material existence as an artificially made object (e.g., model, instantiation) or process (e.g., method, software)" (Gregor and Hevner, 2013, p. 341). The design science process includes six steps: "problem identification and motivation, definition of the objectives for a solution, design and development, demonstration, evaluation, and communication" (Peffers *et al.*, 2007, p. 46). In design science, knowledge is divided into descriptive and prescriptive knowledge (Gregor and Hevner, 2013). While d*escriptive knowledge* "is the 'what' knowledge about natural phenomena and the laws and regularities among phenomena [...]", *prescriptive knowledge* "is the 'how' knowledge of human-built artifacts" (Gregor and Hevner, 2013, p. 343). This paper aims to outline the body of descriptive knowledge or "kernel theories" that "informs design research, including informal knowledge from the field and the experience of practitioners" (Gregor and Hevner, 2013, p. 340).

4. Fundamental concepts relevant for the design of an ICT-tool

4.1 Validation of prior learning

The validation of prior learning is a kernel theory for the design of an ICT-tool to assess professional competences. The validation of prior learning - often also called "recognition of prior learning" (RPL) or "accreditation of prior learning" (APL) (Bohlinger, 2017) is an important instrument for policy making within the EU (European Union, 2012).

Usually, the validation of prior learning is outlined as consisting of subsequent steps – the identification, documentation, assessment and recognition of formal, non-formal and informal learning outcomes (Bjørnåvold, 2000b, 2000a). Identifying prior learning implies making explicit (Nonaka *et al.*, 2000; Nonaka, 1994) what a person has learned in the past. This can be facilitated via appropriate guidance (European Union, 2012) and other facilitation techniques. It is important, however, that methods and approaches are "open to the unexpected" and not be designed in ways which narrow down the range of knowledge, skills and competences that may be considered" (Cedefop, 2015, p. 18). After identifying, learning outcomes, a candidate has to provide appropriate documentation for their learning outcomes. This "involves provision of evidence of the learning outcomes acquired [...] carried out through the 'building' of a portfolio that tends to include a CV and a career history of the individual, with documents and/or work samples that attest to their learning achievements" (Cedefop, 2015, p. 18). The documentation of learning outcomes is comparable to preparing a portfolio (Baeten *et al.*, 2008). Subsequently, the assessment of learning outcomes refers to the comparison of learning outcomes against a predefined standard or criteria (Cedefop, 2015). Learning outcomes can be assessed - besides the portfolio method mentioned above – by interviews, simulations, workplace in real situations and oral/written tests that are highly standardized. Lastly, the recognition of learning outcomes happens through a competent authority by awarding qualifications (certificates, diplomas or titles) or part-qualifications based on the assessment (European Union, 2017, p. 20).

Even though the process seems to be straightforward and highly standardized, it is rather a process that is highly influenced by social interactions between to-be-assessed and guides (Diedrich, 2013) and, users of the assessment tool should be free to jump back and forth between the different phases in the validation of prior learning. In sum, the assessment tool to be developed should cover all relevant steps of the validation of prior learning and should support users while leaving as much autonomy as possible.

4.2 Learning outcomes: Formal, non-formal, and informal learning

If we look at the processes of acquiring knowledge that result in professional competences, we can distinguish three different forms of learning. First, formal learning consists of learning that occurs within an organized and structured context that is set up to transfer knowledge (e.g. formal education, in-company training). This type of learning is intentional from the learner's perspective and may lead to some sort of formal recognition (e.g. diploma, certificate). Second, non-formal learning consists of learning embedded in planned activities that are not explicitly designated as learning activities, but which contain an important learning element. Non-formal learning is intentional from the learner's point of view. Third, informal learning is defined as learning resulting from daily life activities related to work, family, or leisure. It is not structured in terms of learning objectives, learning time, and/or learning support. Typically, it does not lead to certification. Informal learning may be intentional, but in most cases it is non-intentional (Colardyn and Bjornavold, 2004). While the learning outcomes of formal and even non-formal learning are relatively easy to assess, it is more difficult to assess informal learning outcomes. This may be due to the fact that informal is largely invisible, as the growth of knowledge that comes along is non-intended and taken for granted. Thus, persons are not aware of their own learning (Eraut, 2004). Taking this into account the ICT-tool takes a special focus on the assessment of informal learning.

