Sanna Brauer

Digital Open Badge-Driven Learning – Competence-based Professional Development for Vocational Teachers

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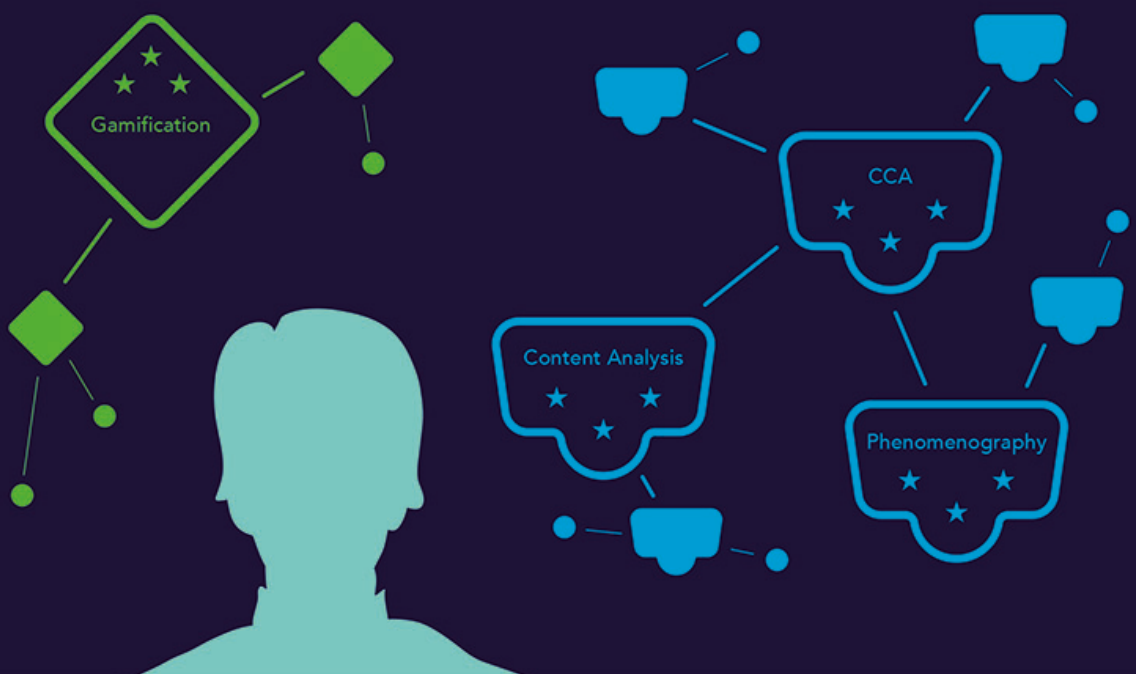

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To Seela. To hearts.

Abstract

Brauer Sanna
Digital Open Badge-Driven Learning
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In the digital era, institutions of vocational education and training (VET) have emerged as transformational and flexible development environments; consequently, it is important to develop digital professional learning opportunities for vocational teachers who need to meet the requirements of their working lives. More research regarding such opportunities is needed in order to find new tools for planning and conducting studies on continuing professional development and to achieve and maintain the versatile competences required in vocational teachers' demanding careers. This study aims to fill a research gap regarding advanced competence-based professional development by investigating the process of digital open badge-driven learning in the context of professional teacher education (vocational teacher education). The research question considers how digital open badges structure the gamified competence-based learning process in the continuing professional development of vocational pre- and in-service teachers. Theoretically, this study draws attention to the motivational effects of digital badging, gamification and the competence-based approach.

The research aimed to explore vocational teachers' different ideas, views and experiences of the competence-based approach to professional development of digital pedagogical competences; it also sought to investigate the structure and process of digital open badge-driven learning. The data were collected from Finnish pre- and in-service vocational teachers (n=29) in 2016 via group online interviews (n=6) and via online questionnaires in 2017 (n=329). The study draws on descriptive mixed research methodologies: qualitative content analysis, constrained correspondence analysis (CCA) and phenomenography. All of these approaches provide researchers with deep conceptual understandings and opportunities to draw new concepts and derive implications for novel educational practices. Further, the latter two studies provide a strong underpinning for further research related to the descriptive quantitative methodology and CCA.

The aim of the first sub-study was to reveal what motivates students in the badge-driven learning process. The study focused on mapping students' experiences of stimulating and supportive digital open badge-driven learning, ultimately determining motivational factors affecting the digital open badge-driven learning process. The findings present a multifaceted model of recognising competence and embracing gamified learning to encourage students' achievement orientation and intrinsic motivation. In the second sub-study, we viewed the process from the perspective of guidance and scaffolding, asking how students experience scaffolding in badge-driven learning. The results indicate that a stage model of scaffolding and instructional badging holds value in structuring the badge-driven learning process. The third study aimed to identify students who were particularly motivated by digital open badge-driven learning. The research question sought to explore what triggers learning in the badge-driven process, with results indicating similarities and differences in experiences based on the achieved skill-set level and competence-development continuum for vocational teachers. The findings also suggest the value of applying gamification and digital badging in the professional development of both pre- and in-service teachers. Based on our findings, we propose digital open badge-driven learning triggered by flexible study options that include customising studies and learning new and up-to-date competences. The final and fourth study further describes vocational pre- and in-service teachers' experiences of the competence-based approach in digital open badge-driven learning. By explaining different aspects of the phenomenon, the study employed both constrained correspondence analysis and phenomenography to deepen our existing knowledge of digital open badge-driven learning. The results describe the impact of the competence-based approach on teachers' professional development during the digital open badge-driven learning process.

Each of the four sub-studies contribute to answering the study's overarching research question: how do digital open badges structure the gamified competence-based learning process in the continuing professional development of vocational pre- and in-service teachers? The primary results from the various sub-studies and theoretical approaches culminate in defining digital open badge-driven learning process grounded on the badge constellation of competences. The entity of digital open badge-driven learning includes learning materials, badge criteria, instructional badging, scaffolding and peer support. This study offers insights into the process structure and layered design for applying the competence-based approach, digital open badges and gamification in professional development. Further, the process approach embodies the ideal of study path customisation and personalisation in order to meet teachers' personal needs for their working lives.

Keywords: Digital Open Badges, Competence-based Approach, Motivation, Gamification, Professional Development, Vocational Teachers

Tiivistelmä

Brauer Sanna
Osaamismerkein ohjautuva oppiminen
– osaamisperusteista osaamisen kehittämistä ammatillisille opettajille
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Digitalisaation aikakaudella ammatillisen koulutuksen oppilaitokset ovat kasvaneet muutoskykyisiksi ja joustaviksi kehittämisympäristöiksi. Siksi on tärkeää kehittää digitaalisia oppimisratkaisuja, jotka vastaavat ammatillisten opettajien työelämästä nousevia osaamistarpeita. Tuoretta tutkimusta ja uusia työvälineitä tarvitaan sekä opintojen suunnitteluun ja toteutukseen että ammatillisilta opettajilta vaadittavan monipuolisen osaamisen saavuttamiseen ja ylläpitämiseen työuran eri vaiheissa. Tutkimuksen tavoitteena on tuottaa uutta tutkimustietoa nykyaikaisesta osaamisperusteisesta osaamisen kehittämisestä tarkastelemalla ja määrittämällä digitaalisin osaamismerkein ohjautuvaa oppimisprosessia ammatillisessa opettajankoulutuksessa. Päätutkimuskysymys on, miten digitaaliset osaamismerkit jäsentävät ammatillisten opettajaopiskelijoiden ja ammatissa jo toimivien ammatillisten opettajien pelillistettyä osaamisperusteista oppimisprosessia ammatillisen osaamisen kehittämisessä. Teoreettinen viitekehys keskittyy digitaalisten osaamismerkkien motivaatioon vaikuttaviin piirteisiin, pelillistämiseen ja osaamisperusteisuuteen.

Tutkimuksessa tarkastellaan, miten ammatilliset opettajat kokevat osaamisperusteisen osaamismerkein ohjautuvan oppimisen digipedagogisen osaamisen kehittämisessä. Tavoitteena on kuvata sen perusteella digitaalisin osaamismerkein ohjautuvan oppimisen rakennetta ja prosessia. Tutkimusaineisto kerättiin suomalaisilta ammatillisilta opettajaopiskelijoilta ja ammatillisilta opettajilta (n=29) vuonna 2016 haastatteluin (n=6) ja vuonna 2017 sähköisellä kyselylomakkeella (n=329). Monimenetelmällisen tutkimuksen menetelmävalinnat (laadullinen sisällön analyysi, rajoitettu korrespondenssianalyysi ja fenomenografia) perustuvat niiden kuvaileviin ominaisuuksiin. Eri lähestymistavat mahdollistavat käsitteellisen ymmärryksen jatkuvan syventämisen ja auttavat kuvaamaan suhteellisen uutta ilmiötä implikoiden samalla tulevaisuuden koulutuskäytäntöjä. Lisäksi kaksi viimeistä osatutkimusta liittyvät erityisesti kuvailevien kvantitatiivisten

menetelmien soveltamiseen ja rajoitettua korrespondenssianalyysia koskevaan lisätutkimukseen.

Ensimmäisen osatutkimuksen tavoitteena on selvittää, mikä digitaalisten osaamismerkkien käytössä motivoi opiskelijoita oppimisprosessin aikana. Osatutkimuksessa keskitytään kartoittamaan opiskelijoiden kokemuksia kannustavasta ja tukevasta osaamismerkein ohjautuvasta oppimisesta, ja sen tavoitteena on määritellä oppimisprosessiin liittyviä motivaationaalisia tekijöitä. Tulokset kuvaavat monitahoisen osaamisen tunnistamisen ja tunnustamisen mallin, joka tukee pelillistettyä oppimista sekä sitä kautta opiskelijan saavutusorientaatiota ja sisäistä motivaatiota. Toisessa osatutkimuksessa tarkastellaan prosessia ohjauksen näkökulmasta kysyen, miten opiskelijat kokevat ohjauksen osaamismerkein ohjautuvassa oppimisessa. Tulokset osoittavat, että vaiheistettu ohjausmalli ja oppimista ohjaavat osaamismerkit jäsentävät osaamismerkein ohjautuvaa oppimisprosessia. Kolmannessa osatutkimuksessa tavoitteena puolestaan on tunnistaa ne opiskelijat, joita malli erityisesti motivoi. Tutkimuskysymys keskittyy selvittämään, mitkä tekijät virittävät (trigger) oppimaan osaamismerkein ohjautuvassa prosessissa. Tulokset kuvaavat eroja ja yhteneväisyyksiä opiskelijoiden kokemuksissa suhteessa saavutettuun osaamistasoon ja ammatillisen opettajan osaamisen kehittämisen jatkumoon. Tulokset ohjaavat soveltamaan pelillistämistä sekä ammatillisessa opettajankoulutuksessa että työuran aikaisessa osaamisen kehittämisessä. Osaamismerkein ohjautuvan oppimisen käynnistävinä triggereinä toimivat joustavat opintomahdollisuudet ja mahdollisuus opintojen yksilöllistämiseen sekä uuden ja ajantasaisen osaamisen saavuttamiseen. Neljäs ja samalla viimeinen osatutkimus syventää käsitystä osaamismerkein ohjautuvasta oppimisesta tarkastelemalla ammatillisten opettajien ja opettajaopiskelijoiden kokemuksia osaamisperusteisuudesta sekä rajoitetun korrespondenssianalyysin että fenomenografisen tutkimusotteen avulla. Tulokset kuvaavat osaamisperusteisuuden ilmenemistä osaamismerkein ohjautuvassa ammatillisten opettajien osaamisen kehittämisessä.

Jokainen osatutkimus tarkentaa osaltaan vastausta päätutkimuskysymykseen: miten digitaaliset osaamismerkit jäsentävät ammatillisten opettajaopiskelijoiden ja ammatillisten opettajien pelillistettyä osaamisperusteista oppimisprosessia ammatillisessa osaamisen kehittämisessä? Eri osatutkimusten ja teoreettisten lähestymistapojen avulla voidaan määritellä digitaalisin osaamismerkein ohjautuva oppimisprosessi, jonka perusta on osaamismerkkijärjestelmä. Osaamismerkein ohjautuvan oppimisen kokonaisuus käsittää myös oppimateriaalit, osaamiskriteerit, ohjaavat osaamismerkit, ohjauksen ja vertaistuen. Tutkimus tarjoaa tietoa kokonaisuuden prosessirakenteesta ja kerrostetun mallin sovellettavaksi osaamisperusteiseen lähestymistapaan, digitaalisiin osaamismerkkeihin ja pelillistämiseen osaamisen kehittämisessä. Lisäksi prosessikuvaus ilmentää yksilöllisten opintopolkujen ja henkilökohtaistamisen merkitystä työelämän osaamistarpeita vastaavan osaamisen kehittämisessä.

Avainsanat: digitaaliset osaamismerkit, osaamisperusteisuus, motivaatio, pelillistäminen, osaamisen kehittäminen, ammatilliset opettajat

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This work was carried out in precisely three years, from 2015 to 2018 at the Faculty of Education, University of Lapland. My expertise has grown continuously within networks of different disciplines, industries and organizations, among incredible talents and inspiring minds. It has been a huge privilege to participate in shared knowledge and engage in intensive, open-minded collaboration with experts and scholars of many professional and scientific backgrounds. Accordingly, there are, indeed, very many people who have contributed to my work and the evolution of this dissertation, and to whom I would like to express my gratitude.

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I would also like to express my sincere gratitude to Adjunct Professor and Senior Scientist Ville Hallikainen from the University of Lapland and the Natural Resources Institute Finland for his inspiration, ideas and cooperation concerning the novel application of constrained correspondence analysis — and, of the most importance, for his inexhaustible patience in guiding us novice researchers. I also wish to thank Jaana Ket-

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To trace it back, the story of my dissertation began in 2006 in Kajaani, where Professor Mauri Ylä-Kotola, the University of Lapland Rector, sowed the seeds for my initial idea of pursuing PhD studies while I was a student in the Masters Programme of Cultural Industry. However, the themes, fields of research, faculty and universities I wished to pursue, have changed over the years before finally proceeding. I wish to thank my mentor, PhD Säde-Pirkko Nissilä, for her persistence in engaging me to finally establish my thesis in the field of education, following the free spirit of multidisciplinary studies in Kajaani.

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I dedicate this work to my daughter Seela for her love and patience during the years I have worked on this research, facing simultaneously the unbearable times of being home-

less, sick and tired. Her heart is solid gold! I'm so proud of her strength and persistence through such a challenging, insecure period of life. No badge could express how awesome she is or show how indebted I am to her. Seela, I love you to Hawaii and back!

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Finally, I would like to thank everyone involved in the development of "Learning Online".

With these sentiments in mind, I would like to close by citing George Siemens (2005, p. 6): *"Our ability to learn what we need for tomorrow is more important than what we know today"*.

Olhava, November 2018
Sanna Brauer

List of Articles

This thesis is based on four articles, which are hereafter referred to as sub-studies I to IV:

Study I

Brauer, S., Siklander, P. & Ruhalahti, S. (2017). Motivation in digital open badge-driven learning in vocational teacher education. *The Journal of Professional and Vocational Education, 19*(3), 7–23.

Study II

Brauer, S., Korhonen, A-M. & Siklander, P. (2018). Online scaffolding in digital open badge-driven learning. Manuscript submitted for publication.

Study III

Brauer, S., Ruhalahti, S., & Hallikainen, V. (2018). Digital professional learning triggers: in an online badge driven process. *Education in the North, 25*(1-2), 64-86. https://www.abdn.ac.uk/eitn/journal/545/

Study IV

Brauer, S., Kettunen, J., & Hallikainen, V. (2018). "Learning Online" for vocational teachers - visualisation of competence-based-approach in digital open badge-driven learning. *The Journal of Professional and Vocational Education: Vocational education and training in the Nordic countries, 20*, 13-29.

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List of Abbreviations

AC	Adobe Connect Web Conferencing Software
CA	Correspondence Analysis
CCA	Constrained Correspondence Analysis
CPD	Continuing Professional Development
DigCompOrg	The European Framework for Digitally Competent Educational Organisations
DigCompEdu	Digital Competence Framework for Educators
ECTS	European Credit Transfer System
ECVET	European Credit System for VET
ICT	Information and Communication Technology
ICT-CFT	UNESCO's ICT Competency Framework for Teachers
ID	Identity Document
LMS	Learning Management System
MOOC	Massive Open Online Course
OBF	Open Badge Factory
PDP	Professional Development Program

SoMe	Social Media
SSL	Skill Set Level
UNESCO	The United Nations Educational, Scientific and Cultural Organisation
USA	The United States of America
VET	Vocational Education and Training
ZPD	Zones of Proximal Development

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1 Introduction

1.1 Digitalisation, Learning and Competence Development

Digitalisation refers to a process in which analogue information and processes are converted into digital format (Brenner & Kreiss, 2014). Day-to-day digital technologies blur the everyday lives of individuals and communities. *Digitalisation is transforming society*, changing how we work, communicate, learn and share knowledge. The literature is replete with evidence examining these changes in working life with concurrent investigations occurring in all disciplines. Due to these significant changes, it has become increasingly important to develop trainings that meet the requirements of digitised working life. Such trainings must increase individuals' capabilities using a sustainable form of *competence-based education and training*. We simply can no longer afford to begin trainings from ground zero. Educational institutions must innovate to meet the requirements of social and technological change while tackling economic challenges (Vähäsantanen, 2015).

New technologies continue to *diversify the ways we work and learn together* (Mattila, Brauer, Arhippainen, & Rantakokko, 2013; Ruhalahti & Kenttä, 2017). In the future, learning will be based on personal study plans and already-achieved competences to a much greater extent. New online applications for learning will enable the visualisation of learning objectives and documentation of achieved skills and knowledge. In such a way, objectives become landmarks on an individualised learning map. Tools to plan and monitor learning vary from digital diaries to online demonstration and documentation of competences. As Redecker (2017) puts it, "Digital technologies enhance the diversity and suitability of assessment formats and approaches" (p. 62). Analysing and interpreting data now extends beyond simple multiple choice online tests, offering promising solutions based on learning analytics (Redecker, 2013; 2017). For instance, *digital open badges* (e.g., Mozilla Open Badges) visualise the achieved competences like levels in games (Abramovich, Schunn, & Higashi, 2013). Students no longer receive credit based on presence or general activity; they have to perform the given tasks and submit evidence of success to receive a grade (Sadler, 2005), complementing the conventional evidence on learner behaviour (Redecker, 2017).

In the future, there will be increasingly numerous ways to develop competences. McClelland (1998; 1973) has referred to *competences as achievement acquired through train-*

ing and development rather than proof of intelligence. Contemporary researchers have studied the domains of *knowledge, skills and abilities* (Nichols, Kobrin, Lai, & Koepfler, 2017) for many years, and this trinity of educational research has great implications for policy makers. The European Reference Framework of Key Competences for Lifelong Learning (European Union, 2007) outlines the concept of "competence" and emphasises not only essential knowledge but also skills and attitudes applied appropriately based on the context. Further, competence can be understood as the ability to apply learning outcomes (knowledge, skills and personal, social and/or methodological abilities) adequately in both educational and workplace contexts as a result of personal or professional development (Cedefob, 2014). Even if competences are acquired differently, they should be assessed equally. Competence framework constructions, such as the ECVET (European Credit System for VET) and the ECTS (European Credit Transfer System in Higher Education), provide tools for *criterion-based competence assessment*. A variety of systems have been introduced to facilitate evaluation processes (Lee, Carberry, Diefes-Dux, Atwood, & Siniawski, 2017).

Different digital pedagogical *competence frameworks* seek to support teaching personnel, educational institutions and policymakers in developing effective and meaningful criterion-based competence development (Kools & Stoll, 2016). Finland has applied the United Nations' Educational, Scientific and Cultural Organisation's (UNESCO, 2011) ICT Competency Framework for Teachers (ICT-CFT) in its national guidelines called Ope.fi. In addition to teachers, UNESCO's ICT-CFT is intended to guide teacher trainers and staff undertaking learning reforms and executing professional development programs. Aiming to reach educational policy makers and to build national competence standards in modern societies, UNESCOs' Framework sets out the competences required to teach effectively with ICT. The framework focuses on the ICT skills needed to generate knowledge that enables reflective and creative problem solving for resourceful citizens who are in charge of their own lives and are active members of society. This study applies the framework in terms of the standards of a qualifying threshold (Sadler, 2005) through the design of the Learning Online professional development program (PDP).

Table 1 explains the framework, as arranged via three different approaches to teaching. Each of these approaches relate to three successive stages of teachers' professional development. UNESCO's framework advances from understanding technology towards the development of learning organisations.

Table 1.

UNESCO's ICT Competency Framework for Teachers (UNESCO, 2011, p. 3)

THE UNESCO ICT COMPETENCY FRAMEWORK FOR TEACHERS			
	Technology literacy	**Knowledge Deepening**	**Knowledge Creation**
Understanding ICT in Education	Policy awareness	Policy understanding	Policy innovation
Curriculum and Assessment	Basic knowledge	Knowledge application	Knowledge society skills
Pedagogy	Integrate technology	Complex problem solving	Self management
ICT	Basic tools	Complex tools	Pervasive tools
Organization and Administration	Standard classroom	Collaborative groups	Learning organisations
Teacher Professional Learning	Digital literacy	Manage and guide	Teacher as model learner

The three successive stages of development emphasise that teachers should become able to enhance collaboration, creativity and problem solving among students using ICT. UNESCO (2011, p. 3) describes these three stages as follows:

> The first is *Technology Literacy*, enabling students to use ICT in order to learn more efficiently. The second is *Knowledge Deepening*, enabling students to acquire in-depth knowledge of their school subjects and apply it to complex, real-world problems. The third is *Knowledge Creation*, enabling students, citizens and the workforce they become, to create the new knowledge required for more harmonious, fulfilling and prosperous societies.

These development stages recently have been augmented by the European Framework for Digitally Competent Educational Organisations (DigCompOrg) promoting effective learning in the digital era (Kampylis, Punie, & Devine, 2015) and the Digital Competence

Framework for Educators (DigCompEdu; see Figure 1) proposing educator-specific digital competences (Redecker, 2017). Figure 1 presents teachers' desirable digital competences, as determined by DigCompEdu, including 22 different competences organised into six areas.

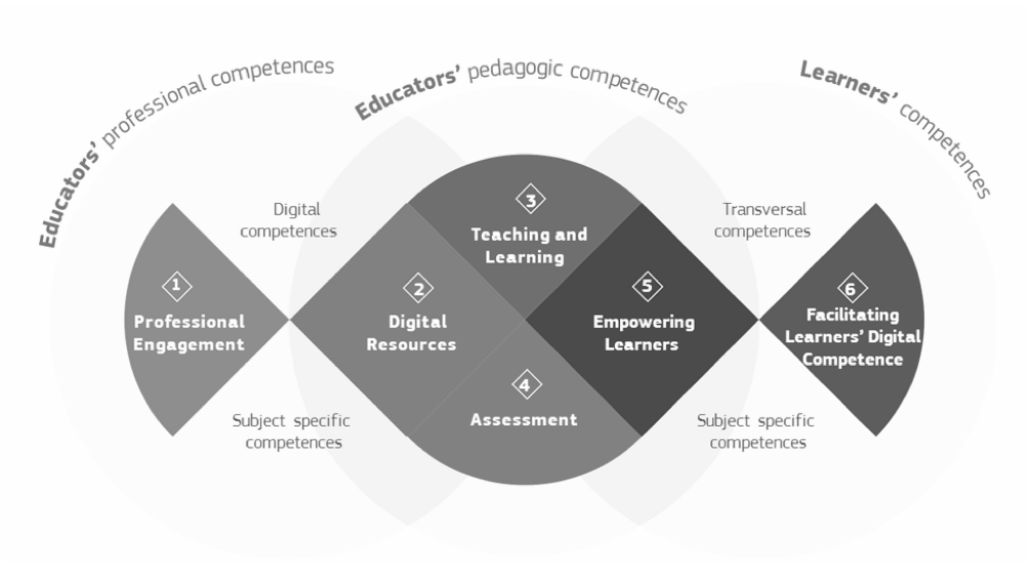

Figure 1.
Digital competence framework for educators: Areas and scope (Redecker, 2017, p. 15).

The framework includes digital resources and offers to facilitate the learner's digital competences. It also discusses assessment strategies, such as formative assessment, summative assessment and related digital technologies that scaffold learning like ePortfolios (Redecker, 2017). However, it is important to note that it does not focus on technical settings or particular skills.

The continuing emergence of new frameworks illustrates how criterion-based competence assessment can never be set in stone, but instead requires continual updating (Sadler, 2005). Still, frameworks offer guidelines for the various processes of integration occurring with digital learning technologies across Europe. This thesis presents evolving frameworks in order to visualise the competences that have been "badgetised" in the Learning Online PDP as well as to inform the construction of competences in the future. More importantly, the thesis also describes the frameworks and defines assessment in terms of educators' pedagogic competences (Fig. 1) in relation to teaching, learning and digital technologies. Kools and Stoll (2016) propose the embedding of professional development into daily practices in order to support teachers' sustainable professional development. Weaving digitalisation into teaching practices remains a common challenge for educational sectors throughout Finland, one that requires support for practical implementation and continu-

ing professional development both in terms of pedagogical and technological competences (Hietikko, Ilves, & Salo, 2016; Karento, Kullaslahti, & Töytäri, 2015; Koramo, Brauer, & Jauhola, 2018; Tanhua-Piiroinen et al., 2016; Ruhalahti & Kenttä, 2017).

Professional development and the digitalisation of vocational education impose new demands on teachers' competences in digital pedagogy and efficient use of ICT (Koramo et al., 2018; Ruhalahti & Kenttä, 2017). At the same time, these evolving technologies and the digitalisation of learning activities offer to support learning at a time when there is great pressure to develop such competences. Although Finnish society is considered to be advanced in terms of digitisation and the exploitation of new technologies, teachers often do not apply technologies and new pedagogical solutions in their own work to the full potential (Tanhua-Piiroinen et al., 2016).

Recent reports (Koramo et al., 2018; Ruhalahti & Kenttä, 2017) show that Finnish teachers have a basic knowledge of digitalisation and hold positive attitudes about developing digital pedagogical competences. Still, more complex skills and knowledge are required in the field of vocational education and training. The advancement of intelligent technologies should be taken into account in the continuing professional development of competences (Ruhalahti & Kenttä, 2017). More research is needed to find *new tools for planning and conducting studies on continuing professional development (CPD)*, and more importantly, *to achieve and maintain the versatile competences required* in the demanding working lives of teachers.

Taking into account that previously acquired competence is important to the individual in the pedagogical process, Kolkka and Karjalainen (2013) challenge us to think about how the competence-based approach may enhance the joy of learning new things while supporting the teacher's professional growth. This approach may lead to a developmental orientation at work while digitalisation restructures the society at large. Nevertheless, efficient and systematic competence development requires a mutual understanding of the criteria for assessing competences; it is natural that we ask what 'criteria' is needed for a policy to be applied appropriately (Sadler, 2005). In line with knowledge exchange and collaboration, we must study *systems to assess progress* and gaps between *current and expected competences*. It is also important to evaluate the impact of the *competence-based approach* on professional learning. When educational institutions increase their collective capacity to engage in the ongoing assessment of competences, remarkable improvements can be achieved.

1.2 Learning Online – Professional Development for Vocational Teachers

The investigated Learning Online professional development program (PDP) is a gamified, open badges-based MOOC (Massive Open Online Course). The MOOC aims to

support teachers of vocational education and training (VET) in applying new technologies and strategies to teaching and learning in online, hybrid and face-to-face learning environments (Brauer, Siklander, & Ruhalahti, 2017). In Learning Online, digital open badges offer novel possibilities in *identifying and recognising digital pedagogical competences* independent of how they were acquired. The design consideres several other aspects of modern cultures in the 21st century, including *digitalisation*, the meaningful use of *gamification* in learning and public sharing of expertise in order to support shared learning within work communities. The Learning Online concept was built during an OsaOppi-project funded by the Finnish National Agency for Education (EDUFI) in 2014 and has been in development ever since.

The original aim of the Learning Online initiative was to develop inspiring in-service training for vocational teachers by implementing new methods of easy-access online learning. In 2014, two schools of professional teacher education (Oulu University of Applied Sciences and HAMK University of Applied Sciences) joined forces with the VET provider Omnia, the Joint Authority of Education in Espoo. Together, partners sought to restructure the CPD to design a competence-based PDP that would support teachers in building working life ICT skills and knowledge. As the scheme of continuing professional development should reflect the sum of competences required from teachers (Day, 2017), the foundation of the PDP rests on competence criteria following the national guidelines (Ope.fi) adapted from UNESCO's ICT-CFT. In Learning Online, the three successive stages follow a level structure: SoMe-Novice, SoMe-Expert and SoMe-Developer (I, II and III, SoMe referring to Social Media). The levels refer to skill sets of personal development, shared expertise and strategic development on the organisational level (Table 1). One cornerstone of the design involved creating an educational setting that would encourage the participants to apply acquired skills and knowledge immediately in practice (Brauer, Kettunen, & Hallikainen, 2018).

In Learning Online, digital open badges visualise the requisite skill-set levels in a way that allows the participants to plan and customise their personal study paths (see also chapter 2.2 Digital Open Badges). The participants apply for competence-based digital badges by providing the required evidence of the competence in question. The assessment process is transparent and egalitarian as teacher trainers from different schools of professional teacher education collaboratively facilitate the application and issuing process in the open badge management system (Open Badge Factory). Scaffolding is provided related to the remediation and rejection of badge applications. Participants are also engaged in a Facebook-based study group. In Learning Online, learning materials and badges are easily accessible 24/7 online and open to anyone interested in developing digital pedagogy and vocational training. All contents are openly licensed with Creative Commons. Themed learning materials supplement instructional badge-criteria and are tagged for different search options. One purpose of the initial pilot was to offer an economical example of an open online education implementation designed by average teacher trainers

without specific technological expertise (such as coding skills) while using free online products and services. The Learning Online landing site is simply a free Wordpress blog (http://www.oppiminenonline.com/), and the tools used to monitor learning were built from different gadgets available on the site and Google tools, such as Forms.

The working group also was keen on applying gamification in online learning. In Learning Online, digital open badges represent a main tool of the game design (Brauer & Siklander, 2017; Deterding, 2015). After thorough research and comparisons between different technical settings, designers settled on Mozilla Open Badges and Open Badge Factory to power the game engine of Learning Online. Badges visualise the requisite skill sets levels: "I-III...bronze, silver and gold and are earned by achieving 10, 25 and 45 badges, respectively" (Stockley, Lius, & Brauer, 2017, n. p.). Each basic badge belongs *to a constellation of similarly-themed badges* encouraging the teachers to continue to develop their competences and reach the next skill set level. Further, the design aimed to support a community experience and inclusion in terms online study groups and competition between locational teams. A live leaderboard is displayed on the site to motivate competitors "to go the extra mile" while first place competitors seek to keep their lead (Stockley et al., 2017, n. p.). Badges also provide a chance to promote a meaningful learning experience; sense of community, and the experience of inclusion, equality (Mäki et al., 2015).