4.3 Professional competences: Discussing the literature

The process of prior learning (and its validation) is closely linked to the long-standing and vivid debate on what professional competence are. Different scientific fields contribute to the discourse. Within psychology, White (1959) identified a personality trait called competence. Since then, competence is seen as a building block for motivation (Rothwell and Lindholm, 1999), and linguistic competence a body of linguistic knowledge possessed by native speakers (Chomsky, 1965). Within testing psychology, McClelland (1973) put forward the proposal to test for competence rather than intelligence. In this regard, the term professional competence has several

definitions (Mulder *et al.*, 2007; Le Deist and Winterton, 2005) that subsequently constrain how professional competence can be assessed.

4.3.1 Professional competences constituted within the entity

Reviewing the relevant literature, three distinctive views on the concept of professional competence crystallize. First, professional competence can be seen as a body of applied scientific knowledge (Alvesson, 2004; Brint, 2001; Schön, 1983); a view that has been supported by the rise of ICT systems and artificial intelligence (Winograd and Flores, 1987; Dreyfus and Dreyfus, 1986). For example, very early already Taylor (1911, p. 6) argued that the "search" for the competent man is of primary importance. The competent should be trained by changing the environment through adequately applying the scientific method (i.e. scientific management based on clear rules and principles).

Second, as pointed out before, other scholars underscore the tacit dimension of professional competence (Polanyi, 1966). Hayek (1945, p. 523) argued that the competent and skilled man is much more than his applied scientific knowledge. This view got support from several disciplines, such as nursing (Benner, 1984), education (Eraut, 1994), or management (Tsoukas, 1996). As Pye (1988, p. 64) puts in reference to Polanyi (1966): "Competence is something about which we can know more than we can tell".

Third, professional competence has been conceptualized as consisting of knowledge, skills, abilities, and other attributes (KSAOs). For example, Boyatzis (1982, p. 21) conceptualizes competence as "an underlying characteristic of a person in that it may be a motive, trait, skill, aspect of one's self-image or social role, or a body of knowledge, he or she uses". Theories describing professional competence as KSAOs are subsequently refined and further developed (Winterton, 2007; Mulder *et al.*, 2007; Winterton, 2006; Le Deist and Winterton, 2005; Rothwell and Lindholm, 1999). In sum, these theories see the locus of professional competence in the single entity.

The latter view on professional competences as KSAOs has been especially influential within human resource management (Wright, 2001; Campion *et al.*, 2011) ever since Taylor (1911). Burgoyne (1993) even identified a "competence movement". It is argued that competence links individual work performance with organizational strategy (Hayton and McEvoy, 2006; Rothwell and Lindholm, 1999). Due to this, the assessment of competences is a key element of job analysis within human resource management (Sandberg, 2000; Hayton and McEvoy, 2006). Job analysis seeks to identify tasks that have to be performed in a certain job and nominate requirements that a person should possess when performing a certain job. Within human resource management, competences are defined on an individual but also collective level (Hayton and McEvoy, 2006; Wright, 2001). Though, this spanning and crossing levels led to considerable confusion and controversy (Wright, 2001). Within the field of human resource management and personnel psychology, the practice of competency modelling is common (Capaldo *et al.*, 2006; Campion *et al.*, 2011; Shippmann *et al.*, 2000).

4.3.2 Professional competences constituted within relations.

The view of professional competence as being part of an entity is increasingly challenged (Blackler, 1995; Cook and Brown, 1999; Stoof *et al.*, 2002). Sandberg and Targama (2007, p. 57) argue that a taxonomy of competences or skills does not "demonstrate whether the workers use the prerequisite attributes, or in what way they use them in accomplishing the work". In this regard, several authors see professional competence as occurring in the relation between the individual and the environment (Gärtner, 2013).

First, professional competence is constituted as knowing-in-action (Schön, 1990, 1983). If someone wants to understand the "essentials of what accomplished engineers know, you need to look at what they do as well as what they possess" (Cook and Brown, 1999, p. 387). In this vein, scholars argue against the "epistemology of possession" of seeing competence as part of a single entity (Cook and Brown, 1999, p. 381).