Over the years, the project grew to provide an open access educational setting open to anyone interested in developing vocational education and training, teachers' ICT-competences and digital open badging. Since 2015, badges have been piloted in professional teacher education qualification programs for VET pre-service teachers, and the results speak for themselves. By June 2018, users have applied for (and received evaluations for) 16270 Learning Online Badges. 2868 applications (~18%) were rejected, and teacher trainers guided the applicants towards the intended learning outcomes. The badge criteria have been examined 73673 times, with acceptance rates (where the badge receiver transfers the badge to a badge repository) currently at 92%.

The goal was to develop the use of open badges as an accreditation of teachers' ICT-competence development and to execute an inspiring form of gamification. The program exceeded all intended learning outcomes in the first year both in terms of quantity and quality. Moreover, the PDP was awarded the 2015 eEemeli Quality Prize in an annual eLearning competition organised by the Association of Finnish eLearning Centre (https://www.eoppimiskeskus.fi/en/) for improving the quality of eLearning operations and activities in Finland. Obviously, digital open badges have become a successful tool in Finland for fostering vocational teachers' professional development. Interest in badging shows no sign of slowing down in the immediate future as the National Initiative of Teacher's Badges follows in the footsteps of Learning Online by offering to create and establish "a national digital badges system to support the recognition and acknowledging of professional competences of vocational teachers during their teacher studies as well as their entire professional career" (HAMK, 2018, n.p.).

1.3 Researcher's Position

From my perspective, I've had the optimum place to study, develop and report on digital open badge-driven learning. I have benefitted from fascinating opportunities to learn, grow and share knowledge. The impetus for this research was the significant success of the Learning Online PDP; in essence, the learning outcomes exceeded all goals set for the program. During the initial stages of the process, I served as a senior lecturer of professional teacher education at the Oulu University of Applied Sciences and as the project manager of the CPD responsible for the design and implementation of the investigated PDP.

I began to write up this research in 2017 after collecting data from 2016–2017. The opportunity to work with experts in a variety of fields helped me to make methodological choices as the research progressed. Table 2 describes the contributions made by co-authors in the sub-studies featured in this compilation.

Table 2.

Description of Authors' Roles and Contributions to Each Research Article

	S. Brauer's Contribution	Other Authors' Contributions
Study I	• Collected and analysed the data • Interpreted the results • Wrote the bulk of the manuscript • Wrote up and finalised the article • Revised the article based on the review process	• Second author revised the theoretical framework and results of the analysis and provided methodological guidance • Third author contributed to the theoretical framework and revised the results and analysis sections as well as the overall structure of the article
Study II	• Collected and analysed the data • Interpreted the results • Wrote the majority of the manuscript • Wrote up and finalised the article • Revised the article based on the review process	• Second author contributed to the theoretical framework and revised the results and analysis sections as well as the overall structure of the article • Third author revised the theoretical background, analysis, and results sections while providing methodological guidance
Study III	• Collected the data • Interpreted the results • Wrote the majority of the manuscript • Wrote up and finalised the article • Revised the article based on the review process	• Second author contributed to the theoretical framework, revised the results and analysis sections and took part in the review process • Third author reviewed the questionnaire, analysed the data and provided meticulous methodological guidance

	S. Brauer's Contribution	Other Authors' Contributions
Study IV	• Collected quantitative and qualitative data • Analysed the qualitative data • Interpreted the results • Wrote the majority of the manuscript • Wrote up and finalised the article • Revised the article based on the review process	• Second author contributed to the co-analysis of the qualitative data, revised the theoretical background and results of the analysis, provided methodological guidance and revised the overall structure of the article • Third author reviewed the questionnaire, analysed the quantitative data and provided methodological guidance

During the different stages of the research, I also had an opportunity to take an in-depth look at my own role as a researcher. My topic has grown along with my work, and some of my writing (e.g., chapter 1.2) serves as documentation for the project I managed as a leader.

Writing this dissertation has challenged my own competences, leading me always to wonder: is there something more I should look into, something I do not know yet? Would such an investigation result in more authentic findings? Xerri (2018a) presents a dual model for teachers to use when constructing the extensive knowledge of literacy required to perform research. First, a teacher must decide to do research after considering their attitudes and beliefs about the process. Second, research literacy also involves the knowledge and skills required to do research in an effective manner (Xerri, 2017; 2018b). For me, the versatile handling of multi- and interdisciplinary literature has been one of the most enjoyable tasks in the researcher process. Fundamentally, teachers should be able to develop teaching and learning through systematic investigation of their own work (Borg, 2013).

In general, the current epoch pushes us to consider novel and more complex approaches to learning. I have enjoyed contemplating the era of digitalisation philosophically; the various interpretations and controversies drew me to the subject. Palak and Walls (2009) have investigated the relationship between teachers' beliefs and educational technology practices, concluding that it is important to be sensitive to context-specific factors. For instance, some studies have concluded that effective integration of ICT technologies push teaching and learning towards the constructivist pedagogical paradigm and student-centred practices (Becker & Ravitz, 1999; Becker, 2000; Becker, 2001; Dexter, Anderson, & Becker, 1999; Matzen & Edmunds, 2007; Palak & Walls, 2009; Ravitz, Becker, & Wong, 2000). As Devedžić and Jovanović (2015) point out, digital badges are "fully aligned with and supportive of the notion of Digital Learning Ecosystems (Laanpere, Pata, Normak,

& Poldoja, 2014) and the practice of Connected Learning (Ito et al., 2013) that put the learner in the center and give them significant freedom and flexibility in shaping their learning environments" (p. 605). Furthermore, Case (2015) challenges us to re-think the contemporary pedagogical model of 'student-centred teaching' in terms of whether we will end up seeking to please students who have become 'satisfied' customers enjoying gamified learning experiences to the full extent (Kelly, 2011). If learning is not commercialised, the substantive sociological theory of interaction at least suggests that we consider the relationship between the operation and structures (e.g., Case, 2015; Piiroinen, 2013; Williams, 2012), challenging the researcher to look at the topic more broadly.

1.4 Research Addressing the Gap

Digital open badges offer to recognise "the expanded landscape of learning" (Grant, 2014, p. 5) and empower alternative ways of acquiring knowledge and skills (Devedžić & Jovanović, 2015; Knight & Casilli, 2012). Badge-related research general focuses on revealing why and how badges work (or don't) in terms of improving learning outcomes (e.g., Abramovich et al., 2013; Hrastinski, Cleveland-Innes, & Stenbom, 2018; Reid, Paster, & Abramovich, 2015). Effective badge design is complex by nature with different mechanics and psychological factors affecting the identification and recognition of competences and eventual earning of badges (McDaniel & Fanfarelli, 2016). Regardless of the approach, studies often emphasise theoretical concepts and approaches to motivation (e.g., Gamrat, Zimmermann, Dudek, & Peck, 2014; McDaniel & Fanfarelli, 2016). Further, digital open badges are considered promising for visualisation of studies (Hickey, Willis III, & Quick, 2015) and competences achieved.

The competence-based assessment process of digital badging takes place on a learning management system (LMS) that was originally designed to support open badge management instead of learning activities (Brauer & Siklander, 2017). Previous research related to digital open badge-driven learning has focused on this initial process of digital badging, the essence of issuing and receiving badges (Hrastinski et al., 2018). The approach underscores the technical possibilities of badges as carriers of rich metadata (Newby, Wright, Besser, & Beese, 2016), but the lack of pedagogical dimensions limit badges to becoming mere certificates or proof of participation (Abramovich et al., 2013) at the expense of competence authentication. However, the pedagogical methods and choices related to gamified badge-driven learning have not been studied extensively.

The majority of badge studies (e.g., Abramovich, 2016; Barata et al., 2013; Brauer & Siklander, 2017; Hamari, 2017; McDaniel & Fanfarelli, 2016) have noted that badges are a feature of gamification that could be applied to non-game contexts. The digital media industry launched the term *gamification* (Deterding, Khaled, Nacke, & Dixon, 2011), the idea of offering gamified applications for large audiences (Deterding, Dixon,

Khaled & Nacke, 2011). Gamification emerged from human-computer interaction and game studies (Deterding, 2012), and Hamari, Huotari and Tolvanen (2015) assert that it is the notion of "affording gameful experiences or using design reminiscent of games" (p. 139). Confirming this concept, Deterding et al. (2011) state that gamification "calls attention to phenomena of 'gamefulness', which should be considered as complementary to but distinct from playfulness" (p. 13). Still, the idea of gamification differs from serious gaming and full-fledged serious games, which make use of the motivating and enjoyable qualities of gaming for non-entertainment purposes (Michael & Chen, 2005); researchers have not yet studied game qualities or game design processes in other settings (Deterding, 2015). Consequently, there is growing interest in gamification as an emergent cross-disciplinary field of research (Nacke & Deterding, 2017). According to Hämäläinen, Niilo-Rämä, Lainema and Oksanen (2018), there is little research referencing different applications of game mechanics that support educational purposes. Nacke and Deterding (2017, p. 450) summarise the previous gamification research as consisting of the following: 1) definitions, frameworks and taxonomies for gamification and game design elements; 2) technical papers describing systems, designs and architectures; and 3) effect and user studies of gamified systems (cf. Hamari, Koivisto, & Sarsa, 2014; McDaniel & Fanfarelli, 2016; Seaborn & Fels, 2015). Within these studies, Hamari (2017) points out significant qualitative divergence (cf. Hamari, Koivisto, & Pakkanen, 2014; Hamari, Koivisto, & Sarsa, 2014).

Previous studies mainly emphasise the positive effects of gamification. Hyrynsalmi, Smed and Kimppa (2017) have noted that there is a serious research gap regarding the negative aspects of the phenomenon. Nonetheless, they suggest focusing more on the possibilities than on areas for improvement in gameful applications. As such, designing engaging forms of gamification to support motivation in nongame systems represents an emerging interest for practitioners and researchers (Deterding, 2012; 2015; Hamari, 2017). Hamari (2017) notes an interesting under-researched area in terms of "how badges affect user behaviour in a gamification setting where users are not predisposed to gaming" (p. 470). According to Deterding (2015), there exists little research-based guidance on designing gameful systems, still, a growing number of gamified applications are released in non-game contexts in order to affect user motivation (Deterding, 2011). To this end, this study aims to provide a detailed description of various aspects in the gamified digital open badge-driven learning context.

The previous paragraphs have addressed the scant research directly related to gamified digital open badge-driven learning. However, there exists a solid ground of preceding studies regarding motivation and educational psychology, the important and frequently-studied concept of scaffolding, and even the competence-based approach. The emerging world of digital badging is growing as anyone can create badges and recognise the achievements of others (Mozilla Open Badges, 2017); consequently, there is strong demand for guidelines and digital pedagogical models for educators to follow and apply.

This study seeks to fill the research gap by providing a structure for digital open badge-driven learning in the continuing professional development of vocational pre- and in-service teachers. It considers this gap in relation to different theoretical concepts linked to digital open badges, gamification, motivation and the competence-based approach. The research questions originate from the success of the Learning Online PDP and the previously discussed research gap. The study contributes to the current educational discourse on the competence-based approach, assessment and professional development. The study identifies new learning environments on learning management systems. The work also draws heightened attention to gamification in educational contexts. Figure 2 illustrates the relationship between different approaches and research themes in this study.

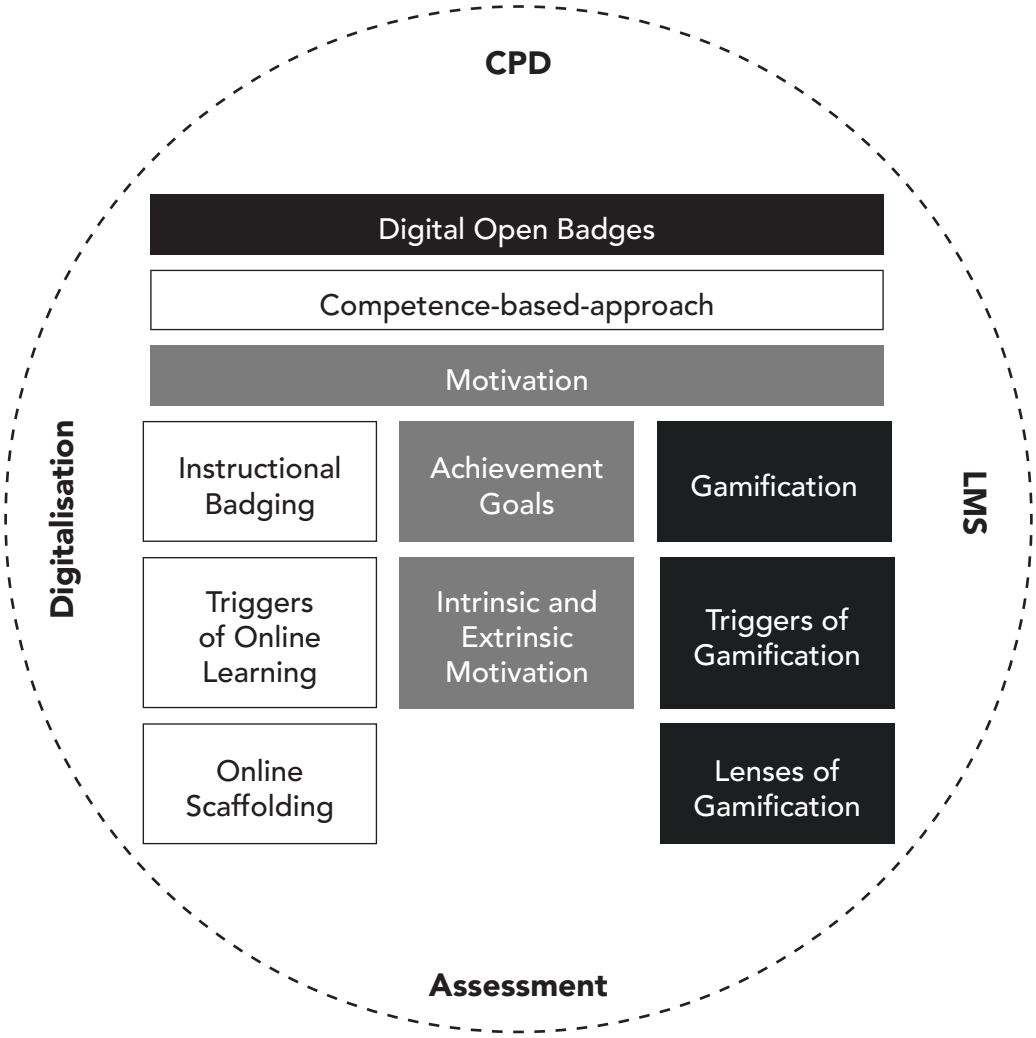

Figure 2.
Theoretical concepts and research themes.

This study considers digitalisation and the development of CPDs, related LMSs and assessments as a topical frame of the evolving practices. Figure 2 represents them in the form of a cycle; however, they should be considered iterative and interactive, not static. The present study examines all of the functions and concepts investigated in relation to digital open badges. Moreover, Figure 2 explains this approach as stacks and layers forming relationships between the different concepts examined. In this study, the competence-based approach is subordinate to digital open badges as badges can be awarded based on criteria other than skills and knowledge. Views on motivation are limited by the competence-based approach and emphasised, for instance, in terms of how gamification affects the learning process. Moreover, the rest of the theoretical key concepts are considered transformable attributes, depending on the approach of the specific research question. Nonetheless, Figure 2 serves as a reference of how the approaches are emphasised in relation to each other in this study.

In particular, the present study aims to meet the following objectives:

1. Examine variables affecting motivation in digital open badge-driven learning (sub-studies I & III)
2. Explore the stages of scaffolding in digital open badge-driven learning (sub-study II)
3. Identify the triggers of gamified digital open badge-driven learning (sub-studies I-IV)
4. Build knowledge about teachers varying experiences with the competence-based approach in digital open badge-driven learning for professional development (sub-study IV)
5. Structure the digital open badge-driven learning process based on the study findings

The thesis sets out to define the different qualities of digital open badge-driven learning and the overall structure of the learning process in order to design competence-based approaches that can engage the full potential of digital badging.

2 Theoretical Concepts and Approaches to Digital Open Badge-Driven Learning

This research holds the ontological view that *the world exists*, even if different people construct it in varying ways (Marton, 1981; Pang, 2003). In this study, I consider the vocational teacher to be an active independent actor, one whose basic pillar of professional development involves lifelong learning. The selected theoretical framework aligns with a competence-based approach in the era of digitalisation, one that therefore is not suitable for all assessment models.

Conducted in the context of Finnish higher education, this study focuses on competence-based professional teacher education, particularly the competence-development continuum for vocational teachers. I consider learning theories to be part of the teacher's individual learning conceptions, which become visible in the teacher's work (Perunka, 2015). This study grounds itself in humanistic learning theories, experiential learning and constructivism, all of which emphasise the individual construction of knowledge (Perunka, 2015).

2.1 The Competence-based Approach in Professional Development and Learning

Competence-based assessment is an effective criteria-based approach to educational grading policies (Sadler, 2005). Mäkinen and Annala (2010) define paradigmatic differences between the concepts of *competency and competence*, connecting the concept of competence into different standards and frameworks that offer to enhance assessment of learning outcomes. Further, they define competency as a concept that refers to the potential of an individual as a whole. In this study, *competence* has been the key factor determining the theoretical approach since the very beginning, clarifying the focus of the study.

The process of competence-based assessment involves ongoing procedures for identifying and recognising skills and knowledge based on standardised criteria for demonstrating required evidence. Here, *criteria* should be understood as a distinct tool, with attributes and rules for judgement (Sadler, 2005). From the practical point of view, Kilja (2018) emphasises the necessity for learners to demonstrate the required competences

in their working lives. In this way, the achieved competences are assessed rather than being mere quantitative demonstrations of students' presence or understanding of information. Students may acquire skills in different learning environments, in various ways and at various paces. Students' earlier achievements or other students' performance on the same or equivalent assignments should not interfere with criteria-based judgements (Sadler, 2005). Assessment can be perceived as a "classification of the level of a student's performance" (Sadler, 2005, p. 176), involving both the quality and extent of the student's achievement. Still, Bartel, Figas and Hagel (2015) consider competence-based learning activities comparable to the scenario of players needing to finish a challenge in time in order to achieve a high performance rating.

As an example, a vocational student of carpentry would be able to demonstrate his or her skills in the form of a wooden chair, independent of how that skill was achieved (e.g., formal or non-formal education, a hobby). During the identifying process for competences, students self-evaluate their existing knowledge and skills according to their intended learning outcomes. The assessment should identify the skills acquired in working and everyday life while acknowledging the whole set of competences acquired. However, assessment models based on individual student performance are not directly applicable to community-based knowledge building and networking or learning and collaboration in social communities (Sadler, 2005; Vartiainen, 2015).

In education, there currently is a fundamental shift from traditional testing of knowledge towards assessment of learning and new grading systems; this shift has been ongoing for more than two decades (Lindblom-Ylänne, Pihlajamäki, & Kotkas, 2006). Redecker (2017) claims that "assessment can be a facilitator or bottleneck to innovation in education" (p. 21). In professional teacher education, identification and recognition of competences is of primary importance, a reflective process that supports the emergence of professional identity while helping to deepen already-acquired competences (Kolkka & Karjalainen, 2013). In the process of identification, the student seeks to understand the competences he/she has acquired in different ways and to structure them in relation to the learning objectives in order to better describe and demonstrate skills (ARENE, 2009). The competence-based approach relates to professional teacher training and professional development not only through identification and recognition of competences, but also through evolving pedagogical choices, digital learning solutions and evaluation processes. These features help students to perceive the competence-based approach as a concept and practice grounded in personal experience.

The competence-based approach already was popular in teacher education in the 1970's in the USA (Whitty & Willmont, 1991). Although the idea of competence-based education has been the subject of ongoing debate in various disciplines, critical analysis and practical applications remain lacking (Lans, Hulsink, Baert, & Mulder, 2008; Malone & Supri, 2012). The core issue has been whether or not the competence-based approach benefits the learner. According to Malone and Supri (2012), the competence-based ap-

proach aims to "increase the rigour and relevance of the curriculum, move students beyond a focus on the memorisation and regurgitation of scientific facts, and better enable them to understand scientific principles and apply them to the practice" (p. 241). Educators and trainers across the world have recommended the adoption of competence-based education in various disciplines and curricula (e.g., Boritz & Carnaghan, 2017; Fan, 2017; Zaytseva, 2017). Recent studies even have taken a stand on the competence-based approach, in the curriculum (Laajala, 2015), in the development of supervision methods (Perunka, 2015) and in enhancing the personalisation of studies (Kilja, 2018).

Legislation has not specified a path for the competence-based approach in Finnish professional teacher training. Nevertheless, institutions of higher education generally have policies for official examination, assessment and grading (Sadler, 2005); however, these policies tend to differ in terms of theory and practice. In Flanders, Belgium, researchers set up an online survey to ascertain the best approach to competence-based teacher education (Struyven & De Meyst, 2010). Urged by a decree from the government, they noticed that particularly more "experienced and subject expert teacher trainers tend to adopt the competence-based approach more often than do younger colleagues and pedagogues" (p. 1495). They found competences presented in the institutions' policies inconsistent with those applied in practice. Results by Struyven and De Meyst (2010) suggest that "teacher trainers tend to take four different approaches to the implementation of competences: (1) during [their] internship, (2) through the institution's policy and program planning, (3) by means of their integration into both the theoretical and practical components of the curriculum and finally, (4) a lack of implementation because the competences are considered insufficiently applicable by the teacher trainers" (p. 1495). Further, Sadler (2005) argues that "there is no common understanding of what criteria-based means or what it implies for practice" (p. 175); as a result, he claims that it is immaterial whether policies are institution-wide or bound to a single department or school.

The great autonomy of Finnish teachers highlights their responsibility to take care of their own competences. The skills and knowledge acquired during professional teacher training (60 ECTS credits to gain a teacher's qualification) are insufficient for the lifetime career of a vocational teacher. Teachers need skills in digital pedagogy along with discipline-specific digital competences that enhance innovative teaching and technology use (European Commission, 2017). *The current methods of continuing professional development do not inspire teachers to continually advance their own knowledge and skills for their professional lives* (Kools & Stoll, 2016). The professional development of vocational teachers involves more than career promotion related to their personal career path; in staff development, it extends beyond a single form of intervention for enhancing teacher development (Glatthorn, 1995).

Teacher trainers' attitudes towards competence-based professional development have not been studied extensively in Finland; nevertheless, one of the main objectives in designing the Learning Online professional development program was to provide voca-

tional pre- and in-service teachers a personal experience with the competence-based approach while supplying a significant amount of practical examples and supplementary instructions (Brauer, Siklander, & Ruhalahti, 2017). Full use of the competence-based approach requires that teacher trainers, teachers and students adopt the theoretical and practical aspects. Furthermore, those involved in the process can help with transitioning the grading system by reflecting on their experiences (Lee et al., 2017). The development of competences is undergoing reform, requiring novel ways of structuring, scaffolding and evaluating learning.

2.2 Digital Open Badges

The standards and frameworks describing the desired competence levels are important at the national and international levels in order to set the direction for development. However, official guidelines are not always the best tool for individuals seeking to identify personal competences or to comprehend the needs of development in practice. Digital open badges are electronic *microcredentials* that can be used to identify and promote excellence and mastery (Abramovich et al., 2013; Brauer & Ruhalahti, 2014). Badges (e.g., Mozilla Open Badges) also may refer to the student's (the earner's) participation in or certificate completion (Rughiniş & Matei, 2013). Digital badges are used in learning to encourage students, to pinpoint progress and to support credentialing (McDaniel & Fanfarelli, 2016).

Created and promoted by the Mozilla Foundation, *Open Badge Infrastructure* allows badge earners to collect multiple badges from different issuers (Devedžić & Jovanović, 2015) into a personalised online repository, such as Open Badge Passport or Mozilla Backpack. Badge earners may display and publish them using online services like LinkedIn or Facebook (Brauer & Ruhalahti, 2014). The architecture of badges seems simple: "an image file embedded with information" (Grant, 2014, p. 7), but the actual anatomy of the digital proof is rather complicated (Figure 3). In a competence-based approach, digital open badges are built to include detailed knowledge and expertise criteria as well as a description of the evidence (e.g., an online document). Still, one's first glance of a badge includes an identification image, graphic or icon, the name of the badge, issuer identification and other information content (Bowen, 2018; Brauer & Ruhalahti, 2014).

Badges may be difficult to earn, but they adequately represent learning (Abramovich, 2016). Badges allow "learners to develop and maintain their learning portfolios throughout their lives" (Devedžić & Jovanović, 2015, p. 606), recognising excellence in diverse manners (Davies, Randall, & West, 2015). It is important to distinguish different types of micro-credentials based on the badge type, its location within the badge system; and its relationship to the primary badge constellation. *The badge architecture* should be designed in such a way that the metadata attached to the badge provides the necessary

information for viewers to estimate the value and type of badge. Hamari (2017) summarises these qualities on a systemic level, explaining that a badge consists "of a signifying element (the visual and textual cues of the badge), rewards (the earned badge), and the fulfilment conditions which determine how the badge can be earned" (p. 470, see also Hamari, 2013; Hamari & Eranti, 2011; Jakobsson, 2011; Montola, Nummenmaa, Lucerano, Boberg, & Korhonen, 2009).

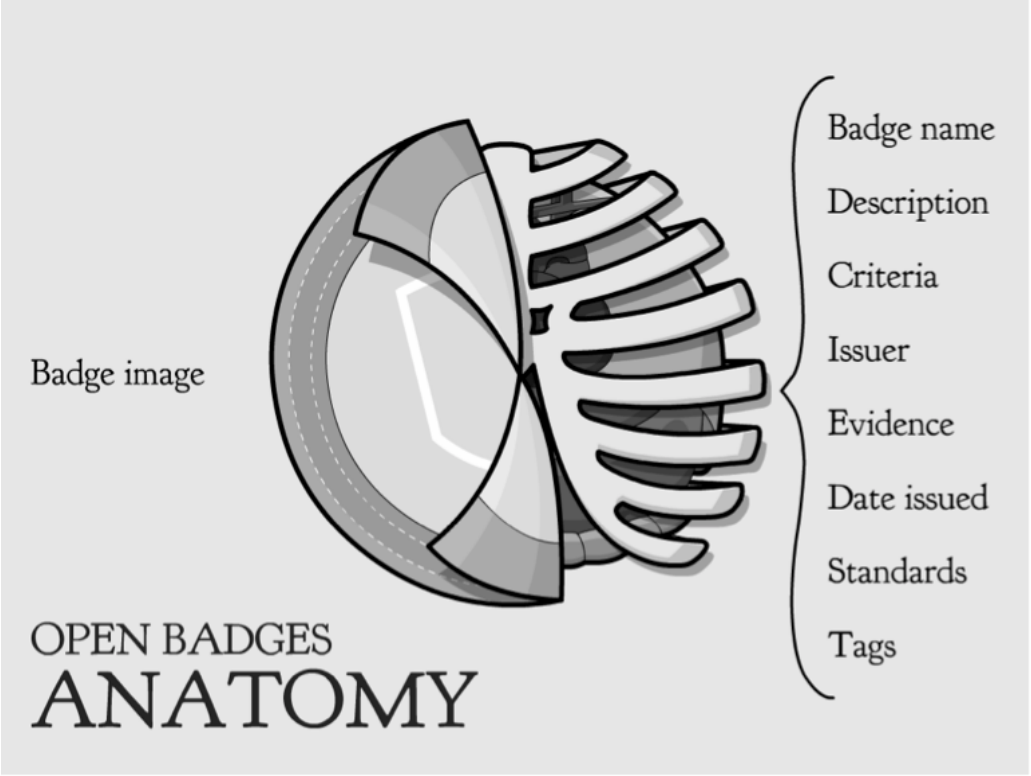

Figure 3. Open badge anatomy (Bowen, 2018, n.p.).

Additionally, comprehensible criteria and standards of assessment help students to understand their existing competences while providing guidance on how to deepen them (Brauer, Korhonen, & Siklander, 2018). For example, the investigated Learning Online PDP allows the identification and recognition of teachers' ICT competences through 50 different badges and three levels of requisite skill sets. Badges are categorized into different themes to form a constellation of badges and connected badge families. For example Mobile Video and YouTube are similarly colored badges connected to the family of Video Media sharing the same square shape of all connected badge families of Content Creation. The badge anatomy and architecture are simplistic and designed by professional teacher trainers instead of graphic designers. Nevertheless, the metadata included in it

describe the principles of judgement (defined in accordance with UNESCO's ICT-CFT) and explain how the competence in question should be demonstrating in the form of a tangible task. Requirements within the badges vary from practical skills demonstrating rather technical knowledge to demanding strategic planning. Further, visualisation motivates students to continue engagement (Hamari, 2017) and to learn new things (Brauer et al., 2017) as different Learning Online badges provide them with progressively deeper challenges. However, the milestones of the learning journey are not qualitative, but quantitative. To show mastery in video media, for instance, teachers must collect all badges related to this theme. To qualify for a specific level in a requisite skill set, teachers must collect a number of badges: Level I – SoMe-Novice equals 10 badges/2 ECTS; Level II – SoMe-Expert 25 badges/2 ECTS; and Level III – SoMe-Developer 45 badges and 5 ECTS. The level badges are granted automatically based on non-assessed milestones.

Digital open badge-driven learning process encourages students to assess their recent performance as well as their achieved competences, including prior learning and competences (Brauer, Korhonen, & Siklander, 2018). Badges are assessed based on an application and may be associated with a range of evidence in different forms (Casilli & Hickey, 2016). Meanwhile, the attached metadata explain the learning experience to those outside the social context (Gamrat, Bixler, & Raish, 2016) in which the competence was acquired. Gamrat et al. (2016) suggest that badge designers should consider whether or not students can personalise their learning pathways using badges from different badge families. The concept of a "choose-your-own-adventure online course" (McDaniel, Lindgren, & Friskics, 2012) demonstrates the scale of customisation possible in this learning process. The role of badges in this connected learning ecology involves "acting as a bridge between contexts, making these alternative learning channels and types of learning more viable, portable, and impactful" (Knight & Casilli, 2012). Digital open badges promote transparent learning processes, equal and egalitarian assessment and relevant learning (Brauer, Korhonen, & Siklander, 2018). Public recognition of different competences encourages people to use their knowledge and skills, to see new opportunities and to grow as experts (Halttunen, Koivisto, & Billett, 2014).

Digital open badges also are considered promising in the *visualisation of studies*; according to Hickey et al. (2015), it remains difficult to estimate the value of badges compared, for example, with the existing certification system. Open Badges are literally open to anyone seeking to create and recognise the achievements of others (Mozilla Open Badges, 2017). At the same time, there are only a few practically tested pedagogical models available, which is unfortunate because "understanding the relationships between formal completion logics and the psychological experience of badging allows designers to better design, deploy, and critique badging systems" (McDaniel & Fanfarelli, 2016, p. 73). Thus far, we have been unable to identify the different aspects of digital badging in educational contexts, nor have we found the optimal digital badge-driven learning process. On the other hand, flexible assessment models can tie together significant scaffolding

resources (Hickey et al., 2015; Brauer, Korhonen, & Siklander, 2018). In the future, digital open badges could become an effective criterion-based learning solution that couples different learning communities and alternative ways of acquiring competences (Knight & Casilli, 2012). Student cohesion is enhanced by common learning objectives; collaborative development challenges; and gamified learning experiences that can be shared with other members of the learning network (Brauer, Korhonen, & Siklander, 2018). Public sharing of the collected achievements may help to explain the success of digital badging (McDaniel et al., 2012).

2.3 Digital Badging in a Learning Management System

Evaluation is often seen as a final (or repeating) stage of the learning process. Institution-centred *assessment management platforms* support formative and summative assessment, storing qualitative and quantitative data concerning students' performance (Barrett, 2004). Today, evaluation has increasingly shifted to open online environments; instead of final evaluation and simplistic grading, the competence-based assessment represents rather an ongoing learning process (Brauer & Siklander, 2017). Assessments may include a student's self-assessment, peer assessments, peer group assessments and teachers' assessments of the path towards competences, in both face-to-face and online learning (Dochy, Segers, & Sluijsmans, 1999).

Open Badge Factory (OBF) provides the requisite digital open badge management platform to create and issue badges (Brauer, Korhonen, & Siklander, 2018). Originally, OBF was not designed to provide a learning environment or gaming platform (Brauer & Siklander, 2017); however, in the era of digitalisation, boundaries between different technological settings are blurring (Hamari, 2017), as investigated in Learning Online. However, launching new forms of evaluation may induce difficulties in terms of data management, new systems operations and even in assessment itself (Lee et al., 2017). The number of practical applications is increasing (Devedžić & Jovanović, 2015), and national badge management systems are being planned (Kerver & Riksen, 2016).

The need for professional tutors and instructors frequently emerges in novel contexts (Hrastinski et al., 2018). Meanwhile, the integration of badges into an active learning process allows a comprehensive system of assessment with scaffolding that supports learning and gamified engagement (Abramovich, 2016; Brauer & Siklander, 2017; Brauer, Korhonen, & Siklander, 2018). Therefore, it is essential that we learn how digital open badges and gamified competence-based learning process in an open badge management system guide and inform students in successful learning outcomes. The scaffolding process of digital open badge-driven learning represents a new area of interest for practitioners and researchers (Devedžić & Jovanović, 2015).

2.4 Digital Badging as Scaffolding

2.4.1 Instructional Badging

Information-rich digital badges provide broader opportunities for learning than conventional credentialing (Casilli & Hickey, 2016). Hamari (2017) notes that badges are able "to guide user behaviour because they set clear goals" (p. 470). Several studies (Brauer & Siklander, 2017; Hamari & Eranti, 2011; Jakobsson, 2011; Montola et al., 2009) demonstrate how badges help students visualise instructions and inform them of the final intended outcome. Further, instructional badges are designed to prompt students to demonstrate the required competences (Brauer & Siklander, 2017); in essence, the badge design and families of connected badges should represent the behaviours that the instructional designer wants to reward and encourage (Gamrat et al., 2016; Reid et al., 2015). However, the creation of high-quality badges requires relevant pedagogical models and thorough instructional design (Brauer & Siklander, 2017). The design processes should be complex and multifaceted enough to engage the full potential of badges, which provide promising solutions in pursuit of a variety of goals. Students should understand the constellation of instructional badges and metabadges as a personalised digital pathway to structure their studies (Ahn, Pellicone, & Butler 2014; Davies et al., 2015; Gamrat et al., 2016). Clear and consistent, a complete design of meta-badges supports the visualisation of learning and summarises the accomplished achievements (Brauer & Siklander, 2017).

Families of connected badges form a badge constellation built from stacks or layers. A carefully designed badge constellation promotes the student's progress, allowing remarkable customisation (Brauer, Korhonen, & Siklander, 2018). The badge criteria should inform the student on how to proceed and include practical instructions concerning the available learning materials, for example. The criteria description also should include the learning objectives (Sadler, 2005), simplistic instructions on "how to unlock a badge", and narratives and challenges that aim to promote intrinsic motivation (Hamari, 2017; Malone, 1981). The badge constellation and the anatomy of the digital proof are not final decisions. As Smith (2015) notes, it is important to review and adjust the contents in line with the progress of the educational setting. The intervals between updates should not be long when the subject of education is digital skills and knowledge (Brauer, Korhonen, & Siklander, 2018). Kolb, Boyatzis and Mainemelis (2001) propose that learning is a continuous process grounded in concrete experience and active experimentation. Competence-based digital open badge-driven learning provides students with different experiences; tangible tasks include a requirement to apply the acquired skills and knowledge in practise in order to provide sufficient evidence and earn a badge (Brauer & Siklander, 2017). The design process of badge-driven learning should be complex and multifaceted (Brauer et al., 2017) to provide inspiring challenges and engage the full potential of the student.

On a flexible study path, personal customisation means providing the option to select badges from different badge families (Gamrat et al., 2016) and allowing earners to accumulate credentials from various sources (Casilli & Hickey, 2016). Further, the personalisation should support the opportunity to produce evidence that can be introduced immediately in one's own work (Brauer et al., 2017). Kilja (2018) argues that "the goal of personalisation of studies is to create a training system that meets the needs of individuals and dismantles the 'one-size-fits-all' attitude" (p. 156). Knight and Casilli (2012) describe the scale of customisation required for such learning processes as a connected learning ecology serving as a bridge between contexts and alternative learning channels. The aim of scalable badges and badge families is similar to gamified constellations: allowing students to reflect on their accomplishments and strengthen their sense of competence and progress (Deterding, 2012). However, badges are a recognised game mechanic (Hamari, 2017). Hierarchical badges provide students with progressively deeper and more complex challenges, similar to progressive obstacles in games. Gamrat et al. (2014) describe a dual model, with badges and "stamps" requiring more or less effort, respectively. Gamrat et al. (2016) call for a badge design offering both granularity and flexibility to expand the evaluation of the degree of mastery beyond the most basic level.

In addition to the instructional metadata of digital open badges, instructional badging also may be realised as an assessment process in the badge management system related to badge applications and their approval/rejection process, including feedback, advice and scaffolding from the trainers (Brauer & Siklander, 2017). According to Abramovich (2016), "Digital badges that are designed primarily as assessments can motivate students to learn by providing feedback that supports learning" (p. 127). The design of digital open badge-driven learning should include comprehensive guidelines for assessment, especially in the case of a badge application that does not meet the requirements. In practical terms, Gamrat et al. (2016) suggest providing feedback or remediation as guidance for the second submission.

The badge earners recognise the full worth of teachers and tutors as experts providing feedback and advice (Brauer & Siklander, 2017). Experienced peer reviewers and automatic solutions remain elusive, especially in cases where the desired process for badge applications include unique claims and evidence (Hickey et al., 2015). In such cases, it is essential that students receive prompt and precise feedback (Brauer & Siklander, 2017); meanwhile, automated responses are valued differently than peer review or professional evaluations (Gamrat et al., 2016). Students appreciate the option to trace who has been evaluating their badge applications (Brauer, Korhonen, & Siklander, 2018; Kerver & Riksen, 2016). As with any standard- and criterion-based assessment, teachers and tutors face a large initial workload and a lack of resources, a problem that has yet to be solved (Hickey et al., 2015; Lee et al., 2017).

2.4.2 Scaffolding Online Learning

While instructional badging offers to guide students in a specific moment regarding a specific task, scaffolding as a concept offers a process view of learning. The extended concept of scaffolding may be understood to include teaching agents like digital technologies, texts, peer-related cooperation and even the learning environment as potential scaffolds (see Kim & Hannafin, 2011; Malik, 2017; McNeill, Lizotte, Krajcik, & Marx, 2006; Sherin, Reiser, & Edelson, 2004; Tabak & Baumgartner, 2010). Wood, Bruner and Ross (1976) formulated the idea of scaffolding not as a learning theory (Maggioli, 2013) but as a model of children's development (Maybin, Mercer, & Stierer, 1992) and a description of the nature of the tutoring process (Wood et al., 1976). Recently, Malik (2017) has revised the notion of scaffolding, arguing that there is a "difference between scaffolding and simply support" (p. 6) and reminding us that scaffolding should be a "real-time, titrated and tentative" (p. 6) process between the instructor and the student. His critical approach to the concept of scaffolding emphasises the central role of the dynamic interactions between the instructor and the learner. However, the preconditions of "real-time, titrated and tentative" (Malik, 2017, p. 6) actions and interactions may be understood broadly in the context of digitalisation.

From a social-constructivist perspective, scaffolding generates personal meaning for learning (Palincsar, 1998). Palincsar (1998) reminds us to always recall scaffoldings' subject and object, here associated with the teacher's guidance to a student (Wood et al., 1976). The aim of teachers' scaffolding is to promote self-regulation of learning. According to Wood et al. (1976), scaffolding should reflect a student's personal need for support in order to achieve learning objectives. This interpretation can be compared to Vygotsky's (1978) ideal of a teacher as a more knowledgeable learner aiming to help students in problem solving within their *zones of proximal development* (ZPD). Zimmermann (2010) suggests that teachers take an instructional approach to guiding students to support their self-regulation. "Just-in-time, just-enough assistance" (Dabbagh, 2003, p. 39) describes the layered learning experience in which "novice learners get enough basic support and information to successfully engage in learning without slowing down advanced" students. The support should diminish gradually in compliance with the learner's advancement; hence, the more competent students should be provided with a different layer of support to maintain their interest in learning. In addition to Dabbagh (2003), previous studies (e.g., Lee, 2008; Sims, Dobbs, & Hand, 2002) on online scaffolding note differences between novices and more advanced learners in terms of their preferred forms of guidance. Practitioners should seek to scaffold student success beyond their existing competences, a principle that should be extended into new learning environments (Quintana et al., 2004).

Scaffolding is an important and frequently studied concept in educational research. In this thesis, I could have chosen to concentrate on descriptive models to study the

interaction between the instructor and learner (Malik, 2017; van de Pol & Elbers, 2013), simultaneously narrowing the focus to the initial stages of the digital badging process (Brauer & Siklander, 2017). Although there is growing interest in online scaffolding and the impacts of learning design, few digital pedagogical models aim to guide the design of online scaffolding. Broader theories of online learning still focus on the general benefits and challenges of defining pedagogy for the digital age (e.g., Anderson, 2008; Sharples, Taylor, & Vavoula, 2016; Siemens, 2005). The required structure of scaffolding varies from one student to another. In the digitised sphere of life, scaffolding should be considered an essential design feature for online environments, adjustable to the target audience (Dabbagh, 2003; McLoughlin & Marshall, 2000). However, Vygotsky's (1978) main principle to provide supportive assistance to the learner remains valid when it comes to inspiring the student and promoting learning. The ability to scaffold is an essential competence for any educator (Dabbagh, 2003), and professional teachers should possess solid digital pedagogical competences in online scaffolding. Therefore, in this study, I build on a recognised and practically tested model of online scaffolding (Salmon, 2011, p. 2018).

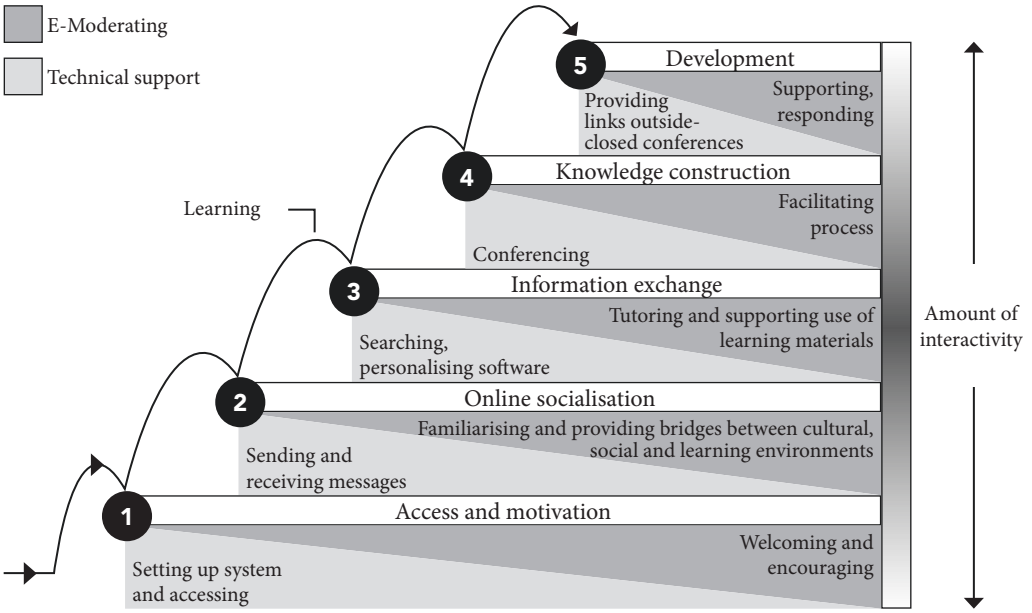

Figure 4. Salmon's Five Stage Model (2018, n.p.).

Descriptive studies often present scaffolding by means and intentions (e.g., Kim & Hannafin, 2011; Malik, 2017; McNeill et al., 2006; Sherin et al., 2004; Tabak & Baumgartner, 2010); according to van de Pol, Volman and Beishuizen (2010), measurement seems to be the main challenge in scaffolding research. Through action research in the 1990s, Salmon

(2011) developed a model for enabling and scaffolding asynchronous online learning. Salmon et al. (2010) emphasise the usefulness and relevance of the five-stage model that has been studied in different educational settings and learning environments for online and blended learning in various disciplines. Salmon (2018) describes varying dimensions of the online scaffolding process, including social interaction, motivation and learning with digital technologies. The stages of the five-stage model (Figure 4) involve a collaborative learning process aimed to increase students' independence and responsibility for their own learning (Salmon, 2011). However, the steps are not always identical. As Salmon (2011, p. 31) puts it, "Learning is a transformation where energy flows and impetus grows, not smoothly, but in leaps and bounds". According to Korhonen, Ruhalahti and Veermans (2018) a sound pedagogical model includes scaffolding; as a result, teachers should follow the proceedings very carefully to accomplish all dimensions of successful scaffolding.

The model focuses on interaction between groups of peers, whilst integrating the interactions of student learning materials and student tutors. According to Salmon (2011), "Individual access and the ability of participants to use online learning are essential prerequisites for group learning to develop later" (p. 31).

The first stage of Salmon's (2011; 2018) five-stage scaffolding model is to set up the required technologies to support online learning and to welcome students. Quick and easily-accessible learning environments and effective help are key variables that affect student attitudes towards online learning and motivate them to return to their studies (Salmon, 2011). During *the second stage*, students become familiar with each other and receive supportive messages from trainers while building bridges between different cultural, social and learning environments. Salmon (2011) argues that technology should enable online socialising and networking. Aimed at sustaining learners' interest, this stage facilitates the growth of self and common interest. *The third stage* seeks to generate interaction in terms of exchanging knowledge, personalising software, facilitating tasks and providing additional support for learning materials. Its key feature involves feeding the information exchange flow with the "broad range of information available" (Salmon, 2011, p. 42). In *the fourth stage*, knowledge construction is a continuing process that the teacher facilitates by asking questions, enhancing discussion, motivating, challenging, complimenting and encouraging (Salmon, 2011). Finally, *the fifth stage* enhances continuing development by giving further information about learning and individual development. As students progress, they become more responsible for their own learning.

The previous chapter about instructional badging noted a few studies (Brauer & Siklander, 2017; Gamrat et al., 2016; Hickey et al., 2015) indicating that automated responses are valued differently than peer review or professional evaluations. Dochy et al. (1999) have studied new assessment forms, such as self-, peer and co-assessment, concluding that the form of assessment impacts the learning process; teachers therefore must

consider the most suitable assessment methods in problem-based and authentic learning in order to improve the quality of student learning. Likewise, Lindblom-Ylänne et al. (2006) found that teachers' and students' experiences of self and peer assessment tend to be very positive; students consider both peer and self-assessment motivational. However, different studies note risks like "over-marking" in peer and self-assessment (Dochy et al., 1999; Lindblom-Ylänne et al., 2006).

The learning processes and environments of digital open badge-driven learning already form a multifaceted process in terms of different teaching agents related to scaffolding (Malik, 2017). Peer mentoring, peer assessment and peer recommendation systems remain under technical development in badge management systems. Still, Malik (2017) concludes that peers may act as instructors, but they "cannot be considered as scaffolds as their relationship with the learner occupies a different interpersonal continuum than that of an instructor" (p. 11). Meanwhile, involving students in assessment should be "perceived as being valid, reliable, fair and as contributing to a growth in competence" (Dochy et al., 1999, p. 347). It is important to note that scaffolding never looks the same; any model or technique should be applied according to the context (Salmon et al., 2010; van de Pol et al., 2010). Applying digital open badge-driven learning, it is essential to adjust the layers of the design process (Brauer et al., 2017) in relation to the recent educational research.

2.5 Motivation for Mastery and Performance

The previous chapters represent the theoretical framework arising from concepts with linear practical implications, such as procedures for badging or scaffolding. However, to understand the last piece of the theoretical approach – gamification – we need to comprehend the related concepts of motivation. Reeve (1992) describes motivation as the energy and intensity of a specific behaviour aimed at a determined goal or outcome. However, Deterding (2015) claims that psychological approaches may be too generic and analytic to offer specific potential or practical advice in designing enjoyable interactive systems. To this end, I begin by describing various concepts of motivation before moving into the distinctive theoretical approaches of gamification. Both discussions inform this work into how digital open badges structure the competence-based learning process.

2.5.1 Achievement Goals

Achievement goals are constructed of mastery and performance objectives reflecting proficiency in a particular setting (Barron & Harackiewicz, 2000; Pintrich, 2000). Abramovich and Wardrip (2016) present how they applied a 2 X 2 matrix of achievement goal theory (Cury, Elliot, Da Fonseca, & Moller, 2006) to earning badges. They describe how the "learners could have a performance goal approach orientation and be motivated to earn

more badges than their peers, or have a performance avoidance orientation and want to earn enough badges to be similar to their peers. Learners could have a mastery approach goal orientation where they earn badges that represent what they want to learn, or a mastery avoidance orientation where they are concerned with keeping the badges that represent their learning" (p. 56). Pintrich (2000) explains the construction of achievement goals, often referring to individual reasons for seeking achievement while representing purposes like mastery or superiority of a specific learning assignment. *Achievement tasks* may enhance learning gains and help instructors adapt learners' attitudes as well (Fryer & Elliot, 2007). Nevertheless, performance is judged based on established criteria or targets, such as progress or self-improvement, albeit from a multiple goals perspective (Barron & Harackiewicz, 2001; Pintrich, 2000). Situation-specific strategies offer significant assistance in building self-regulated learning and goal-setting processes (Fryer & Elliot, 2007).

Badges provide an additional *sense of fulfilment* diverging from the principal activities and purpose of the service at hand (Hamari, 2017). As Hamari (2017) states, "Badges consist of optional rewards and goals" (p. 470). The construction presents important features of gaming and gamified learning solutions, where goals may be considered the key factor, the game mechanic (Salen & Zimmerman, 2004) that significantly empowers progression towards the required outcome (Kivetz, Urminsky, & Zheng, 2006; Nunes & Dreze, 2006). Abramovich (2016) compares the final achievement to "summative assessments, providing feedback on what was accomplished within the game" (p. 127). Abramovich et al. (2013) give a practical example of how badges are similar to videogame achievements: badges can be awarded as merits for incidental activities as well as skills mastery or demonstration of knowledge. In addition, the player's achievements on a videogame are visible to other players; similarly, the badge earner is able to share rewarded badges with peers or with the general public (Brauer et al., 2017). Reid et al. (2015) describe such phenomena as game-like encouragement. Gamification applications seek to arouse and maintain people's enthusiasm to learn in new contexts with excitement mirroring that of playing games.

2.5.2 Intrinsic and Extrinsic Motivation

Digital open badges and their related processes are increasingly studied through two types of motivation, intrinsic and extrinsic (Reiss, 2012), particularly when predicting and explaining behaviour (e.g., Abramovich et al., 2013; Verhagen et al., 2012). Researchers from different disciplines most often study specific intrinsic or extrinsic motives (Kruglanski et al., 2018). Krapp (2002) explains that individual interests are separable by quality and quantity as soon as a child's intrinsic proactivity turns into a developed interest. Theoretically, undivided interest is the most prominent feature of intrinsic motivation; the outcomes are identical for interest-based activities, whether the task is compulsory or play-based (Krapp, 2002). According to Deterding (2011), the motivational pull

of game design is situated, suggesting the importance of studying the triggers of interest in terms of contextual effects and the dual view of motivation.

Previous studies (Abramovich et al. 2013; Hakulinen, 2013) suggest an interplay between different types of learners and types of badges earned as motivators. Abramovich et al. (2013) found that learners' prior knowledge and experiences within the domain being badged influences how quickly and easily badges are earned. They postulate that badges awarded for participation increase all users' motivation. They also found that skill badges are associated with motivational changes in the content area of the badges themselves. Their results indicate that students consider badging significant if they value a specific badge. Denny (2013) adds that the achieved level positively affects student motivation and time spent engaging with the system.

Several studies (Abramovich et al., 2013; Fitz-Walter, Tjondronegoro, & Wyeth, 2011; Montola et al., 2009) have noted both positive and negative consequences of digital badging. Abramovich et al. (2013) found evidence that skill badges support high-performing students familiar with the topic; as a result, the effect on low-performing students might be motivationally negative. This finding aligns with Fitz-Walter et al. (2011) and Montola et al. (2009), confirming that badges may serve as extrinsic rewards depending on the activities that are required to earn a badge. To address this issue, Abramovich (2016) suggests that we "shift current thinking on the use of digital badges in higher education away from a framework that only considers badges as credentials" (p. 126). These findings correspond to Deterding's (2012) assertion that the "entity being gamified needs to have some intrinsic value already — a reason for users to engage with it" (p. 17).

The increasing call to design gameful experiences for non-game contexts necessitates that we direct intrinsic motivation towards the desired behaviour (Deterding et al., 2011; Hamari, 2017; Hamari et al., 2015; Huotari & Hamari, 2012; McGonigal, 2011). The intrinsic motivational orientation moderates a liaison between assignment difficulty and enjoyment, such that students with a high intrinsic motivational orientation enjoy more complex problems than individuals with a lower intrinsic orientation (Abuhamdeh & Csikszentmihalyi, 2009). Further, Csikszentmihalyi (1990) emphasises the flow of optimal experience. As Deterding (2015, p. 299) puts it, "Challenges should be balanced relative to the player's perceived current ability such that they appear neither too hard nor so easy that they generate no uncertainty before nor competence upon overcoming them". In educational contexts, this interpretation sounds similar to Vygotsky's (1978) idea of ZPD. Deterding (2015) calls attention to the importance of motivating, enjoyable experiences, providing students the option to choose "to tackle a challenge for the sake of enjoyment" (p. 299). In operational terms, "fun" challenges likewise mean "a free choice". Intrinsically motivated activities become their own inherent reward, so motivation for these activities should not depend on external rewards (Deci, 1971; Ryan & Deci, 2000). By comparison, Ryan and Deci (2000) relate extrinsic motivation to a separable outcome where the learning activity merely has instrumental value as a behaviour.

Contemporary interest research provides a variety of conceptualisations and theoretical definitions (Krapp, 2002; Kruglanski et al., 2018). With many crossover interests, modern educational research draws on eclectic theories that are not mutually exclusive. Similarly, this study considers different approaches as various layers to study the digital open badge-driven learning process. For instance, I believe that "it would be simplistic to set badges as achievement goals (in the literal sense) in the gamified learning process" (Brauer et al., 2017, p. 12). Therefore, when studying the optimal design for gamified badge constellations, I sought a suitable approach. Reciprocally, the present models of online learning require adjustment in order to fit the entity of the gamified digital open badge-driven learning. Similar to Deterding (2011) who sought out the motivational dynamics of gamified applications, this study explores the interrelationships between motives and gamified dynamics in digital open badge-driven learning.

2.5.3 Triggers of Online Learning and Gamification

This research draws on definitions that offer to combine the triggers of online learning and gamification; recent research (Hidi & Renninger, 2006; Järvelä & Renninger, 2014; Renninger & Bachrach, 2015) in the fields of education and educational psychology provides evidence that interest, motivation and engagement form a process in which triggers play a key role in arousing and maintaining student interest. In this study, the term *trigger* refers to the initial stimulus (Glen & Wilkie, 2000) used by students to support learning (Roberts & Ousey, 2003), communication, reflection and/or action.

According to Hidi (2000), triggers represent the first, initial stage of situational interest. Hidi (2000) considers triggers to be intrinsically motivated behaviour maintaining situational interest. Situational interest may transform individual interest into personal enthusiasm for creating new hypotheses (Hidi & Harackiewicz, 2001). The latest educational research (Järvelä & Renninger, 2014; Renninger & Bachrach, 2015) indicates that interest, motivation and engagement are part of a process in which triggers play a key role in cultivating and maintaining student interest. According to Krapp (2002), interest-triggered learning activities promote deep learning and help the student to achieve set requirements and criteria (Krapp, 2002).

Roberts and Ousey (2003) argue that triggers can be presented in diverse forms to develop problem solving while ensuring that students enjoy their learning. For instance, easy access online environments intrinsically motivate students in continuing education (Waheed, Kaur, Ain, & Hussain, 2015). In addition, research shows that enjoyment is the key consideration when designing gamification (Kendrick, 2011). According to Muntean (2011), a trigger is something that tells the participant "to complete the action in a certain moment" (p. 324). Renninger and Bachrach (2015) suggest further research into the triggering process, particularly in terms of which triggers for interest are effective and which features of the environment allow maintenance of the triggered interest.

In their study, Sailer, Hence, Mandl and Klevers (2013) point out three motivational elements of gamification that serve as triggers: points, badges and a leaderboard. Dichev, Dicheva, Angelova and Agre (2014) describe the point system as the core of many game dynamics; in essence, users want to accumulate points to progress and attain higher levels. Dichev et al. (2014) note that it is essential for participants to have a sense of achievement. Reid et al. (2015) found that badges often are used to recognise learning and to motivate the learner, serving as 'game-like encouragement' in non-game and educational contexts. Providing feedback, such as points and challenging achievements (i.e., leaderboards and levels organised within the badge constellation), satisfies students' intrinsic need for competence (Brauer, Korhonen, & Siklander, 2018; Jung, Schneider, & Valacich, 2010). In terms of game mechanics, the concept of a skill refers to physical, mental and social abilities that a game prompts the players to attain (Hämäläinen et al., 2018). Meanwhile, the topic should be an open problem that is sufficiently demanding for students (Siklander, Kangas, Ruhalahti, & Korva, 2017). The demand for new challenges also appears in the earlier work of Brauer and Siklander (2017), suggesting that badges should provide students with progressively deeper and more complex problems, similar to progressive obstacles in games. Veerpoorten, Westera and Specht (2012) have studied the context of online learning, showing that the use of reflection triggers makes the learning process more tangible.

To sum up, these triggers have the potential to promote learners' interest and productive engagement. According to Hämäläinen and Cattaneo (2015, p. 153), "The future of VET calls for novel instructional approaches to trigger learning processes". They encourage schools of professional teacher education developing pre- and in-service training to focus "on triggering the relationship between teachers' instructional activities and new technology-enhanced learning settings" (p. 155). However, trigger development is complex and requires time, practice and dedication (Roberts & Ousey, 2003). Clearly, a better understanding of the triggering process could contribute significantly to the design of the gamified competence-based learning process with digital badging.

2.6 Gamification

Gamification may be considered a *convivial teachnology* (Kelly, 2011) promoting flexibility in terms of modification and adjustment while promoting collaboration between people and institutions. Hämäläinen et al. (2018) call for a better understanding of the social processes related to gaming and conclude that "emphasising and applying different game mechanics with different collaboration roles (scripted vs. emergent) can be used to support the different educational aims of games" (p. 51). According to Deterding (2015), "Enjoyment or fun are among the most desired experiences" (p. 294). Inglehart (2008) describes modern society through the concept of self-realisation, with an increasing em-

phasis on self-expression values. The need for different experiences and the commercialisation of evolving technologies affect individuals' purchasing decisions (Pine & Gilmore, 2011). Undoubtedly, the idea of intentionally experimental transformation also applies to education and should be reviewed carefully. Economic terms may seem cold in the context of education, but society has become dependent on evolutionary technologies that cross different disciplines (Kelly, 2011). Further, gamification seeks to increase user engagement and commitment to meet goals, which generally reflect intended behavioural outcomes but also rely on service profitability (Hamari, 2017).

A decade ago, the developing Internet technologies and related digital solutions offered to support a variety of online and location-based gaming applications and their related business models (Nacke & Deterding, 2017). These applications exploited the basic idea of gamification - to improve human conditions (Hamari, 2017). This industry-originated practice is based on simple game design elements instead of ludic qualities – the 'gamefulness' of gameful design (Deterding, 2015). The idea of gamification is to use game elements and techniques in a new context, to motivate users towards desired behaviours and to improve their user experience (Nacke & Deterding, 2017); it seeks to arouse enthusiasm about online learning in a way similar to the excitement and enjoyment experienced while playing games (Deterding, 2012; 2015). Gamified learning applications retain only the simplest components of gamification, such as badges, levels, points and a leaderboard (Deterding, 2012). Of these, badges are the most studied concept (Hamari, Koivisto, & Sarsa, 2014). Developing technologies promote novel possibilities, raising the question of how to combine gamification with digital badging in non-game platforms and contexts.

2.6.1 Structuralising Motivation in Gamification

Deterding's (2011; 2012; 2015) studies offer significant insights into the motivation and design of single game elements while addressing the social situation of game play. In 2011, he introduced *the concept of situated motivational affordances* (Figure 5) to conceptualise the motivational pull of single game design elements in varying contexts. He argues that "the concept of motivational affordances and the connected macro-theory of human motivation – self-determination theory – provides a good theoretical starting point to the study of the motivational dynamics of 'gamified' applications and services, if we extend them towards situated motivational affordances" (p. 4).

Krapp (2002) argues that the outcomes are identical for interest-based activities, whether the task is compulsory or play with the precondition of undivided interest based on intrinsic motivation. Deterding (2011) states that labelling an assignment as "play" or "game" already serves to transform the actors' perceptions and subsequent performance. As illustrated in Figure 5, the situation-specific meaning of an artefact - the 'transfer' of a design element from a 'play' context into another usage context - should be supported

by subjectively constructed social meaning, satisfying motivational needs and thus motivating continued activity.

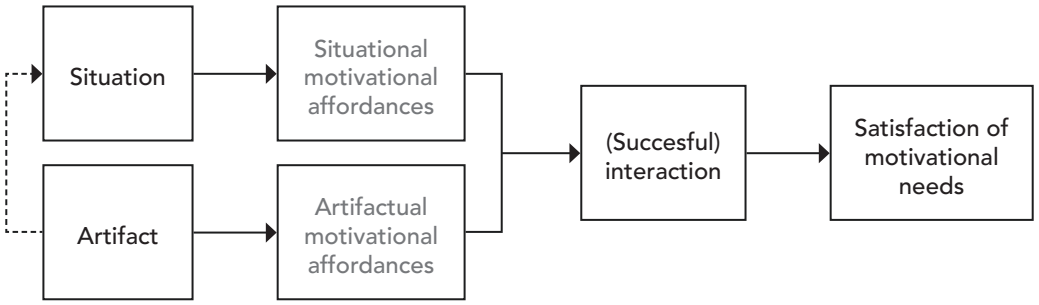

Figure 5. Situated motivational affordances (Deterding, 2011, p. 3).