Second, professional competence has also been conceptualized as based within practice. These approaches include communities of practices (Wenger, 2000) and the activity theory (Engeström, 2001). Everyday practice or activity forms the core of professional competence (Sandberg and Tsoukas, 2011), as it "integrates the subject, the object, and the instruments (material tools as well as signs and symbols) into a unified whole" (Engeström, 1993, p. 67). Within a practice perspective, professional competence is not only in the head of

individuals, neither in assigned tasks or external tools "but lie[s] instead in the relations among them" (Chaiklin and Lave, 1993, p. 9).

Third, professional competence can be defined from a process perspective which tries to understand competence as skilful performance (Sandberg *et al.*, 2017; Gherardi and Strati, 2017). This perspective argues against the ontological conception of competence as a product of learning or as a certain object that a person possesses (Sandberg *et al.*, 2017). A process perspective conceptualizes professional competence as a process of continuous becoming (Tsoukas and Chia, 2002), not as inherent to a stable entity, following a substantive ontology (Sandberg and Tsoukas, 2011). Taking this perspective, professional competence is not a stable entity or something underlying work performance but is constituted in the performance of work itself. Professional competences can be seen as performative accomplishments (Gherardi, 2006).

4.3.3 Implications for the assessment of professional competences

The different conceptions of professional competence afford different methods of assessment. In this regard, we support the call of research (van der Vleuten and Schuwirth, 2005) and policy making (Cedefop *et al.*, 2017) to use multi-method assessment procedures. When professional competences are conceptualized as part of an entity, then standardized tests and procedures may be appropriate to evaluate professional competences. However, if professional competences are seen as relational, i.e. as inherent to action, practice, or a process, then professional competences have to be demonstrated and assessed in performing a certain task. As a consequence, an ICT-tool that assesses professional competences only in a paper-pencil way using standardized psychometric procedures cannot fully account for the latter conception of professional competences. However, the ICT-tool may enable the interaction between applicants and assessors and structure the literal demonstration of professional competences. Being aware of this limitation, we do not propose a specific method as the most appropriate. Rather, we advocate an instructional design perspective (van der Vleuten and Schuwirth, 2005) in which we – besides the design of an ICT-tool - also view the development of a theoretical model and subsequently assessment methods from a design perspective.

5. Presenting a use-case: The net of competence

We have designed a prototype for such an ICT-tool, i.e. the "net of competences". This prototype embodies the theoretical considerations we have previously outlined. In the following, we discuss some of these considerations that have been or are implemented in the ICT-tool. First, the "net of competences" scaffolds the whole process of validation of prior learning (Bjørnåvold, 2000b, 2000a). Second, users can upload evidence (documents of proof) for their formal, non-formal, and informal learning in form of a portfolio (Baeten et al., 2008; McMullan et al., 2003). Third, as we discussed that professional competences are controversely defined, a comprehensive theoretical model underlines the "net of competences" (Fahrenbach et al., 2019). Fourth, as professional competences may be only seen in everyday action, practice, or activity, the ICT-tool scaffolds the interaction of applicants and assessors. Fifth, the theoretical content model of this prototype consists of 32 different competence dimensions divided by four main categories, namely "personal competence", "social competence", "domain competence", and "method competence" which resemble common European competence taxonomies (Le Deist and Winterton, 2005). Sixth, the core of this prototype is a self-assessment with about 200 items, an interface to upload documents to build a portfolio, and an interface for external assessment. Seventh, through this, professional associations evaluate the self-assessment and portfolio of the applicant, and can ask the applicant to demonstrate his or her professional competences in action via simulation methods. At this point of time, the ICT-tool is currently available in a demo version for testing purposes for the Austrian Federal Economic Chamber.

6. Conclusion and outlook

In this paper, we have outlined the theoretical foundations or kernel theories for an ICT-tool to assess professional competences from a design science perspective. We reviewed literature on the validation of prior learning, different forms of learning outcomes, professional competences, and discussed implications for the assessment of professional competences. In so doing, we contribute a theoretical base that scaffolds the design of ICT-tools to assess professional competences. This can serve as a starting point for practical design projects in the field. Consequently, further research may strengthen the theoretical foundations we sketched in this paper, use the findings of this paper this to design respective ICT-tools that support the assessment of professional competences, and explore how new technologies such as machine learning or the blockchain technology can support the validation of prior learning and the assessment of professional competences.