This research relies on Deterding's (2015) study of different motivational lenses in gamification, particularly in terms of conceptualising the layers of gamification in digital open badge-driven learning. Deterding reviews existing methods and identifies challenges and requirements for gameful design while introducing a gameful design method that uses skill atoms and design lenses to identify challenges inherent to a user's goal pursuit. The research provides guidance on restructuring these challenges to include gameplay characteristics, creating motivating, enjoyable experiences. Deterding emphasises Csikszentmihalyi's (1990) study of flow, calling it "arguably one of the most influential models of enjoyment" (p. 296). Deterding (2015) points out that the "central components of gaming motivation are basic psychological needs for autonomy, competence, and relatedness, and a central component of gaming enjoyment is the experience of having these needs satisfied" (p. 301).

Deterding, Dixon et al. (2011) suggest applying a 2 × 2 matrix of the *paidia* (pleasurable play; see Kendrick, 2011) and *ludus* (rule-bound, complex play; see Kendrick, 2011) and qualities of such to game-related design practices with a determination to distinguish gamification from gameful design, game design and toy design. Respectively, Deterding (2015) outlines how gameful design might inform experience-driven design more generally. He analyses the characteristics of gameplay experience in terms of how game structures afford them, how game design creates these structures, and how this information can be translated into interaction design, arriving at a list of six criteria (p. 327-328):

1. *Designing for basic need satisfaction*, specifically competence
2. *Designing around inherent skill-based challenges*
3. *Designing for systemic emergence*

4. *Encouraging formative research*
5. *Synthesising the design* of formative research into a form useful for ideation and prototyping
6. *Mobilising game design epistemically*

In sub-study I, the presented method encouraged the researchers to view different layers of motivation. Further, these six criteria were considered along practical implications for digital open badge-driven learning, offering to inform the methodology of formative research and design synthesis.

3 Research Questions

This study investigates *how digital open badges structure the gamified competence-based learning process in the continuing professional development of vocational pre- and in-service teachers.*

The different sub-studies reflect vocational teachers' different experiences and their competence-development continuum. The studies draw attention to motivation, scaffolding and gamification in the context of higher education. The four empirical studies comprising this thesis represent a continuum describing the concept of digital open badge-driven learning: motivational effects on competence development, stages in the scaffolding process, triggers of gamified learning and the different experiences of the competence-based approach in professional development. The research also aims to offer a structure for the process of digital open badge-driven learning based on the results.

Each of the four sub-studies contributes to answering the study's overarching research question (see Table 3). The study includes four sub-studies, all of which contribute to our understanding of the primary concepts related to the digital open badge-driven learning process.

Table 3.

Summary of the Research Themes and Proceedings

Aims	*Research Questions*	*Data*	*Mixed Methods*	*Publications*
Sub-study I: *Examine variables affecting motivation in digital open badge-driven learning*	*What motivates students in the badge-driven learning process?*	*Group online interviews (n = 6), Pre-service teachers (n=12) and in-service teachers (n=17)*	*Qualitative approach: Data-driven content analysis, quantification of qualitative data, inductive thematic analysis and theoretical mapping*	***Refereed scientific journal*** *Brauer, S., Siklander, P. & Ruhalahti, S. (2017). Motivation in digital open badge-driven learning in vocational teacher education. The Journal of Professional and Vocational Education, 19(3), 7–23.*
Sub-study II: *To explore stages of scaffolding in digital open badge-driven learning*	*How do students experience scaffolding in badge-driven learning?*	*Group online interviews (n = 6), Pre-service teachers (n=12) and in-service teachers (n=17)*	*Qualitative approach: Data-driven content analysis and inductive thematic analysis*	*Refereed international scientific journal Brauer, S., Korhonen, A-M. & Siklander, P. (2018). Online scaffolding in digital open badge-driven learning. Manuscript submitted for publication.*
Sub-study III: *Explicitly identify triggers of gamified digital open badge-driven learning*	*What triggers learning in the badge-driven process?*	*Online questionnaire (n = 329) Pre-service teachers (n=115) and in-service teachers (n=214)*	*Quantitative approach: Constrained correspondence analysis*	***Refereed international scientific journal*** *Brauer, S., Ruhalahti, S., & Hallikainen, V. (2018). Digital professional learning triggers: in an online badge driven process. Education in the North, 25(1-2), 64-86. https://www.abdn.ac.uk/eitn/journal/545/*
Sub-study IV: *Build knowledge regarding the varying experiences with the competence-based approach in teachers' professional development using digital open badge-driven learning*	*How do learners experience the competence-based approach in the badge-driven learning process of professional development?*	*Online questionnaire (n = 329) Pre-service teachers (n=115) and in-service teachers (n=214)*	*Mixed approach: Constrained correspondence analysis and phenomeno-graphy*	***Refereed international scientific journal*** *Brauer, S., Kettunen, J. & Hallikainen, V. (2018). "Learning Online" for vocational teachers - Visualisation of the competence-based approach in digital open badge-driven learning. The Journal of Professional and Vocational Education: Vocational Education and Training in the Nordic Countries, 20, 13-29.*

All of the studies have been reported in peer-reviewed scientific journals in English. In the following chapter, I present a more detailed description of the research design and methodological approaches.

4 Methodologies

4.1 Participants and Data

Participants

The participants were Finnish in-service and pre-service vocational teachers. The subject of the study was the *Learning Online* professional development program (PDP) and the process of identifying and recognising vocational teachers' digital pedagogical competences. The participants followed one of three educational paths: 1) pre-service teachers given a pre-set (compulsory) set of badges, 2) pre-service teachers free to apply for any badges and 3) in-service teachers free to apply for any badges. All three groups utilised the exact same constellation of badges (n=50+) for digital open badge-driven learning. The third group of participants represented the in-service teachers for which Learning Online PDP was originally designed in a project funded by the Finnish National Agency for Education. By describing the different groups of participants, we do not aim to make comparisons but to describe the differences and similarities between the participants' backgrounds.

In sub-studies I and II, participants represented in-service and pre-service vocational teachers (n=29) of vocational teacher programs (Isacsson, Stigmar, & Amhag, 2018), who earned 645 badges over a one-year period in the Learning Online PDP. The study included both men (n=7) and women (n=22) with a previous higher education degree in a professional field. They were invited to group online interviews based on their achievements in the Learning Online PDP. According to several studies (e.g., Dicicco-Bloom & Crabtree, 2006; Sorrell & Redmond, 1995), "The purpose of the interview and the disciplinary perspective affect the format of the interview and type of data obtained" (Sedgwick &

Spiers, 2009, p. 2). The participants of this study were similar in terms of background, online experience and professional networks. Further, they were known to have access to the required technology and Internet connection (Sedgwick & Spiers, 2009).

The groups of interviewees represented badge earners on every level of the Learning Online requisite ICT skill set based on the national ICT-competence framework (Table 4). Therefore, they were competent with online operations and found it natural for interviews to be conducted in this way; thus, organising the group online interviews using a web conferencing system represented an appropriate means for data collection (Sedgwick & Spiers, 2009).

Table 4.

Study I and II Participants Sorted by Educational Path and Achievements

Pre-Service Teachers Institution 1	Pre-Service Teachers Institution 2	In-Service Teachers achieved Level I SoMe-Novice	In-Service Teachers achieved Level II SoMe-Expert	In-Service Teachers achieved Level III SoMe-Developer
9	3	4	5	8

In sub-studies III and IV, participants included in-service trained vocational teachers and pre-service students (n = 329) of vocational teacher programs, with 252 women and 77 men. They represented all disciplines of vocational education, with higher education degrees from different fields and various levels of professional experience, ranging from less than two to over 20 years. Nearly all participants had more than two years of experience in their professional field. Their experience with digital pedagogy, their skills set level measured by achieved digital open badges, ranged from Some-Novice SSL 1 to Some-Developer SSL 3. We also studied a group of participants who achieved less than 10 badges. The youngest group of respondents was under the age of 30 (n = 6) and the eldest participants were 60 years old and over (n = 8). In total, 214 participants already had obtained the qualification to work as vocational teachers; the earliest completed qualification was in 1982. More than a quarter of the participants had been working for over 20 years in their own disciplines, and at the time of this study, 221 respondents were working in the educational sector, at least part time. Nearly half of the participants were pre-service teachers yet to qualify; thus, they had no teaching experience.

Data Collection

I began data collection for sub-studies I and II in the spring of 2016. Compared to traditional means of qualitative research, contemporary communication technologies offer a variety of options for conducting data collection (Deakin & Wakefield, 2014). Guidelines for conducting formative research into gamified qualities remain ambiguous (Deterding, 2015). However, Paharia (2013), along with Kumar and Herger (2013), have recommended using interviews and site visits for data collection; at the same time, they do not provide advice on how to conduct such research in terms of identifying different motivations or actor profiles. Because the interviewees were geographically scattered, the online group interviews were organised through Adobe Connect web conferencing software (AC). This choice assisted in overcoming time and logistical challenges (Deakin & Wakefield, 2014; Sedgwick & Spiers, 2009) while saving on costs (Shore, Brooks, Savin, Manson, & Libby, 2007). Sedgwick and Spiers (2009) endorse "videoconferencing as a medium for conducting in-depth qualitative interviews" (p. 1). The selected medium, AC, enables a voice-over Internet protocol, online screen sharing, simultaneous chat discussions and recording of the active view. In addition to Adobe Connect recordings, the sound was recorded separately in the IC recorder, and the texts were copied as separate files to back up the data collected.

I sent email invitations to participate to potential participants (n=337) and shared the invitation online within professional teacher education study groups. These invitations were sent only after we acquired the necessary research permits from the relevant educational institutions involved in the development of the Learning Online PDP (Oulu University of Applied Sciences, HAMK University of Applied Sciences and Omnia Joint Authority of Education in Espoo). Research participation was absolutely voluntary for interviewees, and the invitation informed participants that they could withdraw from the interview and the study at any time. At the beginning of each group interview, I presented the process and ethics of the research according to the Ethical Code of Responsible Conduct of Research by the Finnish National Board on Research Integrity (TENK, 2012). I also ensured that participants understood the meaning of the guidelines. The interviewees confirmed their consent for the use of collected data by participating in the interview and by selecting "agree" on the system function keys.

The interview groups consisted of 3-8 people at a time. Interviews lasted between 68 and 93 minutes. The technical setting and study design was optimal for participants as they felt themselves capable, comfortable and relaxed operating online. The study situation provided an opportunity to reflect on the experience, and the interviewer sought to ensure sufficient space for interviewees to describe their own thoughts by encouraging participants to share their stories. A guided group interview gave participants the opportunity to share their own thoughts and reflect on their experiences. Different studies lend credence to my choice of an online medium (Chapman, Uggerslev, & Webster, 2003;

Sedgwick & Spiers, 2009), proposing web conferencing to be a rich tool allowing both prosaic speech and nonverbal cues. It also allows for immediate responses, encouraging participants to express their feelings and emotions. Interviewees choose the point of view of the story, its content, and how he or she tells it.

In this context, the interviewer's role becomes sustaining the debate and encouraging the story to be told by presenting additional questions to capture "the most complete and accurate understanding of the phenomenon" (Russell & Gregory, 2003, p. 37). I was prepared to ask questions (see Brauer, Korhonen, & Siklander, 2018) about criterion- and competence-based assessment, learning motivation and digital open badge-driven learning experiences. During each interview, I verified that all of these topics had been discussed in each group. I did not raise questions when the group already had discussed the subject on its own initiative. This approach may be considered preferable compared to more structured interview formats because it enhances interaction and brings up personal opinions (McDonough & McDonough, 1997; Xerri, 2018a).

According to Russell and Gregory (2003), "Qualitative researchers often begin with a general exploratory question and preliminary concepts. They then collect relevant data, observe patterns in the data, organise these into a conceptual framework, and resume data collection to both explore and challenge their developing conceptualisations. This cycle may be repeated several times" (p. 37). This description aptly fits the progress of this study. In the autumn of 2017, I conducted quantitative and qualitative data collection in sub-studies III and IV using an online questionnaire. The Finnish-language questionnaire was sent to 1246 email addresses that were registered in the badge management system of Learning Online from 2014–2017. There were 1100 potential applicants after misspelled addresses were filtered out; the contact information for teacher trainers and tutors as well as duplicates were also excluded from the mailing list. However, the address book might have included some expired student IDs, because Webropol statistics indicated that about half (n = 561) of the recipients opened the questionnaire, and 329 of them answered it. The questionnaire included a cover letter where participants were provided with a description of the research as well as detailed information regarding how the data would be used.

The extensive set of quantitative multiple-choice questions sought to map explanatory background variables, such as experience or field of education for sub-studies III and IV. A likert-scale was used to approach different statements. Table 5 presents statements from sub-study III selected based on our earlier findings in sub-study I explaining the variables affecting learning motivation in digital open badge-driven learning.

Table 5.

Statements Related to Earlier Research and Abbreviations of Study Variables

	It is important to me that…	***Variable affecting learning motivation***	***Variable to study***
1	*I can study and demonstrate my skills in a flexible way, regardless of time and place.*	Option to study regardless of time and place	FSO = flexible study options (time and place)
2	*I can choose what to study in a flexible order.*	Optional study paths	OCS = option to customise studies
3	*The required evidence and demonstration of competence based on the badge criteria offer progressive challenges and variations in the extent of required performance.*	Progressive challenges and the extent of required performance	V = the variety in the extent of required performance
4	*I learn new and up-to-date competences, and I can keep track of my progress.*	Study progress and enthusiasm for badge-driven learning	SP = option to learn new and up-to-date competences and enthusiasm for badge-driven learning (study progress)
5	*The PDP is gamified.*	Inspiring gamification	G = gamified PDP

In sub-study IV, we asked a total of fifteen questions on the questionnaire based on earlier research into digital open badge-driven learning (Brauer & Siklander, 2017; Brauer et al., 2017) and instructional badging (Ahn et al., 2014; Gamrat et al., 2016; Reid et al., 2015). In addition to quantitative multiple-choice questions, the questionnaire contained open questions in order to maximise the data (Bowden & Green, 2010) and to capture a diversity of expressions describing the phenomenon. The following open questions were asked: 1) Why and how does the competence-based approach and digital badges activate teachers' competence development? 2) What were the best and worst aspects of digital open badge-driven learning? 3) What else would you like to tell us about your study ex-

periences related to competence-based digital open badges? The number of participants may be considered high compared to previous phenomenographic studies suggesting that 10 to 15 participants is sufficient for capturing variation (Åkerlind, 2008; Trigwell, 2000).

Data

The data provided by the research were both *qualitative* and *quantitative*. In sub-studies I and II, the data from all six sources were transcribed; the transcription provided 439 minutes and 141 pages for analysis. In sub-studies III and IV, the online questionnaire provided us with a total of 329 different answers for quantitative analysis. The open questions section provided 52 pages of qualitative data.

The data collection was intended to be comprehensive in terms of the strategy chosen for collecting data (Russell & Gregory, 2003). The data were collected first-hand, meaning that I collected data on my own (sub-studies I-IV). All sub-studies were conducted in Finnish; the data collection and analysis were conducted in Finnish, and the results were translated into English. I had exclusive access to personally identifying data. All data were pseudonymised (Cortazzi & Jin, 2006) within the transcriptions for sub-studies I & II and anonymised for sub-studies III & IV in the survey software tool; data then were double-checked for personal information, including institutions and individuals in Microsoft Excel, before running on R for Vegan or phenomenographic analysis. All stored identifying information will be permanently deleted when this study is complete and published.

4.2 Methodological Approaches

Relying on various approaches in its sub-studies, this doctoral thesis consists of four articles and a summary section. Within this study, *mixed methods research* is considered in a broad sense, including both qualitative and quantitative viewpoints and methods (Johnson, Onwuegbuzie, & Turner, 2007). These approaches are specified in accordance with the research questions (Chapter 3). Employing mixed methods means more than simply collecting qualitative data to complement quantitative findings (Sieber, 1973). Mixed methods allow the inclusion of adjacent subjects and strategies for data collection methods (e.g., interviews and questionnaires), research methods (e.g., content analysis, statistics and phenomenography) and associated philosophical issues, such as ontology or epistemology (Johnson & Onwuegbuzie, 2004). The descriptive nature of each method was a key issue in choosing the methodological approaches.

In my research, I aim to highlight participants' different experiences and perspectives of digital open badge-driven learning and variations on the subject in order to reveal new and significant information regarding the subject. The mixed methods process allowed a progression in terms of both methodological and theoretical challenges. It also allowed me to grow in terms of my personal competences, knowledge and skills. *Induc-*

tive thematic analysis (sub-studies I & II) provided important results that encapsulate participants' thoughts regarding what motivates online learning as well as what kinds of scaffolding enhance efforts to apply new skills and knowledge. *Mapping* the results helped to ground the entirety of the related theoretical concepts. By means of *phenomenography* (sub-study IV), we were able to understand and describe the variety of experiences. Finally, I consider the most intriguing methodological approach to be exploring the possibilities of *constrained correspondence analysis* (CCA) as a descriptive statistical method (sub-studies III & IV).

4.2.1 Qualitative Content Analysis and Theoretical Mapping

Sub-studies I & II were conducted via data-driven content analysis using the most popular computer-aided qualitative data analysis software, NVivo 11.3.2 (Leech & Onwuegbuzie, 2011). The approach allowed me to focus on selected aspects of the material; to "translate" the material into preliminary coding categories; and to classify the material accordingly (Schreier, 2012). The unit of analysis was a short expression of words that captured the meaning of an aspect related to learning phenomena. In NVivo, initial codes were identified with an individual code label and the definition of the overall theme (Boyatzis, 1998); additional segments of text representing interviewees' rich expressions offering to validate the findings were sorted as cases and identified with more detailed descriptions of the occurrence (Table 6 and Table 7.) The original data provided total of 1224 expressions related to digital open badge-driven learning. 316 of references addressed motivation and 291 addressed scaffolding.

Table 6.

Study I: Coded Data Compared by Sorted Data on Motivation

Coded Data		**Result Data**	
Expressions Total	1224	References Total	316
Cases Total	57	Cases Total	18

Table 7.

Study II: Coded Data Compared by Sorted Data on Scaffolding

Coded Data		**Result Data**	
Expressions Total	1224	References Total	291
Cases Total	57	Cases Total	12

The individual expressions formed patterns of emerging themes and coding-frames while offering to reveal the categories for analysis (Fereday & Muir-Cochrane, 2006; Schreier, 2012). In both studies, hierarchically inclusive relationships were analysed in an ongoing comparison in order to examine the structure and components of competence-based assessment processes in an open-badge management system. The references related to investigated phenomena were gathered to NVivo's descriptive theme nodes emerging from coding of different sources (n=6 interview transcripts). Categories were organized using folders, hierarchies and aggregation forming finally main coding categories presenting a collection of references about a specific theme or relationship (NVivo, 2018). An ongoing iterative comparison was conducted between data and theory, continually developing categories seeking to identify overarching themes in phenomena described by participants (Fereday & Muir-Cochrane, 2006). The cases were treated as unique, with the aim of revealing new issues regarding the subject under study while seeking to find the significant features of the overall phenomenon (Hirsjärvi, Remes, & Sajavaara, 2007; Kaasila, 2008). The preliminary results were reread in relation to the original coded data and the recent findings were reviewed related to the previous stages of the process before undertaking any further analysis. The proceedings were performed repeatedly in order to ensure that the developing themes were grounded in the original data (Fereday & Muir-Cochrane, 2006). Finally, the main coding categories were formed using the inductive approach (Boyatzis, 1998) in a data-driven manner. The relationships between subcategories and data saturation assisted in merging the categories within the coding process.

Ultimately, the results were quantified and clustered with a mapping of the theoretical framework (sub-study I). Mapping was used as a tool to represent elements of individual and group thinking at a particular time regarding a specific concept (Hodgkinson & Clarkson, 2005). As Hodgkinson and Clarkson (2005) state, cognitive mapping procedures allow us to compare experiences based on structural similarities and differences while searching for patterns and homogeneity. In sub-study II participants' experiences were mapped against each stage of Salmon's (2011) Five Stage Model. Gentner (1983) describes the process as a "domain comparison" where the relational structure (similarities, differences, abstractions and comparisons) is mapped from base to target, wherein "the contrast between analogy and literal similarity is a continuum, not a dichotomy" (pp. 159-161). We compared coding and mapping results and cooperated to discuss and homogenise these results at different stages of the analysis.

4.2.2 Constrained Correspondence Analysis

To analyse the quantitative data, we used a statistical multivariate method, constrained correspondence analysis (CCA) a.k.a. canonical correspondence analysis (Oksanen, 2012). The CCA was computed using R Package Vegan (Oksanen et al., 2017). In this study, the method selection was theoretical because there were several options for oper-

ating with multiple variables (Davison & Sireci, 2000; Johnson & Wichern, 2002; Rencer, 2002). It also was experimental because the method had not been applied in earlier educational research (see also chapters 7.2 and 8.2). Sherry and Henson (2005) remind us to be mindful of the risk of interpreting insignificant functions. As such, we used permutation tests to ensure the statistical significance of the relationships between the variables and demographics in sub-studies III and IV. The coordinate values of the study items for CCA plots were rescaled by multiplying the original coordinate values by 10 in order to make the CCA plot more interpretable. Furthermore, we confirmed our findings by checking the Spearman's rank order correlation matrix of different study items as well as value distributions on the five-point Likert scale by participant groups.

I chose this particular method because it offered the possibility of identifying and visualising a variety of variables related to the phenomena under investigation. Venuleo, Ciavolino, Vernai, Marinaci and Calogiuri (2018) explain the benefits of a simple correspondence analysis (CA) and CCA, suggesting that they provide a summary "of dis(similarities) in the subjects' discourses to be obtained, by identifying the associative pattern assumed by a set of words in the data" (p. 212). This statement mirrors Ter Braak (1986) who represented reciprocal averaging in eigenvector techniques as "a popular ordination technique that extracts continuous axes of variation from species occurrence or abundance data" (p. 1167). Ter Braak emphasises that interpretation of such ordination axes should be supplemented with environmental-variable data and external knowledge. Accordingly, in sub-study IV, we augmented the descriptive statistical findings with an entire qualitative approach and phenomenographic interpretation.

4.2.3 Phenomenography

In contrast with CCA, phenomenography was developed in the context of educational research (Larsson & Holmström, 2007). Larsson and Holmström (2007) found the approach to be a "useful tool for learning and competence development" (p. 55); nevertheless, the approach is not extensively applied. In this study, the phenomenographic approach was used to analyse the qualitative data in sub-study IV. I chose the approach because of its aim to identify, describe and understand qualitatively varying ways of experiencing the target phenomenon (Marton, 1981; Larsson & Holmström, 2007). In qualitative studies, the number of samples is sufficiently small, and purposeful sampling can be understood as a conscious selection of data sources that meet particular criteria (Russell & Gregory, 2003). In phenomenography, significance is generated in the context, and the expression itself is not relevant as in a discourse analysis, for instance. Thus, the phenomenon to be investigated should be sufficiently precise to enable interpretation based on select occurrences.

To begin, I familiarised myself with the data through repeated readings. Reading and re-reading the material was an important part of the process, as each reading offered

a fresh experience and an opportunity to interpret the material in a new way (Åkerlind, 2005). According to Larsson and Holmström (2007), "The study object in phenomenographic studies, conception or way of understanding, differs from attitudes, values, thoughts and opinions" (p. 56). They emphasise the importance of in-depth, open-ended interviews allowing and encouraging participants to speak freely to avoid superficial assumptions. In this study, data were collected with open questions on a questionnaire in order to capture a variety of expressions describing the phenomenon. The sketching of categories began with descriptions of the most important features of phenomena, making comparisons and redefining them. This process continued with the theory of clarification, final classification, categorisation and interpretation (Åkerlind, 2005a). Larsson and Holmström (2007) state that the hierarchy of the final outcome space should be constrained from the data or based on the theoretical analysis of the categories. In the fourth sub-study, we processed theoretical concepts in a parallel and continuous manner from the beginning of the analysis. We noted expressions related to the research questions. The cyclical process allowed the estimation and development of interpretations of "different ways in which people experience the same phenomena" (Pang, 2003, p. 145) aligning with the theory of variation.

The first phase of analysis in sub-study IV focused on identifying participants' different ways of experiencing digital open badge-driven learning and the competence-based approach in general terms. Following Åkerlind (2005b), we developed descriptive categories gradually by comparing and contrasting the identified similarities and differences in expressed meanings. In the second phase, we formed and transformed logical relationships within and between categories based on consistently occurring themes to represent the various ways of experiencing the competence-based approach in digital open badge-driven learning. Larsson and Holmström (2007) describe the categories of description as "the researcher's abstractions of the different ways of understanding, which have been identified" (p. 56). Accordingly, the categorising in sub-study IV refers to a collective level (Larsson & Holmström, 2007) and meaning developed and named through continual comparing and contrasting of descriptive categories (Kettunen, Sampson, & Vuorinen, 2015). We avoided labelling meanings until the final hierarchical construction as it could have created a limitation in further categorisation (Bowden, 2005; Kettunen & Tynjälä, 2017).

The final phase of analysis focused on ensuring that the categories of description met the three quality criteria defined by Marton and Booth (1997): (a) all categories describe clear variations in experiencing the phenomenon; (b) a hierarchical relationship is seen between the different categories in delivery; and (c) a limited number of description categories is presented. As Larsson and Holmström (2007) point out, "All the categories of description, the outcome space, constitute the result of a phenomenographic study" (p. 56). They may ultimately indicate the internal relationships and connections between categories. The logical relationships represented in the final categorisation reflect collective rather than individual experiences (Kettunen et al., 2015; Larsson & Holmström, 2007).

5 Overview and Evaluation of Empirical Studies

This chapter provides summaries and evaluations of the four sub-studies that comprise this thesis. I introduce the sub-studies in terms of their roles and contributions to the research and its themes.

5.1 Research Process

The aim of the *first sub-study* was to reveal what motivates students in the badge-driven learning process. The study focused on mapping theories to cluster students' experiences of stimulating and supportive digital open badge-driven learning. As a complex process with dimensions of online learning and gamification, mapping formed a more detailed theoretical sketch of badge-driven learning and provided options for deepening the perspective in upcoming studies while suggesting practical implications. During this study, I realised that understanding what motivates students in badge-driven learning was not enough to inform the process of digital open badge-driven learning; thus, the results revealed several variables affecting motivation.

In the *second sub-study*, we studied the process from the perspective of guidance asking how students experience scaffolding in badge-driven learning. Our initial study showed a structured model for scaffolding in digital open badge-driven learning. The findings reflect students' experiences regarding the optimal form of assessments and scaffolding. After conducting the second study, I became more interested in gamification and digital badging triggering learning (Figure 6).

The third sub-study aimed to identify students who are particularly motivated by digital open badge-driven learning. Methodologically, this study was the most interesting and challenging because we were the first to apply CCA in educational research. The research question asked what triggers learning in the gamified digital open badge-driven learning process. The findings suggest the importance of applying gamification and digital badging in the professional development of both pre- and in-service teachers. However, the results indicated differences and similarities in participants' experiences.

The previous results encouraged us to dig deeper, and in the *fourth study*, we applied phenomenography in order to gain a wider perspective on the phenomenon. The study employed constrained correspondence analysis and phenomenography to analyse participants' different experiences. Both methods highlight the badge earners' experiences

and offer to deepen the existing knowledge of digital open badge-driven learning, complementing one another by explaining different aspects of the phenomenon. The results describe the impact of the competence-based approach on teachers' professional development in the digital open badge-driven learning process.

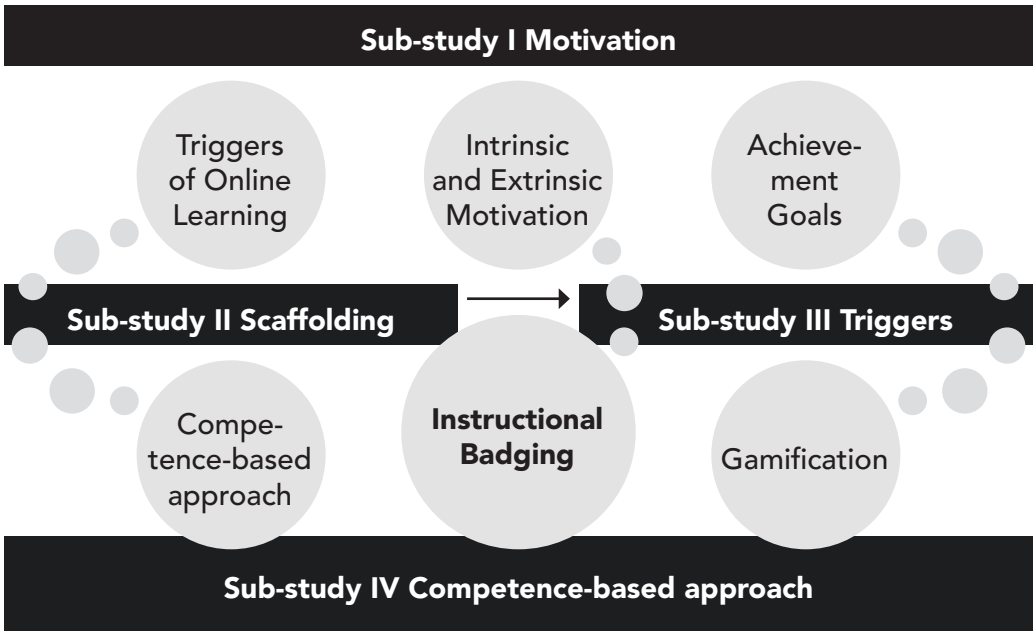

Figure 6. Dissertation study process

Each of the four sub-studies contributes to answering the study's overarching research question: *how do digital open badges structure the gamified competence-based learning process in the continuing professional development of vocational pre- and in-service teachers*?

5.2 Examining Variables Affecting Motivation in Digital Open Badge-Driven Learning

Related Publication

Brauer, S., Siklander, P., & Ruhalahti, S. (2017). Motivation in digital open badge-driven learning in vocational teacher education. *The Journal of Professional and Vocational Education*, 19(3), 7–23.

We introduced the term "digital open badge-driven learning" in this first published article. However, neither the sub-study nor the latter studies describe the process or concept of badge-driven learning. Rather, the first sub-study opens up the theoretical frameworks

related to digital badging in order to offer initial definitions for concepts associated with the phenomenon. The theoretical approach is extensive, allowing the concept of digital open badge-driven learning to be placed within the scientific map of educational research.

Clustering the results with a mapping of the theoretical framework (Fig. 8) indicates that motivation in digital open badge-driven learning is based more on achievement goals and triggers of online learning than factors of intrinsic and extrinsic motivation.

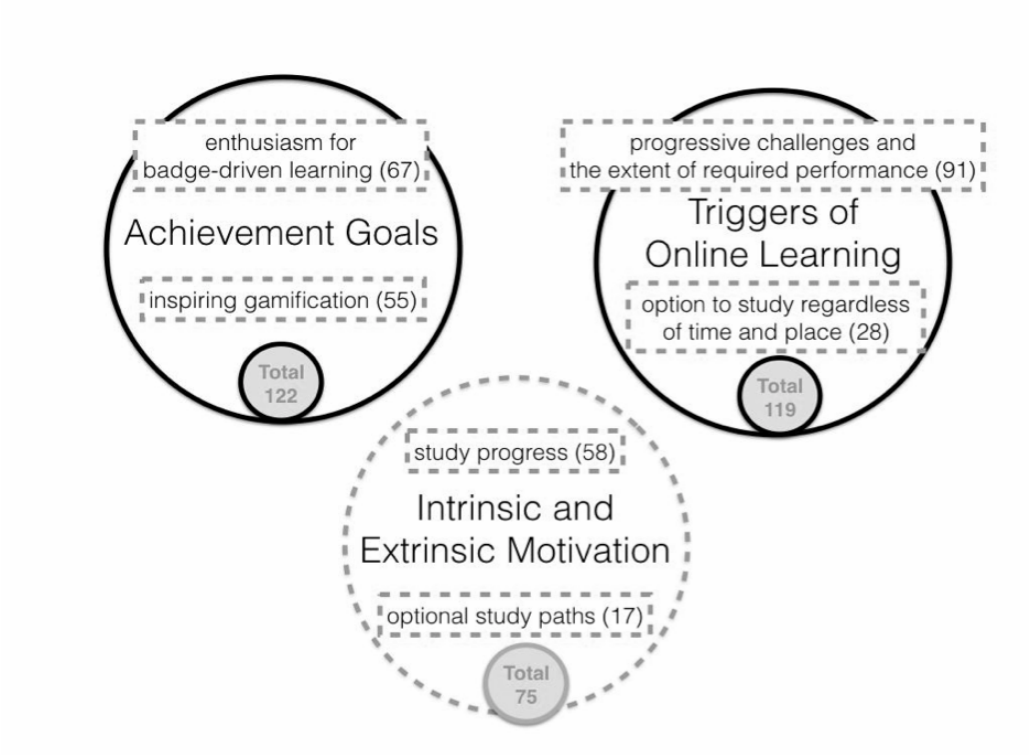

Figure 7. Clustering the results of sub-study I (Brauer et al., 2017, p. 15).

The study sought to examine *what motivates students in the digital open badge-driven learning process*. The results revealed six main variables affecting motivation : progressive challenges and the extent of required performance, enthusiasm for badge-driven learning, monitoring study progress, inspiring gamification, the option to study regardless of time and place and optional study paths. The most significant factors appear to be achievement goals: the recognition of enthusiasm for badge-driven learning and inspiring gamification provided us a fresh starting point to build research towards a better understanding of triggers of gamified badge-driven learning (sub-study III). Indeed, gaming might provide an alternate framework for the process of thoughtful experience and interaction (Deterding, 2012).

The initial findings of motivational factors in sub-study I, formed the study design of all upcoming research. However, the represented concepts relate to one another, serving as complementary aspects of the phenomenon. These results also emphasised the significance of each theoretical approach in relation to the clustered results, or later, with respect to the perspective of the study (cf. Figure 2). Current models of online learning are not directly applicable to the multifaceted process of digital open badge-driven learning. Deterding (2015; 2011) sought out the different aspects of motivational dynamics in gamified applications through *The Lens of Intrinsic Skill Atoms* and motivational affordances. Similarly, this sub-study considered the interrelationships and dynamics of motivational badge-driven learning by means of theoretical mapping. The mapping was by no means thorough, but it did yield important guidelines for studying the different phases of the digital open badge-driven learning process.

5.2 Exploring Scaffolding in Digital Open Badge-Driven Learning

Related Publication

Brauer, S., Korhonen, A-M., & Siklander, P. (2018). Online scaffolding in digital open badge-driven learning. Manuscript submitted for publication.

I was the first author of a conference article (Brauer & Siklander, 2017) that introduced competence-based assessment and digital badging as guidance for an open badge management system. This particular study presented digital open badge-driven learning from the perspective of a tangible process of digital badging consisting of badge-criteria, badge applications and pedagogical guidance provided to students needing remediation. Based on the study, I found it necessary to look at the concept of guidance related to digital open badge-driven learning more extensively.

The aim of the second sub-study was to examine the stages of online scaffolding and instructional badging in digital open badge-driven learning process. The research relied on this question: *how do students experience scaffolding in badge-driven learning?* This paper follows a digital open badge-driven learning process along with an implementation of competence-based professional development that the authors experienced and observed. The theoretical framework follows the concepts of the Five Stage Model of online scaffolding (Salmon, 2011; 2018; Salmon, Nie, & Edirisingha, 2010) and instructional badging (Ahn et al., 2014; Gamrat et al., 2016; Reid et al., 2015). Students' experiences were mapped against each stage of Salmon's (2011) Five Stage Model to create a causal understanding of the individual participants as well as the groups and their views, feelings and experiences. Students described how online scaffolding and instructional badging are related to digital open badge-driven learning. The individual descriptions displayed examples of learning opportunities and challenges experienced at each stage of the model.

Inductive thematic analysis revealed significant features of badge-driven learning related to online learning, competence-based assessment and badge management. Findings reflect students' experiences of the optimal form and frequency of assessments, feedback, scaffolding and advice. The results illustrate the challenges and opportunities involved in badge-driven learning from the perspective of professional development, suggesting a practical model to design and develop online scaffolding in badge-driven learning. Sub-study II promotes digital badge-driven learning as a customised study path consisting of instructional modules, badge application process and assessment. The assessment portion requires the student to provide a demonstration of competence or other evidence (Reid et al., 2015). The results are in line with earlier findings (Brauer & Siklander, 2017; Brauer, Siklander, & Ruhalahti, 2017) emphasising instructional badging as guidance. Further, the findings of the second sub-study suggest that we consider the concept of instructional badging as a stage in the scaffolding process, instead of being the scaffolding process itself. The results help to inform the structure and stages of online scaffolding in digital open badge-driven learning, ultimately suggesting that we continue to test and apply Salmons' Five Stage Model in practice through badge-driven learning.

5.3 Identifying the Triggers of Gamified Digital Open Badge-Driven Learning

Related Publication

Brauer, S., Ruhalahti, S., & Hallikainen, V. (2018). Digital professional learning triggers: in an online badge driven process. *Education in the North, 25*(1-2), 64-86. https://www.abdn.ac.uk/eitn/journal/545/

The second sub-study emphasised the need for additional research to optimise the process and structure of badge-driven learning. That also called for an in-depth reviews of the game models including achievement goals intended to encourage collaborative rather than individual work (Deterding, 2012). The original idea of *the third sub-study, was to find out student groups, who would benefit most from digital badging*. As Kumar and Herger (2013) put it, "understanding the type of player will help you choose the game mechanics that will be most appealing to your target audience." (n.p.). Based on a preliminary analysis, the objectives of the study focused on examining what prompts certain students on studying and learning in digital open badge-driven learning. The third sub-study aims to identify the students who are particularly motivated by digital open badge-driven learning. The key research question was set to ask what triggers learning in such a badge-driven process.

The examination of the theoretical framework of sub-study III offers an *important process description regarding the effects and functions of triggers at different stages of the learning process and offers to couple triggering with gamification*. In brief, the study is

theoretically based on the concepts of gamification (Deterding, 2015, 2012; Reid et al., 2015), the triggers of online learning (Hidi, 2000), and gamification triggering learning (Dichev et al., 2014; Muntean, 2011). In essence, triggers offer to affect learning during several stages of the gamified digital open badge-driven learning process, arousing and maintaining interest (Hidi & Renninger, 2006; Järvelä & Renninger, 2014; Renninger & Bachrach, 2015) until final completion of the desired learning action (Dichev et al., 2014). Further, the study also explains how triggers allow students to continue studying after completing the initial task (Dichev et al., 2014; Werbach, 2014). In terms of digital open badge-driven learning, the prompting trigger of learning might help students visualise their learning as a reward badge, for instance (Fitz-Walter et al., 2011; Gamrat et al., 2016; Hamari, 2017; Montola et al., 2009; Reid et al., 2015). Students also gain a sense of excitement similar to that of playing games (Deterding, 2012; 2015). They also benefit from facilitators' interaction, collaboration and feedback during the learning process (Siklander et al., 2017). Still, knowledge regarding how triggers work remains scant across different learning situations and varying stages of the digital open badge-driven learning process.

The only significant explanatory variable that we found to identify students who were particularly motivated by digital open badge-driven learning was skill-set level (SSL). The findings of the third sub-study reveal that gamification motivates students, especially at the beginning of their studies. Furthermore, the results illustrate the importance of flexible study options that include customising studies and learning new and up-to-date competences triggering digital open badge-driven learning. These findings align with those of sub-study I: the option to study regardless of time and place was the second-most important factor affecting student motivation in digital open badge-driven learning. According to sub-studies I-II, flexible study options also support self-determined studying (cf. Gamrat et al., 2016).

The findings of the third sub-study reveal that the option to customise studies is relatively important to novice teachers. This finding explains novice teachers' eagerness to choose which badges to apply for based on their individual requirements and occupational needs, as found in sub-study II. These results also are consistent with earlier findings from sub-study I suggesting that study path visualisation should provide an interface for customisation. This conclusion receives further support from other recent studies (e.g., Casilli & Hickey, 2016; Gamrat et al., 2016; Swanson, 2013). The third sub-study also points to positive relationships between flexible study options (time and place), the option to customise studies and the option to learn new and up-to-date competences (study progress), all of which are important for students at advanced levels of professional development.

Badges explain what students experience, learn and then apply. Sub-study III findings indicate that gamification is perceived as positively affecting student achievement (Buckley & Doyle, 2014; Dominguez et al., 2013; Sailer, Hence, Mayr, & Mandl, 2017).

The first sub-study reported that study progress motivates students only to a certain degree, while inspirational play through gamification encourages students to continue their studies. In sub-study I, we identified progressive challenges and the extent of required performance as triggers of badge-driven learning. Similarly, Muntean (2011) considers gamification a trigger that encourages the participant to proceed. However, the results of the third sub-study provide an additional insight: gamification, the variety and extent of required performance and progressively deeper and more complex challenges (Abuhamdeh & Csikszentmihalyi, 2009; Deterding, 2015; Roberts & Ousey, 2004) support both novice and expert-level students, motivating them from the very beginning of their studies (cf. Hamari, Koivisto, & Sarsa, 2014; Seaborn & Fels, 2015). This finding is important because, at these levels, the progress of studies can be difficult to understand otherwise. These results also are consistent with Yildirim's (2017) findings that students' attention, motivation and interest are directly correlated with their achievements.

The study group variable was noteworthy in the context of study III even if insignificant according to our obtained data. The results suggested an interesting positive relationship of gamification as the strongest predictor for study group success even if the variety in extent of required performance was negatively related. The fact that earlier qualitative research has failed to determine whether the effects of gamification are the same for all students (Dichev et al., 2014) makes clear the need to further study the linear combinations of different study groups, gamification, collaboration and required forms of evidence. Consequently, sub-study IV offers to widen the perspective of the research based on students' different experiences of digital open badge-driven learning.

In addition to the process approach to the theoretical concepts, I consider the most important result from this sub-study to be the following question for future research: *Why (if) community building and collaboration are more effective in triggering gamified learning than progressively deeper and complex game-like challenges?* The question aligns with recent research in the field of online learning in higher education. In 2017, Siklander et al. concluded from their study that the most significant triggers are collaboration, topic and feedback. Accordingly, collaboration should include rich and reciprocal forms of peer interaction, as well as peer motivation. Hämäläinen et al. (2018) studied the game mechanics associated with the emergence of collaboration and found productive social interactions and collaborative knowledge constructions encouraging shared problem solving and solution discovery. Nevertheless, there is a gap between research findings and practical implications; for instance, recent results from "Digitalisation in vocational education" –research (Koramo et al., 2018) suggest that peer-related activities might enhance the effectiveness of the continuing professional development of vocational teachers, but effective methods remain elusive.

5.4 Investigating Different Experiences of the Competence-based Approach on Teachers' Professional Development in Digital Open Badge-Driven Learning

Related Publication

Brauer, S., Kettunen, J., & Hallikainen, V. (2018). "Learning Online" for vocational teachers: Visualisation of the competence-based approach in digital open badge-driven learning. *The Journal of Professional and Vocational Education: Vocational education and training in the Nordic countries, 20*, 13-29.

The fourth sub-study aimed to examine *how learners experience the competence-based approach in the badge-driven learning process of professional development*. The theoretical framework focused on a single concept of instructional badging in the competence-based approach. Given the narrowest theoretical framework, this study offers to draw the widest view of the results. Further, the study provides an example of using two different methods to build knowledge describing participants' experiences. The study employed constrained correspondence analysis and phenomenography to analyse participants' different experiences. Both methods highlight the badge earners' experiences and offer to deepen the existing knowledge of digital open badge-driven learning, ultimately complementing one another by explaining different aspects of the phenomenon.

The results describe the impact of the competence-based approach on teachers' professional development in digital open badge-driven learning. To view teachers' professional development on a larger scale, we had to study their experiences as well as the contexts and processes of competence development accordingly (Ganser, 2000; Fielding & Schalock, 1985; Villegas-Reimers, 2003). This study sought to examine competence-based digital open badge-driven learning through the experiences of professional in-service and pre-service teachers. The key research question asked the following: *how do learners experience the competence-based approach in the badge-driven learning process of professional development?*

Both of the methods highlight the badge earners' experiences and offer to deepen the existing knowledge of digital open badge-driven learning. Quantitative analysis provides a circle of six variables that participants considered essential in the competence-based approach in digital open badge-driven learning: applications to working life; the competence-based approach; competence development within the community; flexible study options; the option to customise studies; and recognition of the community's competences. Like sub-study I, the results emphasise the importance of participants having the choice to *customise studies* and follow *flexible study options* in digital open badge-driven learning. Similarly, both studies note the significance of the *opportunity to apply new competences in working life*. Overall, the visual badge constellation promotes *independent*

self-evaluation of existing competences and *identification of individual competences needed in working life*. Therefore, it *enhances learning and efficient professional development*; however, it is not as efficient as gamification.

In sub-study III, we were able to conclude that gamification particularly engages novice and expert learners. Based on the quantitative findings of sub-study IV, it is obvious that *gamification prompts learners* to continue their studies towards the highest possible skills level, especially when they have the option to personalise their study paths entirely. This finding aligns with Muntean (2011), recognising gamification as a trigger to student progress. Here, success seems to relate to the ability to self-evaluate existing competences through the visual constellation of badge criteria (Ahn et al., 2014; Davies et al., 2015; Gamrat et al., 2016; Smith, 2015).

The quantitative findings of sub-study IV indicate that vocational teachers are more interested in the shared expertise and professional development within the working or learning community than becoming involved with the individual competence-based learning and assessment process. Further, the phenomenographic results reveal a way of experiencing digital open badge-driven learning as a learning community. This result echoes the question set in sub-study III regarding the efficiency of gamification in learning and whether or not it should be evaluated in terms of community building and collaboration.

In general, digital open badge-driven learning seems to enhance vocational teachers' perceptions of the competence-based approach in practice. Both approaches indicate that, through public sharing, badges may enhance professional development within working communities; the competence-based approach supports identification and recognition of the different competences achieved (Casilli & Hickey, 2016). In addition, statistics indicate that competence-based digital badges help teachers to plan competence development as a continuum. Public sharing of achievements may be one reason for the positive outcomes of Learning Online (McDaniel, Lindgren, & Friskics, 2012). Based on the CCA, learners did consider publicising badges to be significant in their professional development.

6 Structuring Digital Open Badge-Driven Learning

This chapter seeks to amalgamate theoretical insights concerning digital open badge-driven learning while presenting the original process structure of digital open badge-driven learning based on the empirical studies undertaken as part of this dissertation. This research aimed to investigate how digital open badges structure the gamified competence-based learning process in the continuing professional development of vocational pre- and in-service teachers.

To better understand the entire process, I asked the following questions:

1. What motivates students in the digital open badge-driven learning process?
2. How do students experience scaffolding in badge-driven learning?
3. What triggers learning in the badge-driven process?
4. How do learners experience the competence-based approach in the badge-driven learning process of professional development?

I set multiple research questions to explore the process structure of digital open badge-driven learning and its related theoretical concepts. As the study progressed, I was able to parse together not only the digital open badge-driven learning as a process, but also how different triggers work in different phases of the process. This insight offers the opportunity to promote and inform the development of professional competences in a variety of ways. The following chapters discuss the theoretical aspects of these concepts in relation to the overall process and offer to summarise how digital open badges structure the gamified competence-based learning process in the continuing professional development of vocational pre- and in-service teachers. The final results of the different sub-studies allow me to better define the digital open badge-driven learning process.

6.1 Definition of Digital Open Badge-Driven Learning

The main research question addressed how digital open badges structure the gamified competence-based learning process in the continuing professional development of vocational pre- and in-service teachers. The study results allow me to identify the different

qualities of digital open badge-driven learning and describe the overall structure of the badge-driven learning process (Figure 8).

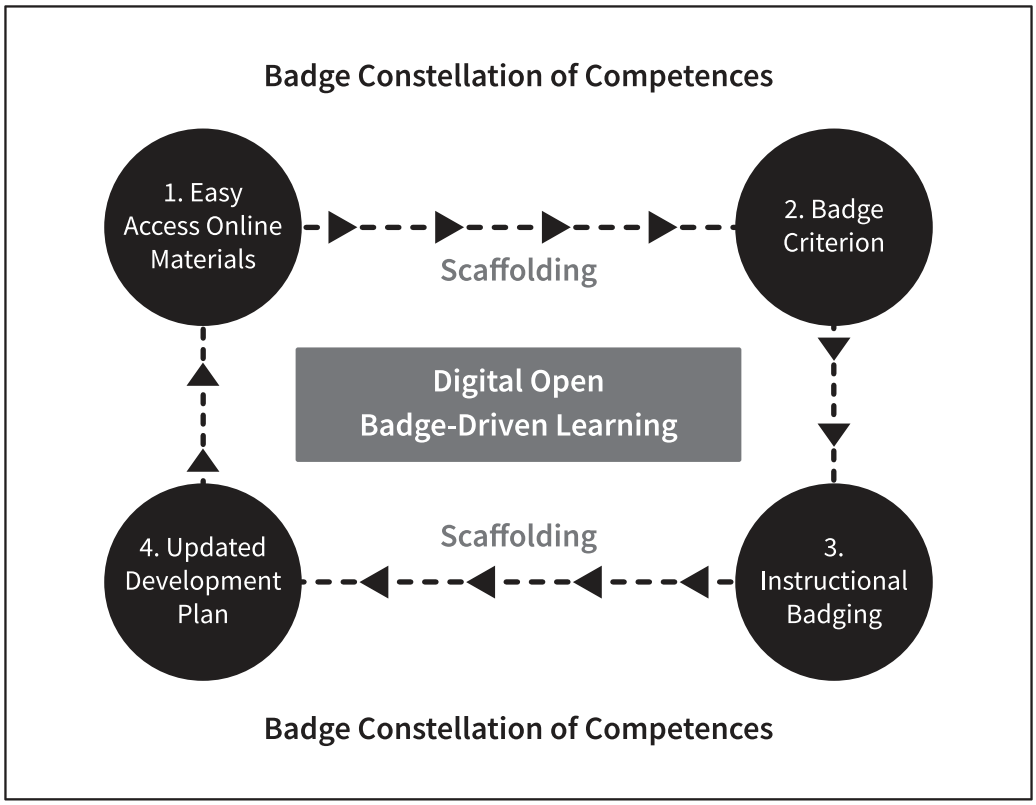

Figure 8. The identified structure for the gamified digital open badge-driven learning process.

The study findings have allowed me to reach a definition of *digital open badge-driven learning as a competence-based learning process grounded on the badge constellation of competences. The process includes identifying and recognising different competences using digital open badges. The entity of digital open badge-driven learning involves learning materials, badge criterion, instructional badging, scaffolding and peer support. The digital open badge-driven learning process supports the gamification of professional competence development* (Figure 8). Further, the triggers of the learning process are more versatile than the triggers of gamification or online-learning alone.

Based on sub-studies I-IV, I suggest to consider the theoretical approaches related to the phenomena during different stages of the process while emphasising different layers of a single stage. The main precondition for planning, designing and implementing digital open badge-driven learning is *the badge constellation of competences*. The badge constellation determines the quality and form of the provided learning materials; it sets the framework and visual form for building criteria-based badges, challenges and tasks.

It also forms the principles of instructional badging and offers tools to plan continuing competence development. All of these aspects represent components for triggering digital open badge-driven learning (see sub-study III theoretical conceptualisation; Deterding, 2012; 2015; Dichev et al., 2014; Fitz-Walter et al., 2011; Gamrat et al., 2016; Hamari, 2017; Hidi, 2000; Hidi & Renninger, 2006; Järvelä & Renninger, 2014; Montola et al., 2009; Muntean, 2011; Reid et al., 2015: Renninger & Bachrach, 2015; Siklander et al., 2017; Werbach, 2014). This study pays respect to the five stages of scaffolding (Salmon, 2011) in the digital open badge-driven, as presented in sub-study II. However, I do not consider scaffolding to be a stage but an ongoing process that includes peer-related activities, such as socialisation within a study group on social media. The badge constellation of competences and recognised stages of the learning process provide different viewpoints and tools for scaffolding. For example, they assure easy access to learning materials, allow self-evaluation of achieved and desirable competences based on the criterion, and promote relevant remediation in accordance with instructional badging. These features allow learners to update their development plan and affect study progress throughout the process.

Encompassing the overall process structure allows to capture and explicitly identify the triggers of gamified digital open badge-driven learning. Sub-studies I-IV addressed these triggers from various perspectives. Ultimately, this research points to the key triggers of digital open badge-driven learning and how they affect learning during several stages of the gamified digital open badge-driven learning process. *First*, gamified criterion-based challenges arouse and maintain interest until the intended competence is achieved (sub-study III). Students visualise their pursuits in the form of a badge constellation when their study paths and progress would be difficult to understand otherwise. *Second*, flexible study options support self-determined studying (sub-study I & sub-study II) and prompt the desired learning action (sub-study III), allowing students to self-select the time and place of learning (sub-study III). *Third*, the option to customise studies represents another central principle: personalised study paths arouse interest and maintain students' motivation and engagement as their studies progress (sub-study III). Further, inspirational play through gamification encourages students to continue their studies after completing an initial task (sub-studies I & IV) even towards the highest possible skills set level; this motivation is particularly apparent when they are given the option to personalise their study paths entirely (sub-study IV). In terms of digital open badge-driven learning, the prompting trigger for learning might be realised at different stages of the learning process in various forms, including community building and collaboration facilitated by gamification, scaffolding or criterion-based challenges.

6.2 Scaffolding Digital Open Badge-Driven Learning

In digital open badge-driven learning, essential preconditions for learning include summarising the process, facilitating tasks and supporting the use of learning materials (Salmon, 2011). Adopted from Salmon's (2011) Five Stage Model, digital open badge-driven learning should provide a home base with easy access learning materials and instructions for the badge application process 24/7 online (Waheed et al., 2015). Educational settings should organise learning materials themed according to digital badge management in order to supplement instructional badge criterion. The need for learning materials grows as the studies progress towards more challenging themes and applications. Materials are expected to be thorough and provide all required information to apply the pedagogical model and technology related to the topic (Brauer et al., 2017). Student still seem to appreciate advanced search options because they are unlikely to proceed gradually or follow the planned study path (Brauer, Korhonen & Siklander, 2018). Students should feel capable, comfortable and confident using resources independently (Salmon, 2011).

In the second stage, it is time to provide tools that assist with exchanging information and personalising studies (Salmon, 2011). Students may perceive "digital badges as an authentic assessment representing the learning objectives of the course" (Abramovich, 2016, p. 128; see also Reid et al., 2015). The criterion-based badge constellation should encourage students to take responsibility for their own learning. The constellation provides the required information for learners to identify different competences, to self-evaluate their personal level of mastery in relation to the requirements of working life and to support badge application procedures (Brauer, Korhonen, & Siklander, 2018). The criteria should inform students of the scale and challenge of the competence demonstration and evidence required. The students depend on clear badge criterion. As such, a carefully-designed badge criterion may even replace learning material and online scaffolding to some extent, guiding students on how to proceed and demonstrate their achieved competences.

The constellation of different criterion-based badges, metabadges and badge families supports students in visualising, customising and personalising their studies. Digital open badges promote the identification and recognition of personal competences while helping to plan the development of competences as a continuum from teacher training to working life. As a visual description of competences, badges support a shared understanding of the required and desired competences between teachers and students. Further, the detailed evaluation criteria scaffolds learning, providing detailed information regarding progressive challenges and variations in the extent of required performance. Clear badge criterion structures increase motivation, and thus, enhance learning outcomes. I also consider it noteworthy that students consider achievement to be deep learning because they can repeat what they have learned in practice (Brauer, Korhonen, & Siklander, 2018). In digital open badge-driven learning process, the criteria-based badge constellation is the most important single factor affecting motivation.

During the third stage, knowledge construction becomes an ongoing process that the teacher facilitates (Salmon, 2011) with instructional badging encompassing the badge criterion and badge application process related to open badge management (Brauer & Siklander, 2017). Instructional badging often provides practical instructions on how to proceed (Gamrat et al., 2016). As a result of our studies, I conclude that this stage includes the process of instructional badging, defined as 1) proceedings related to one specific badge application and 2) proceedings related to several badge applications following the remediation process and instructions related to that same badge criteria. In a sense, the process may also be understood as different badge applications that follow each other; however, it is rare that a student proceeds without any contact areas in learning other than the badge management platform. Applying Salmon's five-stage scaffolding model (2011), digital open badging may be explained as the instructional badging process related to the assessment and feedback provided along with the rejected badge application (Brauer, Korhonen, & Siklander, 2018; Brauer & Siklander, 2017). Such feedback provides guidance regarding the direction of future studies and requires the student to engage in learning activities. The model is similar to Gamrat et al.'s (2016) work suggesting the provision of extensive feedback or remediation to guide learners towards a second submission. Students who fail in the assessment require more extensive feedback, so they can learn more and further develop the evidence needed to meet the requirements defined in the badge criteria. The waiting period for such evaluation should be reasonably short in order to support motivation. The faster the assessment is completed, the more it supports and inspires learning (Brauer & Siklander, 2017).

Finally, the fourth stage seeks to support development by giving further information for learning (Salmon, 2011). The final stage provides time for evaluating the final achievement, the entity of personal competences in relation to one's personal requirements in working life. It also gives an opportunity to restructure one's learning path if needed. Badge-driven learning enhances the progress on customised study paths, and scaffolding is most necessary for students who fail the task on the first try. Based on the rejected badge application and the feedback and scaffolding received, the student continues to learn and develop evidence of mastery. According to Salmon et al. (2010), the scaffolding provided to students during the development stage empowers them to take a meta-cognitive view of their learning. In the fourth stage, students estimate their achievements based on personal goals and integrate their learning experience from the online environment into working life or other forms of learning (Salmon et al., 2010). The further students go, the more independent they become, taking responsibility for their own learning.

Facilitating scaffolding is essential, particularly when it comes to giving the option to collaborate with peers in problem solving and learning. The second stage of Salmon's original Five Stage Model "involves participants establishing their online identities, finding others with whom to interact online, understanding the nature of the online environ-

ment and how it is used for learning, and developing trust and mutual respect to work together at common tasks" (2011, p. 71). In digital open badge-driven learning, scaffolding is not considered to be a stage, but an ongoing activity penetrating different stages, structures and layers of the entire process. According to Salmon (2011), it is essential that students get to know each other. Such online socialisation may include supportive messages from teachers (Hrastinski et al., 2018; Salmon, 2011), and preferably, a closed study group to enhance socialisation between novice and advanced teachers while bridging different educational institutions, disciplines and geographic locations.

Online communities combine different learning environments and offer to support cultural and social interactions among participants (Salmon, 2011). The design of digital badges may drive students towards synchronous or asynchronous communication (Gamrat, 2016); however, the results of this study do not compare different badges or types of communication. Some students considered a common study group unnecessary and found instructional badging, informative online materials and detailed badge criterion as adequate support for their learning. Nonetheless, Hickey et al. (2015) argue that badges benefit most networked and social learning. Gamrat et al. (2016) add that learning pathways should include collaboration between different badge stakeholders. However, peers in a study group must all be interested in developing similar themes. The study group may be organised in different technological environments (e.g., Facebook, Whatsapp or Microsoft Teams). The environment should support an open forum for discussion, allowing quick advice from tutors or peers. The communal nature of study groups makes students feel safe because help is available almost 24/7. Group peer support is valued more significantly than, for example, personal e-mail exchanges with the teacher or tutor. Shared expertise and learning experiences increase cohesion within freely-formed groups of students. The study group provides students with significant new networks beyond institutional boundaries. Therefore, the option to join and leave the network freely is crucial.

6.3 Varying Experiences of Digital Open Badge-Driven Learning

The previous paragraphs explain the activating mechanics and components of the digital open badge-driven learning process. However, it also is necessary to describe the overall process from the student's point of view. This section summarises vocational in- and pre-service teachers' experiences of different stages of scaffolding and their equally varying experiences with the competence-based approach to professional development through digital open badge-driven learning.

First, easy access online environments enhance students' confidence and sense of personal control of studies (Salmon et al., 2010); this situation motivates them to return for

additional badge applications. Similarly, gameful systems should be enjoyable and easy to manage in order to facilitate motivation (Deterding, 2015). Salmon et al. (2010) also emphasise the importance of smooth online environments, considering them an essential precondition for learning. However, not all students use the learning materials, and the ones who do may even search for advanced, optional information from different sources (sub-study I). Students gain motivation by finding up-to-date pedagogical models, instructions on technical solutions and practical tips that they can apply in work.

Second, students' experiences of scaffolding within the digital open badge-driven learning process vary from imitative learning to inspirational peer scaffolding and peer support. In sub-study IV, the scaffolding provided beyond badging was considered imitation learning because the teacher showed students what to do, and students "just pushed the buttons". The students felt they were supported by differentiation, varying instructional strategies out of the Open Badge Factory (OBF) using conventional means like email. When exploring the stages of scaffolding in digital open badge-driven learning (sub-study II), we learned that students' need for scaffolding varies by quantity and quality during the learning process.

Third, the layered view offers the groundwork for exploring badge-driven learning and the criterion-based badge constellation of competences. The approach can be focused on the concepts of intrinsic and extrinsic motivation and the enthusiasm towards badge-driven learning that can support the learner. However, the badge constellation of competences is simultaneously a factor affecting motivation by means of inspiring gamification. Thus, the constellation of badges, metabadges and badge families should be equally functional in terms of achievement goals. The badge constellation of competences does not appear to be the top influencer in creating efficient triggers for online learning. However, designing learning objectives and a hierarchy of skills levels has a direct relationship to progressively deeper and more complex challenges, which students experience as crucial features of inspiring gamification. The systematic approach towards criteria may be considered convincing. Aristotle defined the approach long ago as "the ways of knowing, starting from the simplest and proceeding to the more complicated possibilities" (Himanka, 2015, p. 121).