Acknowledgements

This work was partially funded by the EU H2020 program under MSCA-RISE agreement 645751 (RISE BPM), FFG Austrian Research Promotion Agency (project number: 866270), UNIRIO (PQ-UNIRIO N01/2018) and IAGF – eine Lernende Organisation (project number: 27001223).

References

Alvesson, M. (2004), *Knowledge work and knowledge-intensive firms*, Oxford University Press, Oxford, New York.

Baeten, M., Dochy, F. and Struyven, K. (2008), "Students' approaches to learning and assessment preferences in a portfolio-based learning environment", *Instructional Science*, Vol. 36 No. 5/6, pp. 359–374.

Benner, P. (1984), *From novice to expert, excellence and power in clinical nursing practice*, Menlo Park, CA: Addison-Wesley.

Bjørnåvold, J. (2000a), "Making learning visible. identification, assessment and recognition of non-formal learning", *Vocational Training: European Journal*, Vol. 22, pp. 24–32.

Bjørnåvold, J. (2000b), *Making learning visible: Identification, assessment and recognition of non-formal learning in Europe, CEDEFOP reference document*, Office for Official Publ. of the Europ. Communities, Luxembourg.

Blackler, F. (1995), "Knowledge, Knowledge Work and Organizations. An Overview and Interpretation", *Organization Studies*, Vol. 16 No. 6, pp. 1021–1046.

Bohlinger, S. (2017), "Comparing Recognition of Prior Learning (RPL) across Countries", in Mulder, M. (Ed.), *Competence-based Vocational and Professional Education: Bridging the Worlds of Work and Education*, *Technical and Vocational Education and Training*, Springer International Publishing, Cham, s.l., pp. 589–606.

Boyatzis, R.E. (1982), *The Competent Manager: A Model for Effective Performance*, Wiley.

Brint, S. (2001), "Professionals and the Knowledge Economy: Rethinking the Theory of Postindustrial Society", *Current Sociology*, Vol. 49 No. 4, pp. 101–132.

Burgoyne, J.G. (1993), "The Competence Movement: Issues, Stakeholders and Prospects", *Personnel Review*, Vol. 22 No. 6, pp. 6–13.

Campion, M.A., Fink, A.A., Ruggeberg, B.J., Carr, L., Phillips, G.M. and Odman, R.B. (2011), "Doing Competencies Well. Best Practices In Competency Modeling", *Personnel Psychology*, Vol. 64 No. 1, pp. 225–262.

Capaldo, G., Iandoli, L. and Zollo, G. (2006), "A situationalist perspective to competency management", *Human Resource Management*, Vol. 45 No. 3, pp. 429–448.

Cedefop (2015), *European guidelines for validating non-formal and informal learning, Cedefop reference series*, Vol. 104, Second edition, Publications Office, Luxembourg.

Cedefop, European Commission and ICF (2017), *European inventory on validation of non-formal and informal learning - 2016 update-: Synthesis report*, Luxembourg.

Chaiklin, S. and Lave, J. (Eds.) (1993), *Understanding practice*, Cambridge University Press, Cambridge.

Chomsky, N. (1965), *Aspects of the theory of syntax, Special technical report of the Research Laboratory of Electronics of the Massachusetts Institute of Technology*, Vol. 11, 19. pr, MIT Press, Cambridge/Mass.

Colardyn, D. and Bjornavold, J. (2004), "Validation of Formal, Non-Formal and Informal Learning: policy and practices in EU Member States", *European Journal of Education*, Vol. 39 No. 1, pp. 69–89.

Cook, S.D.N. and Brown, J.S. (1999), "Bridging Epistemologies. The Generative Dance Between Organizational Knowledge and Organizational Knowing", *Organization Science*, Vol. 10 No. 4, pp. 381–400.

Council of the European Union (2008), *Recommendation of the European Parliament and of the Council on the establishment of the European Qualifications Framework for lifelong learning*.

Diedrich, A. (2013), "Translating validation of prior learning in practice", *International Journal of Lifelong Education*, Vol. 32 No. 4, pp. 548–570.