Refining the focus of the kaleidoscope to convivial gamification requires layers that re-organise and evaluate different stages and related process components using the concept of achievement goals. This approach should include the existing knowledge of educational research and the core understanding of gamification and game mechanics. The main requirement of gradual difficulty should be viewed as progressive challenges and as variety in the extent of required performance. In practise, this idea means re-thinking the criterion-based constellation of different badges and intrinsic and extrinsic motivation. The second important layer for gamification is balancing between designing enjoyable challenges and producing game-like excitement. It is easy to refer to Kendrick's (2011) theory of a ludic dialectic between pleasurable and complex play. At the layer of gamifi-

cation, triggers of online learning seem to have moderate effects on learners' motivation in relation to interest-triggering learning activities. As such, triggers in gamified digital open badge-driven learning form a more complicated constellation, consisting of triggers beyond those of online learning. As Deterding (2011) states, the context has a subjectively constructed social meaning that offers to satisfy motivational needs and motivate continued activity (cf. Figure 5.). When students described their experience, they were enthusiastic about the team spirit and simply enjoyed gaming (Brauer, Kettunen, & Hallikainen, 2018).

In general, the competence-based approach allows the identification and recognition of various achieved competences (Casilli & Hickey, 2016). The findings of sub-study IV allowed us to conclude that "independent self-evaluation of existing competences and identification of individual competences needed in working life supported by visual badge constellation offer to enhance learning and efficient professional development" (Brauer, Kettunen, & Hallikainen, 2018, p. 25). Students emphasised the value of the practical approach allowing them to develop evidence into something tangible that they could apply in working life from the first to the last sub-study. Domínguez et al. (2013) confirm that, while practical assignments positively affect learning, badges may have negative effects if written assignments are required. Assignment design relates to the evidence required for a competence, and facilitators should offer in-service teachers the option to apply the task in their own work. Meanwhile, pre-service students should be given simulations of working life challenges. Overall, the possibility of applying new competences in professional life is of significant value in the competence-based approach (sub-study I; sub-study IV).

Finally, students experienced the competence-based badge criteria as a function of *development planning*, which allowed them to identify the individual competences needed in their careers (sub-study IV). These experiences align with the fourth stage of digital open badge-driven learning and respond to Salmon's idea that the (repeating) final stage supports self-determined professional development by giving further information for learning. The quantitative findings of sub-study IV indicate that professional pre- and in-service teachers are interested in shared expertise and professional development within the working or learning community. Phenomenographic results reveal a way of experiencing digital open badge-driven learning as a learning community. The option to promote personal expertise within the work community is the most significant reason for publishing a badge. The value of publicly-shared badges resides in the fact that both the badge earners and their peers can see each other's skill levels in regards to a requisite skills set, and of course, also related to the game progress (Abramovich, 2016). Public badges allow peers to recognise others' reputations (Deterding et al., 2011); through badges, people can see who in the community would be able help with a difficult challenge. The badges seem to promote a sense of community and enhance the experience of inclusion, equality and meaning (Mäki et al., 2015).

7 Implications

This chapter is aimed to perceive the practical implications of digital open badge-driven learning process in the context of higher education, vocational teacher programs and professional development within the era of digitalisation. Finally, I will discuss the methodological contributions of this study as applying quantitative method new to educational research.

7.1 Practical Approach in Designing Digital Open Badge-Driven Learning

Transforming assessment requires both design and development (Nichols et al., 2017). The development of digital open badge-driven learning processes should emphasise the intended learning outcomes and the competence-based approach. Further, gamified design should include the metrics of the game, including the time required and the quality of the results (Bartel et al., 2015) as well as the tools to measure different activities. In addition, the participants should be informed of the rules of the game, including how and when the metric values will be collected (Bartel et al., 2015). Reflecting on the six principles of gameful design (Deterding, 2015) allows us to evaluate the gamified digital open badge-driven learning process against the characteristics of the gameplay experience with the intention to learn 1) how game structures afford digital open badge-driven learning, 2) how game design creates these structures and 3) how these structures are transferable to learning design. Following Deterding (2015), the design principles should meet the primary need of competence development in practise, thus allowing motivational and enjoyable experiences to fulfil learners' basic needs. Nevertheless, vocational teachers enjoy having tangible tasks that serve them in working life; therefore, the design should include inherent skill-based challenges (Deterding, 2015). One aspect of gamified designs is competence-based challenges that progressively deepen to maintain the flow of experiences and flow of learning (Deterding, 2015; Csikszentmihalyi, 1990).

Based on sub-study I, I suggest that we consider the cyclical model of design (Figure 9), which emphasises layers of theory as the basis for planning practical applications of digital open badge-driven learning.

The design cycle illustrates the stages of the design process on a practical level and offers to facilitate the choice of theoretical approach at different stages in the design process. For example, in the design of a badge constellation, teachers often feel it natural to define the achievement goals (intended learning outcomes or competences required)

first. Next, it is important to ascertain how these goals support gamification (progressive challenges) and what gamification requires in terms of visually inspiring and informative contents (badge families, connected badges). Then, the planner should consider how these badges help to visualise studies to enhance customisation (optional choices) and intrinsic motivation. In essence, the cyclical model represents a form of continuity in innovative development (Bereiter, 2002).

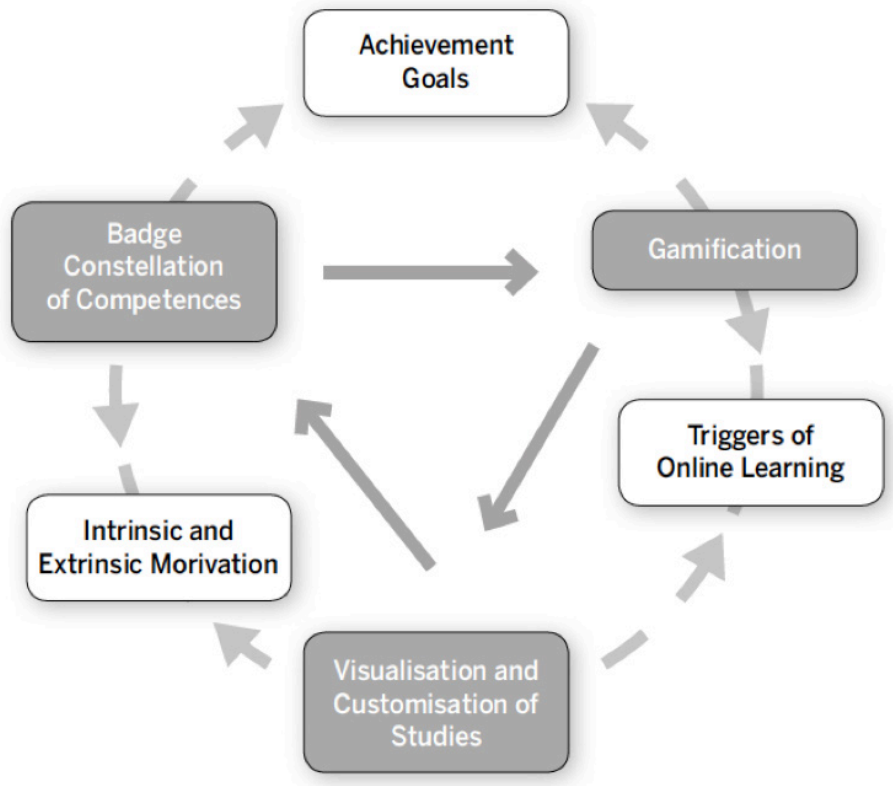

Figure 9. The design cycle and theoretical cross-relationships and dynamics (Brauer et al., 2017, p. 20).

In addition to gamification, the dimensions of interaction design and game mechanics can be applied in designing gameful digital open badge-driven learning. The principles of interaction design can complement people's different needs both in their working and daily lives (Rogers, Sharp, & Preece, 2012, p. 9); the preconditions have mostly focused on identifying the purpose of a design, not on how to get there (Deterding, 2015). Deterding (2015) claims that game design should be concerned with just that: "designing interactive systems around experiential goals" (p. 302). However, after adding filters of layers to the theoretical approaches (sub-study I) at each stage of the simplistic process

model (see Figure 8.), we arrive at a view similar to a kaleidoscope. It allows us to focus on each stage using several approaches (Figure 10), not simultaneously but in stacks.

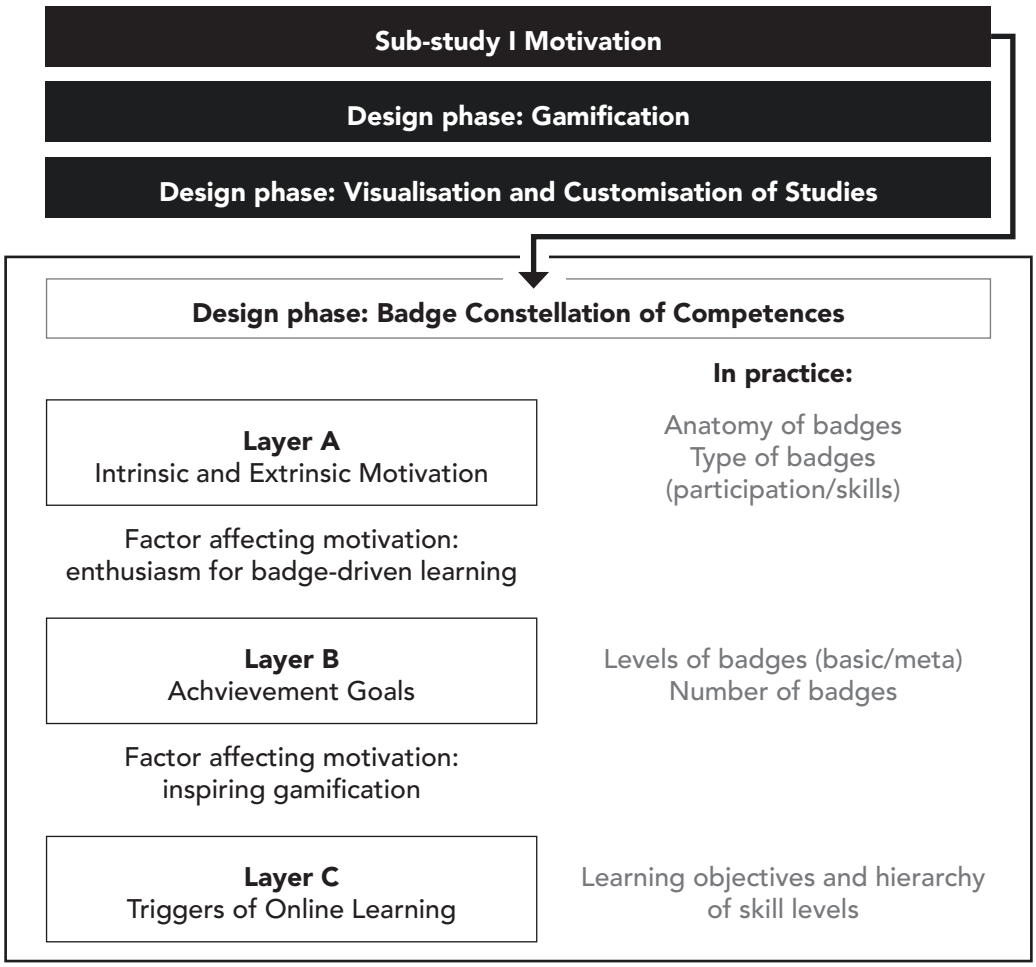

Figure 10. Example of different layers in the creation of badge constellations, adopted from Brauer, Siklander and Ruhalahti (2017, p. 17-19).

The first sub-study presents an additional design layer of visualisation and customisation of the studies, which is an important layer to consider in designing practical applications. However, the latter studies recognised the concepts of visualisation and customisation to study arrangements, structure and delivery of the studies and thereof flexible study options, as essential triggers of the digital open badge-driven learning process.

When introducing or exploiting digital open badges in regulated studies, developers should note that the standards underlying evaluation are evolving. Learning Online was designed based on the UNESCO ICT Competency Framework for Teachers. This ICT-

CFT has been applied in Finland in the national guidelines. Though these guidelines are not standardised, designers should follow developing frameworks, such as DigiCompEdu (Redecker, 2017) at the European level, and adjust professional teacher education accordingly in order to support continuous professional learning for all staff members (Kools & Stoll, 2016). Nevertheless, the transition from simplistic grading to assessment of competences can be a demanding challenge for both teachers and students (Lee et al., 2017). Lee et al. (2017) consider "the extensive effort necessary to shape an environment favourable for good practice requires the support of educators, understanding of perceptions, time for learning, and opportunities to practice, so that educators can become empowered to push the reformation" (p. 6). Devedžić and Jovanović (2015) further suggest applying a layered "lens-view" to estimate the different value propositions in developing and deploying badge systems. They recommend structuring the layers from the viewpoints of educational institutions and associations, employers and other relevant institutions instead of the stages of the initial learning process.

Regardless of the initial intentions in designing the Learning Online PDP, it seems that the designers of the PDP managed to "explore ways in which even routine activities can be transformed into personally meaningful games that provide optimal experiences" (Csikszentmihalyi, 1990, p. 51). The result may be considered to be a crystallisation and bold expression of creativity as well as a reflection of the expertise of the teacher trainers who designed the concept. However, this research has been necessary in order to make such propositions visible and accessible for further development. Learning Online and the subsequent competence development programs provide teachers with an easily approachable and encouraging way of becoming acquainted with new online practices to identify and recognise competences. Still, future designers should heed Lee et al. (2017) who remind us of the gradual expansion of new standards for grading while noting that shared challenges become shared expertise and finally best practices that can be shared with others. Like Lee et al. (2017), I would like to emphasise the utmost importance of support structures and the online community for both students and designers.

7.2 Methodological Contributions

This study was the first to apply CCA in educational research. CCA originally was introduced as a method for plant ecological research (Oksanen et al., 2017). The technique is an extension of correspondence analysis (CA), which allows the evaluation of different dimensions in the phenomenon. I noted the potential of CCA when Hallikainen (2017) presented his earlier ecological research at the summer research school in 2017. I became curious and further explored the qualities of this descriptive statistical method compared to qualitative approaches that offer to visualise such phenomena in depth. We applied constrained correspondence analysis for the first time in educational research in

sub-study III. As the research progressed, it became apparent that we were even more up-to-date with our research than originally imagined. At the same time, Venuleo et al. (2018) were applying the method in social and human studies, comparing the method to correspondence analysis. We sought to define the qualities of this descriptive statistical method compared to other approaches that could analyse the various qualities related to a phenomenon. I chose this approach because multivariate methods in general offer to provide a visual representation of a complex set of relationships (Borgatti, 1997). In addition, Hallikainen (2017) had presented the potential of the application to visualise and describe various phenomena. I chose to use the phenomenographic approach in order to identify the variation within the same set of participant experiences. Two very different methods explored these experiences with the aim of creating a study design to open a 360° view on the digital open badge-driven learning process.

A recent study by Venuleo et al. (2018) sought out differences between CA (correspondence analysis) (Beh & Lombardo, 2014; D'Ambra & Lauro, 1989; Fisher, 1940; Lombardo & Beh, 2016; Lombardo, Beh, & Kroonenberg, 2016) and constrained correspondence analysis (CCA). According to Venuleo et al. (2018), both methods allow the identification of associative patterns of different expressions. This study is particularly interesting in terms of their initially transcribed qualitative data, which they ran through the part-of-speech tagger (treetagger). Thereafter, they conducted CA in order to identify a variety of different factors that could explain the inertia in the text, i.e., diminishing lexical variability. Venuleo et al. (2018) found CA useful in examining possible dissimilarities. After they conducted simplistic proceedings with CA, they used CCA to analyse the same data. Venuleo et al. (2018) conducted both analyses using the R package (Lombardo & Beh, 2016), and we computed the CCA using R package vegan (Oksanen et al., 2017). Ciavolino, Carpit and Nitti (2015) argue that CCA is applicable when additional information, such as prior knowledge, could affect the final result of the analysis. Therefore, it is important in evaluating different dimensions of the phenomenon and the final multidimensional representation in a situation where an individual respondent cannot be excluded from the study (Venuleo et al., 2018). Venuleo et al. (2018) found "no substantial differences (from the visual/qualitative point of view) between the output of simple correspondence analysis and constrained correspondence analysis based on the incorporation of external information (about context, gender age, and the kind of problem motivating the request for help)" (p. 219). Both approaches resulted in similar characterisation of the dimensions throughout the analysis, allowing Venuleo et al. (2018) to conclude that CA without constraints and CCA results are identical.

In sub-study IV, we offer to deepen the understanding of CCA's characteristics in educational research by combining two very different methods, both descriptive by nature. In parallel, these methods offer an enriched view of a variety of different experiences, adding value to each other by explaining different aspects of the phenomenon. Further, in sub-study IV, the findings of phenomenographic analysis provided a wider range of

variation in experiences than CCA. The phenomenographic approach allows us to hear a variety of different and relevant voices, a negative tone, but also an enthusiastic one. The strength of CCA in educational research seems to be its ability to encapsulate different dimensions and associative patterns of a phenomenon in the same simple plot. Rather than illustrating the voice of the majority, it incorporates different sonorous tones. Based on the findings of Venuleo et al. (2018), it would be interesting to compare the next the results using CA, CCA and phenomenography. As a result of our studies, I argue, that different approaches offer to explain unexpected findings and confirm complementary results. However, involving both in the same mixed research is demanding in terms of the clarity of descriptive and interpretive texts.

8 General Discussion

8.1 Ethical Considerations of Novel Approaches

This study aims to fill the research gap for gamified competence-based learning processes in the professional development of vocational pre- and in-service teachers by structuring the overall process of digital open badge-drive learning in relation to different theoretical concepts related to digital open badges, gamification and the competence-based approach. We have endeavoured to meet the research excellence criteria (REF, 2018) of Finland, which provides guidelines and ethical questions relating to research, as provided by the Finnish National Board on Research Integrity (TENK, 2012). Accordingly, research should address new and complex problems, apply innovative research methods, engage active discussion in the field and prove to be *novel* and *rigorous* both in terms of agenda and research design. *The validity* of qualitative research may be expressed apart from issues in quantitative research. In qualitative research, validity is described in terms of "rigour, credibility, trustworthiness, and believability" (Russell & Gregory, 2003, p. 36). However, Russell and Gregory assert that specific qualitative approaches have moderately different variations in how rigour and validity are addressed in their designs.

The data collection, analysis and reporting in this study was conducted while being mindful that "every human being has the right to privacy" (Behi & Nolan, 1995, p. 712).

These aspects of the study have been reported in chapter four. According to Russell and Gregory (2003, p. 36), "Qualitative approaches arise from specific disciplines and are influenced by theoretical perspectives within those disciplines". In the critical evaluation of this study, it is essential to consider what the study sought to answer and to estimate the clarity and precision of the research questions based on the methodologies (Russell & Gregory, 2003). The multiple research tasks prompted me to utilise mixed methods, culminating with equal integration of both qualitative and quantitative methods. Johnson and Onweugbuzie (2004) explain mixed methods research as "an approach to knowledge (theory and practice) that attempts to consider multiple viewpoints, perspectives, positions, and standpoints" (p. 113). Indeed, the concept of mixed methods has several definitions. Multiple operationalism constructs a validation technique (Johnson & Onweugbuzie, 2004) that is easy to understand by equating it to triangulation as "the combination of methodologies in the study of the same phenomenon" (Denzin, 1978, p. 291).

In this study, I have asked how digital open badges structure the gamified competence-based learning process in the continuing professional development of vocational pre- and in-service teachers. The strength of mixed methods is that the results can describe multidimensional phenomena. I have constructed theoretical and practical approaches for future researchers and educators in the field. The approaches contribute to the overall concept of digital open badge-driven learning and offer to structure the digital open badge-driven learning process. Further, the current study contributes to novel methods of educational research by introducing constrained correspondence analysis as a tool for quantitative research. The methodological choice met my expectations while experimenting with a new method that offered to describe the phenomenon by means of quantitative research. As a researcher, I feel that all of these dimensions are relevant. The topic has opened into new dimensions as I've been growing with the emerging knowledge.

I have conducted this work with co-researchers from different backgrounds, all of whom demonstrate true enthusiasm and willingness to cross organisational boundaries. Ethical values and common research standards enable cooperation within the scientific community and diverse organisations. While membership in the community allows in-depth interpretations of jointly-produced data (Laajala 2015), the different ethical dimensions of research has to be taken into account throughout the process. It has been interesting to do research in networks of various educational institutions linking both organisational practices and individual experiences. Many ethical standards and practices were considered and applied in different communities.

Before proceeding with a full-fledged review of the study, I'd like to emphasise the fact that the process model of digital open badge-driven learning has yet to be explored excluding the studies that I have contributed to personally. There is an evident need to develop knowledge regarding novel approaches to professional learning and competence development. Professionals from different fields of education and technology should collaborate in order to find new solutions to apply to game mechanics (Hämäläinen et al., 2018) in the

innovative design of the digital open badge-driven learning process. Therefore, this study is an important early contribution to the discussion on educational research needs and the practical implications arising from the growing demand to apply digital badging in continuing professional development.

8.2 Limitations of the Study

The study does have limitations, including methodological shortcomings. In sub-study I, the research field of motivational psychology provided similar results using different approaches when exploring factors affecting motivation. The use of computers does not equate to analytic rigour (Russell & Gregory, 2003) even if conducting qualitative data analysis with computers is practical and desirable (Leech & Onwuegbuzie, 2011). Qualitative data analyses software emphasise the comparison of different codes throughout the dataset. According to Leech and Onwuegbuzie (2011, p. 71), "Other types of relationships in the data are not identified and might be overlooked". However, these tools (such as NVivo 11.3.2 used in this study) assist the researcher with qualitative analyses and help to reveal the underlying theories and relationships. Still, the software "does not analyse the data for the researcher" (Leech & Onwuegbuzie, 2011, p. 71). In addition to researcher triangulation, we could have sought greater clarification from participants in order to ascertain whether our interpretations make sense based on participants' different viewpoints and experiences (Russell & Gregory, 2003). This exploration could have been beneficial, especially because the aim of the first sub-study was to explore competence-based assessment and digital badging as a whole, and these results would be vital in structuring more accurate conceptualisations for upcoming research.

Data collection also should be "adequate in breadth and depth" (Russell & Gregory, 2003, p. 38). It is possible that, in sub-studies III-IV, the quantitative sample was not completely random in terms of how we selected active teachers to be respondents (Russell & Gregory, 2003). Further, the sample size was too small to be trusted in obtaining reliable results. A larger dataset would have permitted us to exclude the possibility that our results might be the expression of other latent or unexplored factors related to the phenomenon and therefore provided different results. Further, despite applying an appropriate sampling plan, our research could have been affected by different factors with respect to the variables, the descriptive functions or generalisation of relationships.

As another limitation, the results may be difficult to interpret because multivariate data tend to be mathematically elegant and descriptive (Spicer, 2005). For this reason, the method is not suitable for testing strong hypotheses. In essence, all studies adopted different types of triangulation: researcher, data, theory and methodological triangulation (Denzin, 1978) in order to improve the validity of the research. The consistency of the results and high reliability of strong correlations were confirmed by checking Spearman's

rank-order correlation matrix in both quantitative studies. We enhanced the reliability of the studies by including co-authors independent of the study - that is, not working with PDP – in order to analyse the initial data, for example. In sub-study IV, the researcher's personal perspective was minimised in order to build reliability in the phenomenographic approach. All themes and categories were discussed with another researcher before analysis. In addition, logical relationships were not confirmed until categorisation was final (Åkerlind, 2005b).

Inevitably, this study does still face some limitations related to the researcher's positioning, which may impact the research (Yin, 2009). It should be noted that I have been involved in developing the Learning Online PDP; however, this research does not take a stand on the functionality of the investigated PDP. Also co-authors Ruhalahti (sub-studies I & III) and Korhonen (sub-study II) have been involved in the development of the PDP from the beginning; our assumptions and actions may have influenced the research process, and the results may not be generalisable to other contexts of implementation where the researchers did not influence the proceedings so directly (Barab & Squire, 2004).

Technology-enhanced analysis still depends on the researcher who creates "the keywords, categories, and logical relations used to organise and interpret the electronic data" (Russell & Gregory, 2003, p. 38). Personally, I have tried to maintain my objectivity by distancing myself from the discussions during data collection (giving space to participants in group online interviews and shedding my own earlier role). I also had to dispose of my own expectations in the analysis phase and not force my own views (via researcher, data, theory and methodological triangulation). Finally, I considered how to present the results without focusing on the desired future and educational trends (in an ongoing comparison between theory and data).

8.3 Towards the Future

In the future, vocational teachers will become networked dual professionals in a dynamic, flexible and evolving coaching position (Andersson & Köpsén, 2015; Brauer, 2011; Paaso & Korento, 2010; Ruhalahti & Kenttä, 2017; Ryymin, 2017). The challenges of the modern information society, constant changes in professional life and the developmental reform of competence-based vocational education and training will promote teachers to collaborate across different disciplines and educational institutions to generate shared expertise (Mäki et al., 2015). Different learning opportunities will help teachers to structure a new kind of interaction culture, as a theoretical, practical and communal process.

To ensure teachers' professional development, their training should be considered a competence-development continuum supporting professional growth (Mahlamäki-Kultanen et al., 2014). The challenge in opening up such a continuum in continuing professional development rests in how to facilitate pre-service teachers in creating a personal

plan for CPD – a plan towards motivating them to develop their competences as future in-service teachers and to strengthen their self-motivation as well. The personal CPD plan should improve the quality of vocational teaching and competences in the vocational subjects teachers handle, and it should follow the principles of lifelong learning to meet the current expectations of working life (Andersson & Köpsén, 2015).

We have identified the ongoing changes in the paradigm of continuing professional development (Kools & Stoll, 2016) and noted that these changes necessitate supportive technological and digital pedagogical models. This study contributes to the current educational discourse on competence-based approaches, assessment and professional development. Moreover, the findings allow us to define the process of digital open badge-driven learning. The study identifies open badge management platforms as new learning environments and suggests an application to design badge-driven learning. The work also draws heightened attention to digital badging and gamification in educational contexts. Digital open badges could substantially support the competence-development continuum of professional growth in the contexts of vocational teacher programs, professional development and higher education.

Systematic teacher research offers to improve learning and teaching practices (Borg, 2013; Xerri, 2018a). In modern society, it is essential that teachers structure learning in a way that meets the requirements of digitalisation (Kolls & Stoll, 2016; Redecker, 2017). In the future, digital open badges can be integrated into different studies in order to support the identification and recognition of required competences. The badge constellations include different badge families from a variety of degrees with varying challenges. The open badge management system allows one to acquire competences in formal, non-formal and informal studies. Skills and knowledge may be recognised in small fractions as well as in large sets. Badges describe achievements in greater detail, complementing degree certificates and transforming curricula into personalised degree programs. The process will enable multidimensional dialogue between badge earners, employers, educational institutions and education developers (Brauer, Ruhalahti, & Pakanen, 2018). The criteria for the future skills and knowledge are developing and evolving while staying compatible with the nationwide administration and learning management systems. A common European standard allows one to link badges acquired from different places using the International Europass of Life-Long Learning. Badges offer to inform and improve learning outcomes, but also to scaffold and assess learning, thus allowing efficient use of learning analytics. The student is in charge of his/her own learning process, thus scaffolding them just-in-time instead of just-in-case. Meanwhile, the flow of learning is supported by inspiring gamification.

None of the above illustrates possible future scenarios, but all of the presented issues relate to ongoing or upcoming development projects. For instance, the Teachers' Badges Project aims to create and establish a national digital badges system to support the recognition and acknowledgment of professional competences for vocational teachers

(HAMK, 2018, n.p.). The Chips for Game Skills project (Brauer, Ruhalahti, & Pakanen, 2018) aims to define the criteria for future skills in the gaming industry and to cross the boundaries of educational institutions in order to provide badges based on the needs of working life as proof of the required level of mastery in specific areas of expertise. A new nationwide project of working life pedagogy aims to pilot digital open badges in academic universities and higher education contexts to improve students' working life competences and to enhance alumni cooperation. Further, several projects are developing and evolving, including a revision of the Europass framework, the New Europass and a standard to allow European-wide administration and learning management systems (European Union, 2018). The New Skills Agenda for Europe invites "member States, social partners, industry and other stakeholders to work together on ten actions to improve the quality and relevance of skills formation, to make skills more visible and comparable and to improve skills intelligence and especially information for better career choices" (European Union, 2018, p. 2). In Finland, the CompLeap Project (CSC, 2018) is answering the call to seek out better career choices with gamification. The list of related projects could continue indefinitely – change is evident.

Teacher trainers are in charge of the pre- and in-service training of vocational teachers. They have been the first to serve the educational reform and to see the effects of digitalisation on different disciplines. It is essential that the standards and guidelines are developed on a national and European level; however, to serve the students, trainers need to learn how to apply the competence-based approach in practice and further develop their digital pedagogical competences and practical applications. Based on five years of experience in the development of a competence-based PDP and research into digital badging, I suggest that teacher trainers explore and apply digital open badges in different disciplines. Badges offer to inform and improve learning outcomes, but also to scaffold and assess learning, thus permitting efficient use of learning analytics and inspiring gamification that supports consistent competence development as a continuum.

Furthermore, Finns should develop competences in collaboration and shared expertise (Taajamo, Puhakka, & Välijärvi, 2015). Where people care for each other as individuals, they commit to the organisation's vision and the tasks of improvement together (Hargreaves, 2003; Giles & Hargreaves, 2006). A collaborative culture enhances effective change management in strong professional learning communities (Fullan, 2003; Hargreaves, 2007). Technology-enhanced learning offers great potential for collaboration (Kools & Stoll, 2016), creating new learning communities and shared practices (Drayton & Falk, 2009). Knowledge sharing in collaborative and supportive peer networks may be essential for teachers and educational management (OECD, 2015) as well as for the organisational culture of "inquiry, exploration and innovation" (Kools & Stoll, 2016, p. 45). Individual learning is a precondition to organisational learning, and expertise should be shared and employed by the organisation and its members (Kerka, 1995). Badges may assist in all of these areas.

However, different stakeholders have various value expectations of badges. Frameworks of knowledge provide differing interpretations of national and personal development (European Commission/EACEA/Eurydice, 2018). The DigCompEdu sets a European-level requirement defining educator-specific digital competences (Redecker, 2017). However, previous studies have not been able to determine how teachers generate and use pedagogical content knowledge (Abell, 2008) and related frameworks; the knowledge transformation process has yet to be explained. In practice, digital open badges offer to inform and improve both professional development and professional knowledge constructions. As a matter of fact, it is truly delightful to imagine the colourful badge constellation of 22 different competences in DigCompEdu (Redecker, 2017) organised into six families of connected badges, for instance.

Nevertheless, in some countries, these constellations have been created already. For example, the Dutch higher education model is striving to meet future challenges with open badges and micro-credentials (Kerver & Riksen, 2016). Kerver and Riksen (2016) establish an interest in badges based on options to implement more adjustable demand-driven education that allows "lifelong learners to take modules at different institutions and obtain their degree. Flexible education is no longer based on educational programmes with a fixed curriculum" (p. 6). This situation necessitates new tools to visualise different competences and study paths for acquiring them. For instance, *All Aboard* (2018) is a compact representation of three different strategies (National Digital Strategy; Digital Agenda for Europe; and the Digital Roadmap for Irish Higher Education) applied in Ireland's digital pedagogical development. Finland currently lacks such a standardised framework (European Commission/EACEA/Eurydice, 2018); however, there is a growing need to promote flexible professional competence development and a trustworthy way to identify, validate and recognise different competences.