Dreyfus, H.L. and Dreyfus, S. (1986), *Mind Over Machine*, Free Press.

Engeström, Y. (1993), "Developmental studies of work as a testbench of activity theory: The case of primary care medical practice", in Chaiklin, S. and Lave, J. (Eds.), *Understanding practice*, Cambridge University Press, Cambridge, pp. 64–103.

Engeström, Y. (2001), "Expansive Learning at Work: Toward an activity theoretical reconceptualization", *Journal of Education and Work*, Vol. 14 No. 1, pp. 133–156.

Eraut, M. (1994), *Developing professional knowledge and competence*, Falmer Press, London, Washington, D.C.

Eraut, M. (2004), "Informal learning in the workplace", *Studies in Continuing Education*, Vol. 26 No. 2, pp. 247–273.

European Commission, Cedefop and ICF International (2014), *European Inventory on validation of non-formal and informal learning: Final synthesis report*, available at: http://libserver.cedefop.europa.eu/vetelib/2014/87244.pdf.

European Union (2006), "Decision No.1720/2006/EC of the European Parliament and of the Council of 15 November 2006.", *Official Journal of the European Union*.

European Union (2012), "Council recommendation of 20 December 2012 on the validation of non-formal and informal learning", *Official Journal of the European Union*, pp. 1–5.

European Union (2017), *Recommendation on the European Qualifications Framework for lifelong learning*, and repealing the recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the

European Qualifications Framework for lifelong learning., Official Journal of the European Union, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017H0615(01)&from=EN.

Fahrenbach, F., Kaiser, A. and Schnider, A. (2019), "A Competence Perspective on the Occupational Information Network (O*NET)", in Bui, T. (Ed.), *52th Hawaii International Conference on Systems Science*.

Gärtner, C. (2013), "Cognition, knowing and learning in the flesh: Six views on embodied knowing in organization studies", *Scandinavian Journal of Management*, Vol. 29 No. 4, pp. 338–352.

Gherardi, S. (2006), *Organizational knowledge: The texture of workplace learning, Organization and strategy*, Blackwell, Malden, Mass.

Gherardi, S. and Strati, A. (2017), "Talking about competences: that something which exceeds the speaking subject", in Sandberg, J., Rouleau, L., Langley, A. and Tsoukas, H. (Eds.), *Skillful Performance: Enacting Capabilities, Knowledge, Competence, and Expertise in Organizations (Perspectives on Process Organization Studies)*, Oxford University Press, pp. 103–124.

Gregor, S. and Hevner, A.R. (2013), "Positioning and Presenting Design Science Research for Maximum Impact", *MIS Quarterly*, Vol. 37 No. 2, pp. 337–355.

Hayek, F.A. (1945), "The Use of Knowledge in Society", *American Economic Review*, Vol. 35 No. 4, pp. 519–530.

Hayton, J.C. and McEvoy, G.M. (2006), "Competencies in practice: An interview with Hanneke C. Frese", *Human Resource Management*, Vol. 45 No. 3, pp. 495–500.

Hevner, A.R., March, S.T., Park, J. and Ram, S. (2004), "Design Science in Information Systems Research", *MIS Quarterly*, Vol. 28 No. 1, pp. 75–105.

Le Deist, F.D. and Winterton, J. (2005), "What Is Competence?", *Human Resource Development International*, Vol. 8 No. 1, pp. 27–46.

McClelland, D.C. (1973), "Testing for competence rather than for "intelligence."", *The American psychologist*, Vol. 28 No. 1, pp. 1–14.

Mulder, M. (2018), "Foundations of Competence-Based Vocational Education and Training", in McGrath, S., Mulder, M., Papier, J. and Suart, R. (Eds.), *Handbook of Vocational Education and Training: Developments in the Changing World of Work*, Springer International Publishing, Cham, pp. 1–26.

Mulder, M., Weigel, T. and Collins, K. (2007), "The concept of competence in the development of vocational education and training in selected EU member states: a critical analysis", *Journal of Vocational Education & Training*, Vol. 59 No. 1, pp. 67–88.