In the future, more research is needed on how students experience digital open badge-driven learning. Personally, I take particular interest in findings indicating that gamification positively affects student achievement (sub-studies I & III). Also fascinating is the varying impact of gamification on different students at various stages of competence development. Study progress motivates students only to a certain degree, and they find inspirational play through gamification encouraging in continuing their studies. Nevertheless, we have identified the progressive challenges and the extent of required performance to be triggers of badge-driven learning. The results of the third sub-study indicate that gamification depends on challenges that become deeper and more complex, which supports both novice and expert-level students. These challenges motivate them even at the very beginning of their studies when progress remains difficult to understand otherwise. Further, the findings on sub-studies III and IV provide information regarding the motivational effects of gamification and game mechanics, raising the question of whether or not to emphasise various factors for different students at diverging stages in their competence development in order to trigger their learning as efficiently as possible.

Further studies on digital open badge-driven learning are needed to evaluate the linear combinations of different study groups, gamification, collaborations and required forms of evidence. According to Hämäläinen et al. (2018), recent research has identified the game design mechanisms that strengthen collaborative learning (e.g., Reuter, Tregel, Mehm, Göbel, & Steinmetz, 2014; Rocha, Mascarenhas, & Prada, 2008; Zagal, Rick, & His, 2006). Hämäläinen et al. (2018) state that the "diverse game mechanisms used in the game design raise different collaboration activities that should be taken into account in educational game design". Based on the results of sub-studies III and IV, it would be intriguing to study the game mechanics that promote collaboration in gamified settings, such as competition (Bartel et al., 2015). In addition, I am looking forward to studying and applying novel methods of educational research that may describe phenomena either by limiting the variation (e.g., descriptive statistical methods like constrained correspondence analysis) or by using methods that show the whole spectrum of varying experiences, such as phenomenography.

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Original Publications

Motivation in Digital Open Badge-Driven Learning in Vocational Teacher Education

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Abstract

Digital open badges, a set of micro-credentials, have recently been introduced as tools for digital identification and recognition of expertise acquired in practice or through studies. The current study aims to examine what motivates students in the badge-driven learning process. The theoretical framework focuses on concepts of achievement goals, triggers of learning, and intrinsic and extrinsic motivation. Data were collected in 2016 from group interviews (n=6) of in-service trained professional teachers

(n=17) and pre-service students of vocational teacher education (n=12) who earned 645 badges over one year in a Learning Online PD program. The research was conducted via data-driven content analysis. Results revealed several variables affecting motivation: progressive challenges and the extent of required performance, enthusiasm for the badge-driven learning, study progress, inspiring gamification, the option to study regardless of time and place, and optional study paths. This paper informs future researchers aiming to understand how badge-driven learning supports motivation.

Keywords: *motivation, digital open badges, vocational teacher education, digital pedagogy, professional development*

Motivaation ilmeneminen digitaalisin osaamismerkein ohjautuvassa oppimisessa ammatillisessa opettajankoulutuksessa

Tiivistelmä

Digitaaliset osaamismerkit on otettu käyttöön eri tavoin saavutetun osaamisen tunnistamisen ja tunnustamisen välineenä. Tutkimuksen tavoitteena on kuvata, mikä digitaalisten osaamismerkkien käytössä motivoi opiskelijoita oppimisprosessin aikana. Teoreettinen viitekehys perustuu saavutusorientaation, oppimisen virikkeiden sekä sisäisen ja ulkoisen motivaation käsitteisiin. Tutkimusaineisto kerättiin vuonna 2016 ryhmähaastattelemalla (n=6) digipedagogiseen täydennyskoulutukseen osallistuneita ammatinopettajia (n=17) ja ammatillisen opettajankoulutuksen opiskelijoita (n=12), jotka ansaitsivat vuoden aikana 645 osaamismerkkiä Oppiminen Online -osaamisenkehittämisohjelmassa. Aineistolähtöisen sisällönanalyysin perusteella esitämme motivaatioon vaikuttaviksi muuttujiksi seuraavat: tehtävien haastavuus ja vaadittu laajuus, osaamismerkeistä innostuminen, oppiminen ja opinnoissa edistyminen, innostava pelillisyys ja mahdollisuus opiskella asiat ajasta ja paikasta riippumatta vapaavalintaisessa järjestyksessä.

Avainsanat: *motivaatio, digitaaliset avoimet osaamismerkit, ammatillinen opettajankoulutus, digipedagogiikka, osaamisen kehittäminen*

Introduction

Digitalisation has changed society in terms of how we work, teach, learn and assess learning. As a result, it has become socially significant to increase individuals' competences in order to meet the requirements and needs of working life. McClelland describes competences as achievements acquired through training and development rather than proof of intelligence (1973; 1998). The European reference framework of key competences for lifelong learning (European Union, 2006, p. 3) emphasises that "competence" involves not only essential knowledge but also the skills and attitudes applied appropriate to context. The Centre for the Development of Vocational Training defines competence as the ability to apply learning outcomes adequately in education, work, personal or professional development; these outcomes inclu-

de knowledge; skills; and personal, social, and/or methodological abilities (Cedefop, 2014).

Digital badges are electronic microcredentials that can be used to identify and promote competences. Badges (such as the Mozilla Open Badge) refer to the student's, the earner's, participation in education or skills development; they may also be awarded following completion of a certificate. The Open Badge architecture is built upon an identification image, graphic or icon and the accompanying information content. This content shows the name of the badge, issuer identification, the knowledge and expertise criteria required, and a description of the evidence (e.g., an online document) (Abramovich, Schunn, & Higashi, 2013; Brauer & Ruhalahti, 2014).

Many studies have noted the promise of digital open badges (Hickey, Willis III, & Quick, 2015). The problem in digital badging is that we don't know their full potential. It is difficult to estimate the value of badges compared with the existing certification system, for instance. Anyone can create Open Badges and recognise the achievements of others (Mozilla Open Badges, 2017), and there exist few practically tested pedagogical models available. This limitation makes it challenging to design optimal digital open badge-driven learning processes. Therefore, this study aims to examine what motivates students in the badge-driven learning process.

Theoretical Framework

The eclectic approach of the study involves three concepts intended to open up the phenomenon: 1) achievement goals (cf. Elliot, 1999), 2) triggers of online learning (Glen & Wilkie, 2000; Hidi, 2000), and 3) intrinsic and extrinsic motivation (Abramovich et al., 2013; Reiss, 2012). These entities differ conceptually, but, in this context, they include the same phenomena. In this study, we focus on mapping theories to cluster students' experiences of stimulating and supportive digital open badge-driven learning. As a complex process with dimensions of online learning and gamification, mapping forms a more detailed theoretical sketch of badge-driven learning. This study provides options to deepen the perspective in the upcoming studies and practical applications.

Achievement Goals

Achievement goals are constructed of mastery and performance objectives reflecting the accomplishments in a particular situation (Barron & Harackiewicz, 2000; Pintrich, 2000). According to Pintrich (2000), the construction often refers to individuals' reasons for pursuing achievement while representing purposes like mastery or superiority of an academic learning task. Performance is judged based on a specific criteria or targets. As a student, a teacher often plans to use situation-specific strategies to attain outcomes. These strategies are important aspects of self-regulation in learning and goal-setting processes (Fryer & Elliot, 2007).

Achievement goals represent an important part of the structure of gaming and gamified learning solutions. Competence-based badges used by the Boy Scouts or military are commonly offered for learning as a merit, a practice sharing the same features as game models. Abramovich et al. (2013) confirm that badges are similar to videogame achievements, as badges

can be awarded for incidental activities as well as skills mastery or demonstration of knowledge. In addition, a player's success on a videogame is viewable to other players; similarly, the badge earner is able to share badges with peers within institutions or within the general public. Reid, Paster and Abramovich (2015) describe such phenomena as "game-like encouragement": in educational settings, badges are often used to recognise learning and to motivate the learner. The idea of gamification is to use elements of gaming in a new context aiming to motivate users of the product or service towards a desired behaviour. These online systems seek to arouse people's enthusiasm to learn, similar to the excitement of playing games. As such, designing engaging gamification to support motivation in nongame systems is a new area of interest for practitioners and researchers (Deterding, 2012; 2015).

Triggers of Online Learning

The trigger is the initial stimulus (Glen & Wilkie, 2000) used by students to help them learn (Roberts & Ousey, 2003) and to communicate, reflect and react. Hidi (2000) defines triggering as "the first stage of situational interest". She suggests that maintained situational interest may lead to increased knowledge if the situational interest continues. When triggers are used to maintain situational interest, Hidi (2000) considers it to be intrinsically motivated behaviour. Situational interest may move the learning process beyond the development of individual interest to personal enthusiasm for creating new hypotheses (Hidi & Harackiewicz, 2001). Interest-triggered learning activities enhance deep-learning and help the student to meet the set requirements and criteria (Krapp, 2002).

Interest-triggered learning activities enhance deep-learning.

The latest educational research (Järvelä & Renninger, 2014; Renninger & Bachrach, 2015) indicates that interest, motivation and engagement build a process with triggers playing a key role by cultivating and maintaining student interest. According to Krapp (2002) interest is content-specific. Waheed, Kaur, Ain and Hussain (2015) found that autonomous and easy accessibility in online learning environments intrinsically motivates further education students. Roberts and Ousey (2003) have stated that triggers can be presented in a variety of ways to develop problem solving while ensuring that students enjoy their learning. Trigger development takes time, practice and dedication to the concept (Roberts & Ousey, 2003). Clearly, a better understanding of the triggering process could make a significant contribution to the design of online learning environments.

Intrinsic and Extrinsic Motivation

Digital badging is considered to be a form of motivation to assess competences and to structure studies (Ahn, Pellicone, & Butler, 2014). Scholars have posited two types of motivation, intrinsic and extrinsic (Reiss, 2012). As a result of their studies Verhagen, Feldberg, van den Hoof, Meents, and Merikivi (2011) suggest taking both intrinsic and extrinsic motivation into account when predicting and explaining behaviour. Individual interests differ by quality and quantity as a child's intrinsic proactivity later turns into a de-

veloped interest (Krapp, 2002). The theoretical foundation of intrinsic quality is the concept of undivided interest; the results are similar for interest-based activities whether the task is compulsory or play (Krapp, 2002). However, the motivational pull of game design elements in non-game contexts is considered situated (Deterding, 2011), underscoring the importance of studying the triggers of interest in more detail. Krapp (2002) discovered that interest research is compatible with the concept of self-determination theory (SDT), a connected macro-theory of human motivation (Deterding, 2011; Ryan & Deci, 2002). Deterding (2011) considers motivational affordances and SDT to be a promising approach for systematically conceptualising gamification in non-game contexts. For online studies, it seems that we should observe the intersectionality of intrinsic and extrinsic motivation given that the dual view might be rather simplistic in terms of contextual effects and motivation itself.

Abramovich et al. (2013) suggests an interplay between different types of learners and different types of badges earned as motivators. They found that learners' prior knowledge and experiences with the domain being badged influenced how quickly and easily badges were earned. They theorised that badges awarded for participation would increase motivation for all users. In addition, skill badges were associated with motivational changes in the content area of the badges themselves. Students considered badging significant if they valued a specific badge. Abramovich et al. found evidence that skill badges support high-performing students familiar with the topic; hence, the effect on low-performing students might be motivationally negative, and badges could be considered extrinsic rewards. This finding corresponds to Deterding's (2012) assertion that the "entity being gamified needs to have some intrinsic value already — a reason for users to engage with It".

Intrinsic motivational orientation is seen to moderate linear relationships between learning assignment difficulty and enjoyment, such that students high in intrinsic motivational orientation enjoy more difficult assignments than individuals with a low intrinsic orientation (Abuhamdeh & Csikszentmihalyi, 2009). When changing the perspective in gamified applications and the flow of optimal experience, "challenges should be balanced relative to the player's perceived current ability such that they appear neither too hard nor so easy that they generate no uncertainty before nor competence upon overcoming them" (Deterding, 2015, p. 299; Csikszentmihalyi, 1990). Deterding (2015) underscores the importance of motivating, enjoyable experiences, providing students the option to choose "to tackle a challenge for the sake of enjoyment". Intrinsically motivated activities provide their own inherent reward, so motivation for these activities does not depend on external rewards (Deci, 1971; Ryan & Deci, 2000). Using an operational definition, "fun" challenges also mean "free choice". By comparison, Ryan and Deci (2000) explain that extrinsic motivation refers to doing something because it leads to a separable outcome; therefore, behaviour is driven by the instrumental value of the learning activity.

Modern interest research has produced a variety of conceptualisations and theoretical definitions (Krapp, 2002). With many crossover interests, motivation and gamification research draw on an interesting net of eclectic theories. However,

these approaches are not mutually exclusive. It would be simplistic to set badges as achievement goals (in the literal sense) in the gamified learning process. In learning research, understanding the basics of gaming mechanics is not enough, particularly when seeking to maintain and cultivate the student's interest in learning. Current models of online learning are not directly applicable to the entity of the gamified badge-driven learning process. Deterding (2011) sought out the motivational dynamics of gamified applications. Similarly, we are considering the cross-relations and dynamics of motivational badge-driven learning by means of theoretical mapping.

Methodology

Research Question

This study aimed to examine the digital open badge-driven learning process related to the competence-development continuum of vocational teachers, in particular the identification and recognition of digital pedagogical competences. The research objective was to reveal what motivates students in the badge-driven learning process?

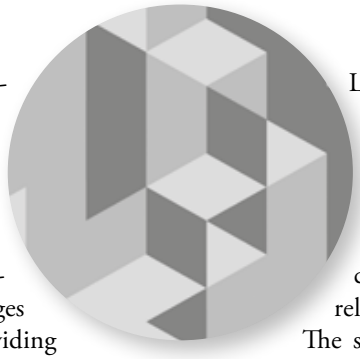
Participants and Context

Participants were Finnish in-service trained professional teachers (n=17) and pre-service students of vocational teacher education (n=12). The study included both men and women with a previous higher education degree in a professional field. They were invited to group interviews based on their achievements in the Learning Online PD program. The participants represented badge earners on every level of the Learning Online requisite ICT-skill set based on the national ICT-competence framework. Therefore, they were known to be competent at operating online and would find it natural for data collection to be implemented with new means. The groups of interviewees were similar in terms of background, online experience and professional networks.

The context of the study was a competence-based vocational teacher education, both in-service and pre-service training focusing on competent professionalism instead of abstract learning goals. The pedagogy originates from professional growth and learning as a process. The digital pedagogical training for teachers supports the principles of life-long learning. This learning emerges from competences the individual needs in work, growing with the community's shared expertise and collaboration (Oamk, 2015, pp. 4-12)

Learning Online

Funded by the National Board of Education in Finland, Learning Online is a national professional development program for vocational teachers started in 2014. Learning Online was built on a national ICT-competence framework (Ope.fi) aligning with the Unesco ICT competency framework for teachers. The requisite skill sets consist of three levels, and assessment is based on identification and recognition of competences. The learning process on Learning Online is facilitated by a MOOC (Massive Open Online Course) with gamified elements. Learning Online provides approximately 50 different subjects for online study (http://www.oppiminenonline.com) at one's own pace. An online training session on a specific subject is offered for each badge on the skill set to allow the student to meet the badge criteria.



Digital badges are issued based on an application, in accordance with the criteria displaying the expertise achieved in detail. Location-based teams compete online, collecting badges that are earned by providing evidence of a skill competency online. Seeking to motivate peers and achieve better results, the leaderboard indicates a team's performance based on badges earned while playing at the defined skill set. The participant-centred pedagogical model aims to inspire and encourage teachers to share their existing and updated digital pedagogical expertise within their working communities.

Study Design and Technological Settings

Group interviews were organised through Adobe Connect web conferencing software, which enables voice over internet protocol, online screen sharing, simultaneous chat discussions and recording of the active view. In addition to Adobe Connect recordings, the sound was recorded separately in the IC recorder and the texts were copied as separate files to back up the data collected.

At the beginning of the meeting, the interviewer presented the process and ethics of the research. The interviewees confirmed their consent for the use of collected material by participating in the interview and selecting "agree" on the system function keys.

The interviewer controlled both the discussion and group dynamics in the guided group interview (Ronkainen, Pehkonen, Lindblom-Ylänne, & Paavilainen, 2013, p. 116). The technical setting and study design was optional for participants as they felt themselves capable, comfortable and relaxed operating online. The study situation provided an opportunity to reflect on the experience, and the interviewer sought to ensure sufficient space for interviewees to describe their own thoughts, encouraging participants to share their stories.

Data

Data were collected from group interviews (n=6) with teachers (n=17) and teacher students (n=12) who earned 645 badges over one year. All online group interviews were implemented in the spring of 2016, and data from all six sources were transcribed. The pseudonymised data reveals only elements that will help to describe and understand the context of the study (Cortazzi & Jin, 2006). The transcription provided 439 minutes and 141 pages for analysis.

Analysis

Methodologically, the research was conducted via data-driven content analysis (Schreier, 2012) using NVivo 11.3.2 software. The content analysis focused on identifying significant factors affecting motivation in badge-driven learning. We categorised data into hierarchically inclusive relationships and analysed with ongoing comparison. The unit of analysis was a phrase, sentence or other short expression of words that captured the meaning of an aspect related to the phenomena.

Table 1. Coded Data Compared by Sorted Data Resulting Motivation

Coded Data		Result Data	
Expressions Total	1224	Nodes Total	316
Cases Total	57	Cases Total	18

The main coding categories were formed in a data-driven manner based on the relationship between subcategories. The inductive thematic analysis revealed variables affecting motivation, as can be seen in Table 2.

Table 2. Main Coding Categories Compared by Coding References

Nodes	Sources	References
Progressive challenges and the extent of required performance	6	91
Enthusiasm for badge-driven learning	6	67
Study progress	6	58
Inspiring gamification	6	55
Option to study regardless of time and place	4	28
Optional study paths	5	17

The saturation of the data assisted in merging the categories within the coding process. Table 3 exemplifies these subcategories based on nodes and node frequencies.

Table 3. Example of Subcategories of Enthusiasm for the Badge-Driven Learning

Enthusiasm for badges	5	27
Enthusiasm for studies	6	25
Perceived value of badging	3	15

Enthusiasm for badges included the following initial codes (examples):

- *It was interesting to seek more badges (based on existing competences), and on the other hand, to jump to a strange, new thing that gives you basic info. Say, for example, 3D was for me such a relatively strange topic. It felt pretty exciting that I also learned some basic information about that by achieving the badge for myself.*
- *I think those badges are so cool to do - a bit at the time and somehow I learned so well.*
- *I was excited about this because competence-based assessment works really well here. If you know how to do something, you do not have to do it again from the beginning.*

In the final outcome, we clustered the results with a mapping of the theoretical framework. Clustering was relational to

the research question and revised via triangulation in order to increase the validity of findings.

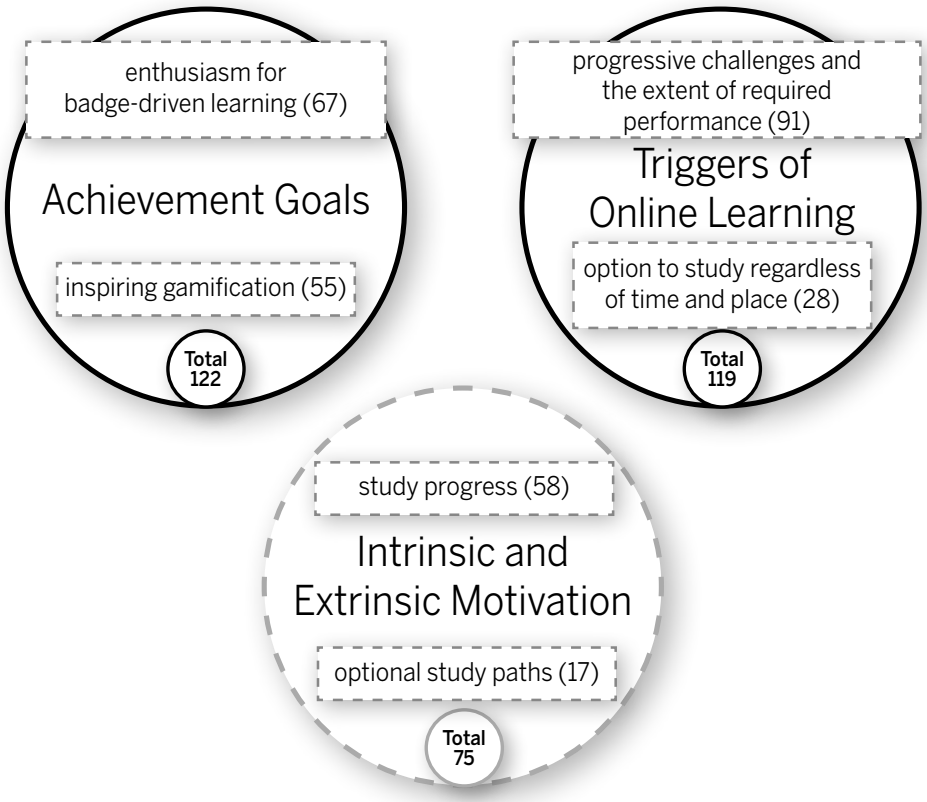


Figure 1. Clustering data

The mapping consists of the theoretical framework of achievement goals and of intrinsic and extrinsic motivation, both of which are emerging in badge-related studies of motivation (Abramovich et al., 2013; Ahn et al., 2014) and in studies of gamification and game-like encouragement (Deterding, 2011, 2012; Reid, Paster & Abramovich, 2015). Previous research has not identified the pedagogical or gaming-mechanics elements that trigger student activity in badge-driven learning in practice. Although the results of assignment difficulty and study arrangements could have been explained using the previous theory, interest-triggered learning activities (Krapp, 2002) and the triggers of online learning (Järvelä & Renninger, 2014; Renninger & Bachrach, 2015) were included in mapping, because the theory suggests that triggers may provide a success key for gamified solutions (Sailer, Hense, Mayr, & Mandl, 2017). We investigate whether triggers also explain how gamification in practice turns badges from certificates into activating tools of learning.

Findings

The aim of the study was to examine what motivates students in the digital open badge-driven learning process. The results reveal six main variables affecting motivation. The clustering (Fig. 1) of quantified results indicates that motivation in digital open badge-driven learning is based more on achievement goals and triggers of online learning than factors of intrinsic and extrinsic motivation. However, these concepts relate to one another as complementary aspects of the phenomenon and the significance of each theoretical approach is emphasised related to the clustered results.

Data-driven thematic analysis revealed the importance of *achievement goals* (122) in designing digital open badge-driven learning. Participants' *enthusiasm for badge-driven learning* (55) indicates that competence-based assessment may attract pre- and in-service vocational teachers to learning. Students get excited about the badges, but above all, about learning new, tangible things:

> *"It was more sensible to do something properly and apply it in my own work. Sometimes I used some old stuff (to demonstrate a competence), but several tasks required the use of a specific tool. It has been really useful to me. Knowledge has become homogeneous with the fact that there aren't whole black areas, like 'I'm not familiar with it and I'm not using it.' These kind of assumptions disappeared altogether."* (In-service teacher on skills set developer-level III)

Inspiring gamification (55) enhances learning because participants begin to keep track of their learning in terms of what to learn next and how to reach the target level as soon as possible. Participants in study groups were even betting on who would reach a certain level first and collect the most badges. Participants who had considered themselves "anti-gamers" became excited about the game and found badge achievement refreshing.

> *"Yes, it was a big motivator and you craved more. I also did a batch of badges at a time or in waves. I had that flow on."* (In-service teacher on skills set expert-level II)

Designing and implementing effective gamification for online learning requires that participants find both new challenges and demonstration of competences rewarding. Research indicates that *triggers of online learning* (119) affect motivation. By identifying progressive challenges and the extent of required performance as triggers, we specify badges as a tool to structure and activate studies.

> *"I have been able to create my own schedule and my own task order, and I've also looked for the background materials quite a lot myself. My role as an expert is emphasised in this way. The assignments are not fixed."* (In-service teacher on skills set novice-level I)

The formulation of learning objectives and badge criteria should vary, not rise linearly, both by complexity and extent to maintain and cultivate the students interest. The criteria required should inform the scale and challenge of the demonstration of competence and evidence required. Relatively small assignments inspire studies regardless of time and place:

> *"The competition between teams was nice, but the most important thing was playing. I used to play Mafia Wars for four hours a day until my husband banned it. This is how I satisfy the craving when going to bed but not feeling sleepy yet. One more. I got one more badge. It*

seemed to me the best quality (of education), the most addictive and interesting learning experience of my life, although not an easy achievement." (In-service teacher on skills set developer-level III)

Successful studies motivated students to a certain degree; however, it is more important to build badge constellations of competences and to incorporate these into inspirational play through gamification. Though trainers considered badges suitable for visualising the study path, the students did not find it particularly important in this context. Nonetheless, participants in Learning Online enjoyed customising the study path. The autonomy and freedom to choose between different challenges motivated students to demonstrate existing competences while allowing them to focus on content directly applicable to their working lives.

Discussion

This study sought to examine what motivates students in the digital open badge-driven learning process in the context of vocational teacher education. We suggest a practical implication in the design process of digital open badge-driven learning.

The practical implication is concluded as a result of a reasoning chain in which the resulting variables affecting motivation are linked to the practical level of the design process. Based on a clustering of the findings, the theoretical approach connects to the design phase of badge-driven learning, providing the option to view each phase through different layers based on previous research. A similar multifaceted approach, called "game design lenses," is presented to instruct designers how to review game designs and domains from different perspectives. This concept of design lenses provides an example of a model suitable for studying multifaceted concepts, even though Deterding (2015) considers the approach difficult to apply beyond games. Focusing the theoretical approach on a phase-by-phase basis deepens the design process of badge-driven learning, as shown in Figures 2–4. However, neither the sequence of layers (A–C) nor the design phases appear in the same order in every design cycle; hence, the layer and practice may connect otherwise.

Figure 2. Example of different layers for the creation of the badge constellation

The design phase of the badge constellation of competencies involves the creation of badges and the definition of badge levels (basic/meta) to support enthusiasm for badge-driven learning and to inspire gamification. The findings suggest that achievement goals are the most suitable layer to look at in this design phase; however, achievement goals are necessarily tied to intrinsic and extrinsic motivation, which, as the theoretical framework, enables a review of the badge constellation—for example, by the relation and ratio of different types of badges (badge of participation/skills badge). Badge constellation structures gamification of learning. Game-like encouragement relates to the theory of achievement goals (Reid et al., 2015), but a change of perspective to the triggering of online learning focuses the design process of badge constellation on the activation and maintaining of learning (Hidi, 2000). Formulation of learning objectives or badge criteria are triggers that stimulate (Glen & Wilkie, 2000) students and enhance learning (Roberts & Ousey, 2003; Krapp, 2002). Gaming might provide an alternate framework for the process of thoughtful experience and interaction (Deterding, 2012).

Figure 3. Example of layers for gamification

Similar to the visible achievements of gamers, gamification of the digital open badge-driven learning process has the potential to motivate students (Abramovich et al., 2013; Reid et al., 2015). Challenging learning assignments reflecting real life are significant for gamification as triggers of online learning and intrinsic motivation (Abuhamdeh & Csikszentmihalyi, 2009; Roberts & Ousey, 2003; Deterding 2015). Assignment difficulty refers to enjoyment in gaming (Deterding, 2015; Roberts & Ousey, 2003), the flow of optimal experience (Csikszentmihalyi, 1990) and superior performance. Triggers cultivate and maintain student interest during the learning process (Järvelä & Renninger, 2014; Renninger & Bachrach, 2015).

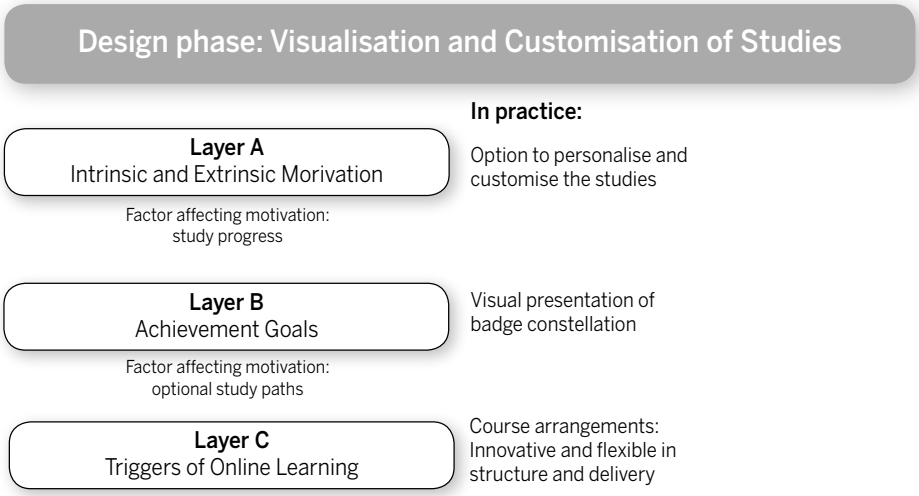


Figure 4. Examples of layers for study path visualisation

Badge constellation visualises the opportunity to customise studies to the achievement of personal goals. Our findings indicate that teachers' motivation in digital open badge-driven learning may be related to pre-ability and mastery of skills and competences. These results align with Abramovich et al. (2013) who indicated that the success of high-performing, competent students does not depend on participation badges but on skill badges. Badge achievement positively confirms students' beliefs regarding their current abilities, and these students expect to succeed. In terms of gamification, assignments should not appear too difficult or easy (Deterding, 2015). Visual presentation of badge constellation is part of the learning environment and should support easy access to learning material and flexibility regarding the time and place of learning to motivate further education students (Waheed et al., 2015).

The findings suggest that study path visualisation constitutes an interface for customisation. Digital open badges visualise the learning process further (Davies, Randall, & West, 2015) making it easy to study. Learning Online PD program provides a perfect example of a gamified learning application with reduced complexity. Deterding (2012) claimed the simplest components of gamification to be badges, levels, points, and leaderboards. Based on a few elements of gaming, Learning Online has already proved successful in terms of both quantity and quality of learning outcomes. In a user-centred theoretical framework, Nicholson (2012) articulates useful design values for meaningful gamification, such as user centricity, transparency and personalisation (cf. Deterding, 2015); however, no actual methods are provided in this framework. Deterding (2015) explains that existing research often identifies challenges and requirements from the perspective of gameful design, which includes ludic qualities or gamefulness in nongame contexts. Gamification seeks to increase motivation using game design elements to create systems affording the motivating, enjoyable experiences characteristic for gameplay. This mo-

del provides a practical approach for designing competence-based challenges and needs to be reviewed further.

The studied experiences and experiment form a cyclical model of design emphasising layers of theoretical aspects shown in Figure 5. The concepts cross-relate to one another as complementary aspects of the phenomenon, even though the practical choices of the design process recur stepwise in cycles. The nodes of emerging solutions, as well as the constraints preventing the development of innovation, may be processed one challenge at a time (Bereiter, 2002).