Nonaka, I. (1994), "A Dynamic Theory of Organizational Knowledge Creation", *Organization Science*, Vol. 5 No. 1, pp. 14–37.

Nonaka, I., Toyama, R. and Konno, N. (2000), "SECI, Ba and Leadership. a Unified Model of Dynamic Knowledge Creation", *Long Range Planning*, No. 33, pp. 5–34.

Peffers, K., Tuunanen, T., Rothenberger, M.A. and Chatterjee, S. (2007), "A Design Science Research Methodology for Information Systems Research", *Journal of Management Information Systems*, Vol. 24 No. 3, pp. 45–77.

Polanyi, M. (1966), *The Tacit Dimension*, University Of Chicago Press, Chicago.

Pye, A. (1988), "Management competence in the public sector", *Public Money & Management*, Vol. 8 No. 4, pp. 62–64.

Rothwell, W.J. and Lindholm, J.E. (1999), "Competency identification, modelling and assessment in the USA", *International Journal of Training and Development*, Vol. 3 No. 2, pp. 90–105.

Sandberg, J. (2000), "Understanding Human Competence at Work: An Interpretative Approach", *Academy of Management Journal*, Vol. 43 No. 1, pp. 9–25.

Sandberg, J., Rouleau, L., Langley, A. and Tsoukas, H. (Eds.) (2017), *Skillful Performance: Enacting Capabilities, Knowledge, Competence, and Expertise in Organizations (Perspectives on Process Organization Studies)*, Oxford University Press.

Sandberg, J. and Targama, A. (2007), *Managing understanding in organizations*, Sage, London.

Sandberg, J. and Tsoukas, H. (2011), "Grasping the Logic of Practice. Theorizing Through Practical Rationality", *Academy of Management Review*, Vol. 36 No. 2, pp. 338–360.

Schön, D.A. (1983), *The reflective practitioner: How professionals think in action*, Basic Books, New York.

Schön, D.A. (1990), *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions*, Jossey-Bass.

Shippmann, J.S., Ash, R.A., Batjtsta, M., Carr, L., Eyde, L.D., Hesketh, B., Kehoe, J., Pearlman, K., Prien, E.P. and Sanchez, J.I. (2000), "The practice of Competency Modelling", *Personnel Psychology*, Vol. 53 No. 3, pp. 703–740.

Simon, H.A. (1996), *The sciences of the artificial,* 3. ed., MIT Press, Cambridge, Mass.

Stoof, A., Martens, R.L., van Merriënboer, J.J.G. and Bastiaens, T.J. (2002), "The Boundary Approach of Competence: A Constructivist Aid for Understanding and Using the Concept of Competence", *Human Resource Development Review*, Vol. 1 No. 3, pp. 345–365.

Taylor, F.W. (1911), *The principles of scientific management*, Dover, Mineola, NY.

Tsoukas, H. (1996), "The firm as a distributed knowledge system: A constructionist approach", *Strategic Management Journal*, Vol. 17 No. S2, pp. 11–25.

Tsoukas, H. and Chia, R. (2002), "On Organizational Becoming. Rethinking Organizational Change", *Organization Science*, Vol. 13 No. 5, pp. 567–582.

van der Vleuten, C.P.M. and Schuwirth, L.W.T. (2005), "Assessing professional competence: from methods to programmes", *Medical Education*, Vol. 39 No. 3, pp. 309–317.

Wenger, E. (2000), "Communities of Practice and Social Learning Systems", *Organization*, Vol. 7 No. 2, pp. 225–246.

White, R.W. (1959), "Motivation reconsidered: The concept of competence", *Psychological review*, Vol. 66 No. 5, pp. 297–333.

Winograd, T. and Flores, F. (1987), *Understanding Computers and Cognition: A New Foundation for Design*, Addison-Wesley Professional.

Winterton, J. (2006), "Social dialogue and vocational training in Europe", *Journal of European Industrial Training*, Vol. 30 No. 1, pp. 65–76.

Winterton, J. (2007), "Building Social Dialogue over Training and Learning: European and National Developments", *European Journal of Industrial Relations*, Vol. 13 No. 3, pp. 281–300.

Wright, P. (2001), "Human resources and the resource based view of the firm", *Journal of Management*, Vol. 27 No. 6, pp. 701–721.