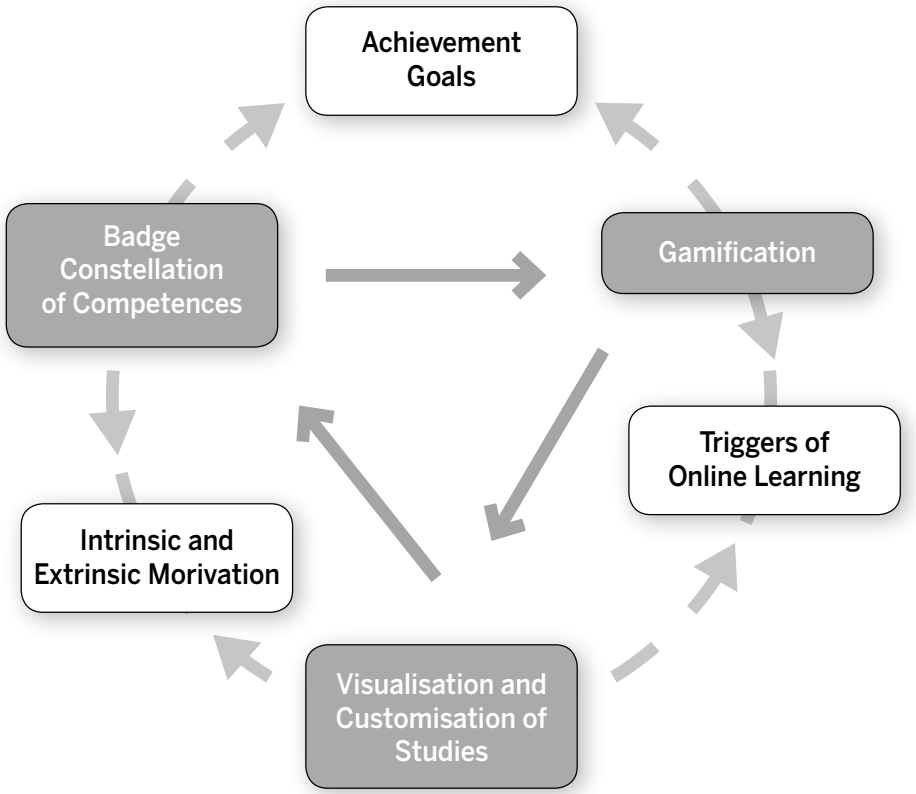


Figure 5. Design cycle and theoretical cross-relations and dynamics

Figure 5 illustrates the steps of the design process in practice, and it facilitates practical choices from the theoretical frameworks. The positioning of each theoretical approach in relation to the findings is emphasised. The figure facilitates the selection of a theoretical approach for studies of badge-driven learning and gamification visualising options, which will deepen the perspectives of future studies and practical applications.

In the future, the cycles of pedagogical design and developing learning solutions will provide both educational innovation and theoretical knowledge of learning.

The cycles of the model presented in this paper may give rise to a continuous model of innovative development (Bereiter, 2002) and a deepening circle that will facilitate the visualisation of future trends and address the needs of future research. It is essential to continue exploring connections between gamified learning processes and triggers. Similar to Reid et al. (2015), we believe that a hybrid model of competence recognition and gamified learning applications could maximize impacts on learner achievement and intrinsic motivation. However, badges may become extrinsic motivators when the process is not planned carefully. Deci, Koestner and Ryan (1999) noted that people receiving less than optimal rewards signifying competence are less likely to perform up to the specified standards. Likewise, Abramovich et al. (2013) found that it may be highly detrimental when people fail to achieve the maximum reward because this structure conveys negative competence information.

The study does have limitations. Two authors of the article have been involved in the development of the PD program from the beginning; however, this research does not take a stand on the functionality of the system. Furthermore, the research field of motivational psychology provides similar results using different approaches to explore factors affecting motivation. The aim of the current research was to further explore competence-based assessment and digital badging as a whole. These results will be used as a tool for more accurate conceptualisation in upcoming research.

This paper may inform future researchers seeking to understand how badge-driven learning supports motivation and enhances learning outcomes in higher education. The challenge for the future is to define how student guidance during the digital badge-driven learning process affects motivation and learning outcomes. Gamification initiatives and implementation of new technologies provide novel possibilities for combining gamification with digital badging more efficiently while improving learning outcomes.

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Digital professional learning: triggers in an online badge-driven process

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Digital professional learning: triggers in an online badge-driven process

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Abstract

Digital open badges describe in detail the expertise and professional competencies achieved in digital environments. “Learning Online” is a Finnish national professional development programme (PDP) of digital pedagogical competencies for vocational teachers. This study aims to identify the students who are particularly motivated by digital open badge-driven learning. The research question asks what triggers learning in such a badge-driven process. The data were collected in 2017 from in-service trained professional teachers and pre-service students (n = 329) of vocational teacher education who have earned digital open badges in a Learning Online PDP. A questionnaire was used to collect data, and a constrained correspondence analysis was conducted to analyse the data.

The theoretical approach focuses on the concepts of gamification, the triggers of online learning and the triggering effect of gamification in learning. The study is based on recognized variables affecting motivation in badge-driven learning: progressive challenges and the extent of required performance, enthusiasm for the badge-driven learning, study progress, inspiring gamification, option to study regardless of time and place and optional study paths. The results indicate differences and similarities in the experiences associated with achieved skill-set levels. The findings also suggest applying gamification and digital badging for the professional development of both pre- and in-service teachers; gamification motivates students, especially in the beginning of their studies. Furthermore, the results propose considering flexible study options that include customising studies and learning new and up-to-date competencies triggering digital open badge-driven learning.

Key Words: Motivation, Digital Open Badges, Digital Pedagogy, Professional Development, Constrained Correspondence Analysis

Introduction

Current methods of continuous professional development fail to inspire teachers to advance their own knowledge and skills continuously in working life (Kools and Stoll, 2016). The professional development of vocational teachers should include more than career growth related to their personal career paths or staff enrichment, both of which could be considered a singular form of intervention (Glatthorn, 1995). The Organisation for Economic Co-operation and Development (OECD) has created a survey known as the Teaching and Learning International Survey (TALIS, 2018). This survey assists countries in identifying challenges related to changes in educational paradigms while following the development of teachers' professional competences using various measures (Taajamo, Puhakka and Välijärvi, 2015). According to the results, the greatest challenges faced by Finnish teachers in developing their skills involve the use of information and communication technology (ICT). The great autonomy of Finnish teachers reflects a belief in their responsibility to enhance their own competences, yet tteachers rarely have a personal development plan; such a plan would focus on their specific training needs based on the competences required to implement a specific curriculum or set of degree requirements (OKM, 2016). The skills and knowledge acquired during the professional teacher training (60 ECTS credits for a teacher's qualification) are insufficient for a vocational teacher's entire career. This research focuses on these challenges in the context of Finnish professional teacher education.

To ensure teachers' continued professional development, their training should include a competence-development continuum supporting their growth (Mahlamäki-Kultanen *et al.*, 2014). The challenge in opening up such a continuum rests in supporting pre-service teachers in creating a personal plan for their ongoing professional development – a plan motivating them to develop their competences as future in-service teachers while strengthening their self-motivation. The Teacher Education Forum examines the challenges and opportunities for national development in Finland and suggests that pre-service teachers prepare a personal plan for developing the competences they will need in working life; the Forum also asserts that in-service teachers then should review these plans in relation to the development goals of their employing educational institution (OKM, 2016). According to Andersson and Köpsén (2015, p. 1), 'vocational teaching as a profession is based on a type of dual professionalism'; furthermore, 'vocational teachers are expected to be well qualified and up-to-date in the vocation they teach to meet the current expectations of working life'. As such, a teacher's personal plan for continuing professional development should aim to enhance the quality of both their teaching and their competences in their respective vocations. Following the principles of lifelong learning, professional development should be embedded sustainably in their daily practices, supporting the development of their profession (Kools and Stoll, 2016).

The working life and digitalisation of vocational education impose new demands on teachers' competences in digital pedagogy and efficient ICT use in learning (Koramo, Brauer and Jauhola, 2018; Ruhalahti and Kenttä, 2017). Digital technologies are changing current teaching and learning practices, leading to the formation of numerous guidelines and frameworks. For instance, the United Nations Educational, Scientific, and Cultural Organization (UNESCO, 2011) has released an ICT Competence Framework for Teachers. The professional competence development program investigated in this study follow national ICT-competency guidelines based on this UNESCO ICT-CFT. Meanwhile, the European Framework for Digitally Competent Educational Organisations (DigCompOrg) also promotes effective learning in the digital era (Kampylis, Punie and Devine, 2015). Such publications offer guidelines for the process of integrating digital learning technologies across Europe. In this context, it has become essential to find new tools for planning and conducting studies. More importantly, it remains important for teachers to achieve and maintain the versatile competences required to thrive in this environment.

Digital open badges offer detailed descriptions of the expertise and competences achieved (Brauer and Ruhalahti, 2014). Digital badging allows the gradual identification and recognition of competences, motivating the learner towards the achievement of intended learning outcomes (Brauer, Korhonen and Siklander, 2017). Siklander and Ruhalahti (2017) recently introduced digital open badge-driven learning as a multifaceted process with several layers that support different aspects of motivation in learning. They consider inspiring gamification to be a key factor in motivation. The progressive challenges in the performance required and intended learning outcomes can encourage enthusiasm for badge-driven learning while positively impacting learners' progress. Furthermore, digital badging supports success on a customised study path by allowing self-determined learning and flexibility in terms of time and place (Brauer, Korhonen and Siklander, 2017; Brauer, Siklander and Ruhalahti, 2017; Gamrat, Bixler and Raish, 2016). Swanson (2013) explains customisation as 'user-generated learning' brought about by contributions to 'a self-selected collaborative space' (pp. 11-12) in which learning happens 'on demand' (Kools and Stoll, 2016, p. 43), anytime and anywhere. Accordingly, all participants become actors in the user-generated process, actively searching for knowledge while contributing to evaluation and sharing. Digital pedagogy offers the potential to foster creativity, play, and problem solving in learning (Spiro, 2013). Spiro (2013) suggests combining theory with practice and creating with thinking in order to design learning that encourages participation, collaboration, public engagement, and even critical understanding of digital environments. Previous research has failed to identify the digital pedagogical tools and game-like elements that trigger student activity in badge-driven learning. There remains a need for up-to-date research supporting the visualisation of a

competence-development continuum; this line of inquiry must consider new directions, such as gamification and novel forms of online learning, especially in higher education.

Triggers of Gamified Digital Open Badge-Driven Learning

The commercial deployment of gamified applications for large audiences (Deterding, Dixon, Khaled and Nacke, 2011) has borrowed the term *gamification* from the digital media industry (Deterding, Khaled, Nacke and Dixon, 2011). The idea of gamification originates from human-computer interactions and game studies, specifically focusing on inventions that apply game elements and techniques in new contexts. Gamification enhances user motivation by arousing enthusiasm mirroring the excitement and enjoyment of playing games (Brauer, Siklander and Ruhalahti, 2017; Deterding, 2012, 2015). Though teachers have used different forms of educational games and gamified learning for years, the literature largely has overlooked this important topic (Kangas, Koskinen and Krokfors, 2017). Digital badges represent one under-researched area despite their ability to enhance digital pedagogical models easily and purposefully.

Instructors often use digital open badges to reward the learner with "game-like encouragement" in non-game and educational contexts (Reid, Paster and Abramovich *et al*., 2015, p. 379). Furthermore, Sailer, Hence, Mayr and Mandl (2017, p. 372) define 'gamification as the process of making activities in non-game contexts more game-like by using game design elements'. According to Deterding (2015), the 'gamefulness' of a design can be based on the elements people are accustomed to when playing games. Accordingly, the simplest components of gamification (e.g. badges, levels, points, and leaderboards) should be sufficient to provide the same sense of excitement as games (Brauer, Siklander and Ruhalahti, 2017; Deterding, 2012). Ultimately, the gamification of e-learning aims to trigger student engagement and support more efficient learning behaviour (Muntean, 2011).

Our paper draws on definitions that couple the concept of gamification with the triggers of online learning (Järvelä and Renninger, 2014; Renninger and Bachrach, 2015). Recent research has considered interest, motivation and engagement in the fields of education and educational psychology (Hidi and Renninger, 2006; Järvelä and Renninger, 2014; Renninger and Bachrach, 2015); these studies found that triggers play a key role in arousing and maintaining student interest. Roberts and Ousey (2004) define the term *trigger* as the initial stimulus that can be presented in a variety of ways to ensure that students enjoy learning. According to Muntean (2011 p. 324), a trigger is something that tells the participant "to complete the action in a certain moment". Renninger and Bachrach (2015) suggest research seeking a more complete understanding of the triggering process; specifically, they suggest more research into which triggers are most effective and which environmental features allow the triggered interest to be maintained.

In the field of online learning in higher education, Siklander, Kangas, Ruhalahti and Korva (2017) conclude that the most significant triggers are collaboration, topic and feedback. Collaboration includes rich and reciprocal forms of peer interaction and motivation. Meanwhile, the topic should represent a sufficiently difficult open problem for students. This demand for new challenges aligns with Brauer and Siklander's (2017) findings, suggesting that badges should provide students with progressively deeper and more complex challenges, similar to the progressive obstacles present in games. In their study, Sailer, Hence, Mandl and Klevers (2013) point out three motivational elements of gamification that primarily serve as triggers: points, badges and leaderboards. Dichev, Dicheva, Angelova and Agre (2014) state that the point's system serves as the core of many game dynamics; as such, the users desire to accumulate points in order to progress and attain higher levels. Dichev et al. (2014) have noted that participants must have a sense of achievement. Providing feedback with points and challenging achievements (i.e., leaderboards and levels organised in the badge constellation) satisfies students' intrinsic need for competence development (Brauer, Korhonen and Siklander, 2017; Jung, Schneider and Valacich, 2010). Veerpoorten, Westera and Specht (2012) have studied the context of online learning, showing that the use of reflection triggers makes the learning process more tangible. Indeed, these triggers have the potential to promote learners' interest and productive engagement.

Studies have shown more positive than negative effects of gamification on motivation (Hamari, Koivisto and Sarsa, 2014; Seaborn and Fels, 2015). For example, Brauer, Siklander and Ruhalahti (2017) indicate that motivation in digital open badge-driven learning is based more on achievement goals and triggers of online learning than on factors of intrinsic and extrinsic motivation. This argument finds support in Yildirim's (2017) notion that students' attention, motivation and interest directly relate to their achievements (cf. Martí-Parreño, Segui-Mas and Segui-Mas, 2016). Research also shows a positive relationship between gamification and student achievement (Buckley and Doyle, 2014; Domínguez *et al*., 2013). However, Seaborn and Fels (2015) point out that there is no theoretical foundation to explain these motivational effects. Dichev *et al*. (2014) state that, even if student motivation is high, the expected behaviour does not necessarily occur. They consider triggers to be the missing pieces in the process – inspiring sparks of hope, alarms or announcements from the facilitator, or simple signals prompting the students to proceed. Applying the proper trigger at the right time may push a participant across the threshold of activation. Werbach (2014) views gamification as a process and believes that user experiences trigger continued engagement. According to Lee and Hamer (2011), gamification gives students the freedom to learn without the fear of failure.

Because previous studies primarily emphasise the positive effects of gamification, there exists a serious research gap regarding the negative aspects of the phenomenon

(Hyrynsalmi, Smed and Kimppa, 2017). Despite this omission, several researchers acknowledge possible problems and consequences related to gamification. For instance, Hyrynsalmi *et al*. (2017) have categorized the limiting and harmful implications of gamification using a tertiary literature review. In addition to ethical questions (Bui, Weit and Webster, 2015; Kim and Verbach, 2016), they found some very practical challenges. For example, participants might become immersed in the game itself and forget the original purpose of the activity. Others might find the task too childish and simple to proceed (Augustin, Thiebes, Lins, Linden and Basten, 2016). Despite these negative elements, the results overwhelmingly suggest a need to focus more on the possibilities of gaming solutions than on the shortcomings (Hyrynsalmi et al., 2017).

In conclusion, triggers offer the potential to affect learning during several stages of the gamified digital open badge-driven learning process, arousing and maintaining interest (Hidi and Renninger, 2006; Järvelä and Renninger, 2014; Renninger and Bachrach, 2015) until completion of the desired learning action (Dichev *et al*., 2014). Triggers also allow students to continue studying after completing an initial task (Dichev *et al*., 2014; Werbach, 2014). In terms of digital open badge-driven learning, the prompting trigger for learning might come in the form of a reward badge and new level or in the sense of excitement achieved while playing games; the trigger might also manifest as interactions, collaborations or feedback from the facilitators of the learning process. However, because digital open badge-driven learning remains so new to researchers, we lack information regarding how triggers work in different learning situations and at varying stages of the learning process. Our research aims to study different stages and aspects of the badge-driven learning process and to explore the triggers in more detail.

Methodology

Research Question

This study seeks to identify those students who were particularly motivated by digital open badge-driven learning in relation to the competence-development continuum for vocational teachers; in particular, it considers the identification and recognition of digital pedagogical competences. The key research question is as follows: what triggers learning in badge-driven process?

Context and Participants

Conducted in the context of Finnish higher education, our study focuses on competence-based vocational teacher education, particularly the competence-development continuum for professional teachers. The subject of our study is the Learning Online professional development program (PDP) and the process of identifying and recognizing professional teachers' digital pedagogical competences. In terms of implementation type, Learning Online follows a gamified massive open online course (MOOC) model (Brauer, Siklander

and Ruhalahti, 2017). In this MOOC, badges represent the simplest components of game design elements (Brauer and Siklander, 2017; Deterding, 2015). The PDP's badge criteria follow national ICT-competency guidelines based on the UNESCO ICT Competency Framework for Teachers (2011). This standard (and its equivalents around the world) supports teachers' access to high-quality, continuous professional development (Kools and Stoll, 2016).

Professional development and its related activities should reflect the sum of competence required from teachers (Day, 2017). In Learning Online, digital open badges visualise the requisite skill sets (1–3) in a way that allows participants to plan and customise their personal study paths. The participants apply for competence-based digital badges by providing the required demonstration or evidence of the competence in question. Teacher trainers from different schools of professional teacher education facilitate the application and issuing process in the open-badge management system (Open Badge Factory).

Scaffolding is provided for remediation and rejection of the badge application. Participants also participate in a Facebook-based study group. Designed by professional teacher trainers, the badge anatomy and architecture are simplistic; however, the included metadata describe the competence criteria in detail, explaining the required evidence in the form of a tangible task. The competence-based approach encourages participants to put into practice their acquired skills and knowledge immediately (Brauer, Kettunen and Hallikainen, in press). In Learning Online, openly-licensed learning materials and badges are open to anyone interested in developing digital pedagogy and vocational training.

The participants (N=329) followed one out of three educational paths: 1) pre-service teachers given a pre-determined (compulsory) set of badges to attain, 2) pre-service teachers free to apply for any badges and 3) in-service teachers free to apply for any badges. All groups utilised the exact same constellation of badges (N=50+) for digital open badge-driven learning. The third group of participants represented the in-service teachers for whom the Learning Online PD was designed originally in a project funded by the Finnish National Agency for Education. Their experience with digital pedagogy and skills-set level (SSL) was measured by their achieved digital open badges, ranging from Some-Novice SSL 1 (N=132) to Some-Developer SSL 3 (N=26). A total of 94 participants achieved fewer than 10 badges [SSL 4]. All participants came from Finland, comprising 252 women and 77 men. They represented all disciplines of vocational education, with higher education degrees from different fields. They had varying years of experience in their working lives, ranging from less than two to over 20 years; however, nearly all participants had more than two years of experience in their respective professional fields. The youngest group of respondents included individuals under the age of 30 (N=6), and the eldest

participants were 60 years old and over (N=8). In total, 214 participants already had obtained their qualification to work as professional teachers; the earliest completed qualification was attained in 1982. More than a quarter of the participants had been working for over 20 years in their disciplines, and at the time of this study, 221 respondents were working in the educational sector at least part time. Nearly half of the participants were pre-service teachers; thus, they had no teaching experience yet.

Data

Using an online questionnaire, we collected quantitative data for analysis in the autumn of 2017. The Finnish language questionnaire was sent to all e-mail addresses (N=1246) registered in Learning Online's badge management system from 2014 to 2017. In total, 329 people responded to the questionnaire. There were 1100 potential participants after filtering out misspelled addresses and duplicates. The mailing list also included the contact information of teacher trainers and tutors; it also may have included some expired student IDs. Webropol statistics indicated that about half (N=561) of the recipients opened the questionnaire, and 329 responded to it. Answering the questionnaire was completely voluntary. The questionnaire included a cover letter providing participants with a description of the research as well as detailed information about how the data would be used. Personal identification data was accessed exclusively by the first author, and all data were anonymised in the survey software tool. We then double-checked for identifying personal information in Microsoft Excel before analysis on R for Vegan. All restored identifying information will be deleted permanently when the study is complete.

We employed an extensive set of quantitative multiple-choice questions to map explanatory background variables, such as experience and field of education (cf. Analysis). As shown in Table 1, participants responded to five statements using a Likert scale. We selected these statements based on the earlier findings of Brauer, Siklander and Ruhalahti (2017), research that delineated the variables affecting learning motivation in digital open badge-driven learning.

Table 1

Statements related to earlier research and abbreviations of study variables

It is important to me that…	***Variable affecting learning motivation***	***Variable to study***
1. I can study and demonstrate my skills in a flexible way, regardless of time and place.	Option to study regardless of time and place	FSO = flexible study options (time and place)
2. I can choose what to study in a free order.	Optional study paths	OCS = option to customise studies
3. The required evidence and demonstration of competence based on the badge criteria offer progressive challenges and variation in the extent of required performance.	Progressive challenges and the extent of required performance	V = the variety in extent of required performance
4. I learn new and up-to-date competencies, and I can keep track of my progress.	Study progress and enthusiasm for badge-driven learning	SP = option to learn new and up-to-date competencies and enthusiasm for badge-driven learning (study progress)
5. The PDP is gamified.	Inspiring gamification	G = gamified PDP

Analysis

We conducted this research using the statistical multivariate method of constrained correspondence analysis (CCA), also known as canonical correspondence analysis (Oksanen, 2012). The method selection is theoretical because there are several options for operating with multiple variables (Davison and Sireci, 2000; Johnson and Wichern, 2002; Rencer, 2002). Although the CCA is more commonly used in plant ecological research, it recently has been applied in behavioral studies (Venuleo, Ciavolino, Vernai, Marinaci and Calogiuri, 2018) and in educational contexts (Brauer *et al.,* in press). Both studies have noted the potential of CCA, seeking to further define the qualities of this descriptive statistical method compared to other approaches. Venuelo *et al*. (2018) explain the benefits of CA and CCA, suggesting that they provide a summary 'of dis (similarities) in the subjects' discourses to be obtained, by identifying the associative pattern assumed by a set of words in the data' (p. 212). This idea aligns with Ter Braak's (1986) statement that reciprocal averaging in eigenvector techniques is 'a popular ordination technique that extracts continuous axes of variation from species occurrence or abundance data' **(p. 1167).** Ter Braak (1986) emphasizes that researchers should supplement their interpretations of such

ordination axes with environmental-variable data and external knowledge. Spicer (2005) characterises mathematically elegant multivariate methods as tools that provide challenging results for interpretation, making them suboptimal for testing strong hypotheses.

Brauer, Siklander and Ruhalahti (2017) introduced different layers of digital open badge-driven learning. Based on their findings, we chose this particular method because it can visualise and identify a variety of variables related to the phenomena under investigation. We conducted the CCA by using the nine background variables (sex, age, province, study group, skill-set level [SSL], occupation, field of education, working experience and teacher qualification) explaining the variables affecting learning motivation (Brauer, Siklander and Ruhalahti, 2017). We selected these variables to extract common features and to evaluate linear combinations between two multidimensional variable sets. The method enabled us to visually plot the relationships between study items while also allowing us to add the dummy-coded categories of the background variables (demographics) as gradient vectors into the same plot. Additionally, we used permutation tests to determine the statistical significance of the relationships between the study items and the background variables. Thus, we felt encouraged to test the method in educational research, and we confirmed the findings in the CCA plot (Figure 1) by checking the Spearman's rank-order correlation matrix of the five study items and the distributions of the values of the five-point Likert scale by the groups of the respondents. R package vegan was used to compute the CCA (Oksanen *et al.*, 2017).

The Results of Constrained Correspondence Analysis

CCA inertia was divided mostly to the unconstrained axes (Table 2), similar to the magnitude of the eigenvalues of the two most important axes. The background variable called SSL was the only significant explanatory variable found when testing the nine background variables using permutation tests (Table 3). In order to make the CCA plot more interpretable, we rescaled the coordinate values of the five study items for CCA plot (CCA1 and CCA2) by multiplying the original coordinate values by 10.

Table 2

The share of inertia of the CCA model

	Inertia	***Proportion***	***Rank***
Total	*0.0250*	*1.0000*	
Constrained	*0.0012*	*0.0484*	*3*
Unconstrained	*0.0238*	*0.9516*	*4*

The eigenvalues for constrained axes 1 and 2 were CCA1 9.079e-4 and CCA2 2.999e-4. The eigenvalues for unconstrained axes 1 and 2 were 11.9522e-3 and 5.670e-3.

Table 3

The permutation test for the CCA under the reduced model

	Df	*Chi-sq*	*F*	*Pr(>F)*
Skill-set level (SSL)	*3*	*0.00012*	*2.594*	*0.004*
Residual	*153*	*0.02381*		

The tables above demonstrate that the identification of student profiles was not associated, for instance, with subgroups of in-service and pre-service teachers; rather, it related to the competence-development continuum for vocational teachers and the identification and recognition of digital pedagogical competences. We observed only one significant explanatory variable in identifying students who were particularly motivated by digital open badge-driven learning: skill-set level [SSL]. Because of this finding, we studied the variables affecting student motivation during the digital open badge-driven learning process only in relation to their achieved SSL.

Generally, multivariate methods aim to reveal simplified structures based on information about the distance, similarity or difference between observations (Akaho, 2006; Hardoon, Szedmak and Shawe-Taylor, 2004). We iteratively searched the data-specific distances in order to present the findings, identifying and labelling the dimensions based on visual inspection, subjective interpretation and respondent information (Ding, 2006). Figure 1 illustrates the relationships between the five study items (Table 1) and the attached gradient vectors for the SSL categories. We did not display the first category because it was a redundant parameter; according to the dummy-coding scheme, the coordinates were situated at origo. Our purpose was to present the phenomenon such that the interpretation would be as simple as possible without losing any relevant information. Furthermore, we used triangulation to evaluate the results and increase their validity.

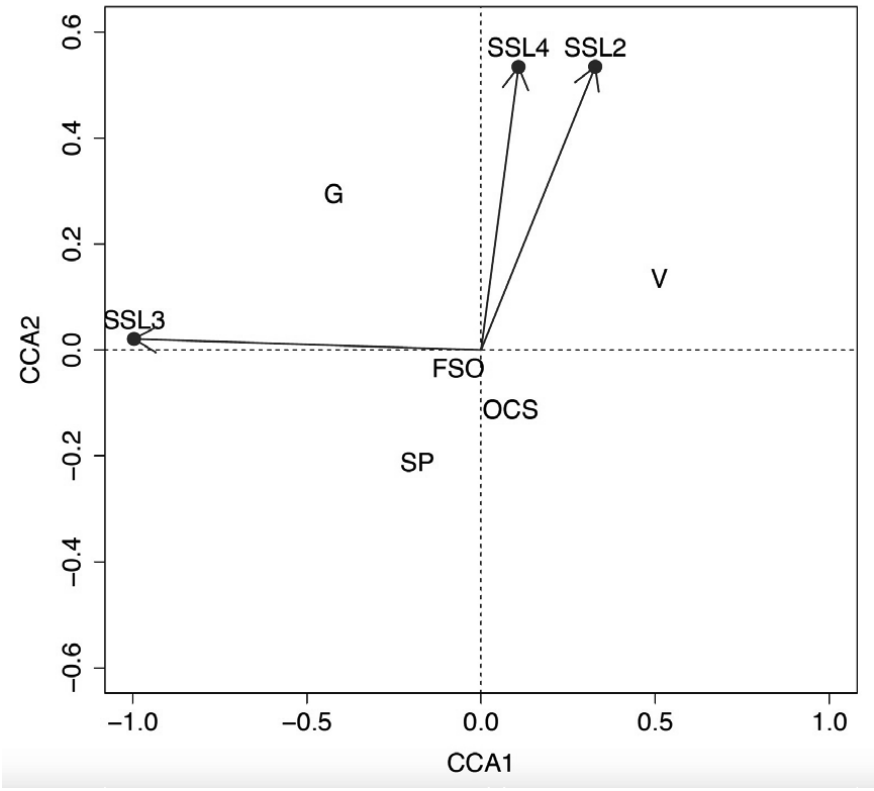

Figure 1. CCA plot with two dimensions.

Symbols representing the background variable (SSL = skill-set level) and the online questionnaire statements: FSO = flexible study options (time and place), OCS = option to customise studies, V = variety in the extent of required performance, SP = option to learn new and up-to-date competences (study progress) and G = gamified PDP.

Keeping in mind the risk of interpreting insignificant functions, researchers should only interpret the functions explaining the variance between variable sets (Sherry and Henson 2005). Figure 1 represents a simplification of various dimensions of the digital open badge-driven learning process. Five statements were addressed (cf. Table 1) based on earlier findings documented in the literature. In this study, we sought to explain these variables affecting learning motivation by using nine background variables. However, our analysis revealed only one significant variable, achieved SSL (Table 3). As such, this was the only variable we could use to interpret and explain the variance and to evaluate linear combinations of the relationships (Akaho, 2006; Hardoon *et al.,* 2004). Our results indicate the significance of certain variables that affect motivation in the digital open badge-driven learning process. Based on these results, the following triggers appear to be meaningful in digital open badge-driven learning: the option of flexible study (time and

place), the option to customise studies, the option to learn new and up-to-date competences and gamification.

Discussion

The current paper contributes to the search for novel methods in educational research by introducing constrained correspondence analysis as a tool for quantitative research. In the present study, we used the method to identify student profiles associated with subgroups of in-service and pre-service teachers, particularly in terms of their competence-development continuum as vocational teachers. This methodological choice met our expectations; it offered a means of describing the phenomenon through quantitative research. The research question sought to ascertain which aspects trigger learning in the badge-driven learning process. The results suggest that it might be important to identify different subgroups. The critical variable related to achieved skills set levels and not, for instance, to pre- or in-service teacher status. These findings imply that these subgroups derive the most advantages from digital open badge-driven learning.

Statistical-mathematical multivariate methods face challenges that may can be perceived as reducing the data and simplifying the structure; in complex situations, the linearity of analysis might extract useful features (Akaho, 2006). However, previously-published research supports our study's findings regarding digital open badge-driven learning and motivation (Brauer, Siklander and Ruhalahti, 2017). Together with the theoretical framework of triggers, the literature enables us to evaluate the reliability of the results. Theoretically, our study draws from recent research into the concepts of gamification (Deterding, 2015, 2012; Reid *et al.,* 2015), the triggers of online learning (Hidi, 2000) and the triggering effect of gamification in learning (Dichev et al., 2014; Muntean, 2011). Based on the literature and our findings, we propose three primary contributions.

First, we found flexible study options to be the most important trigger of learning at the requisite SSL 1 (coordinates situated at origo) for novice teachers (i.e., those who are just starting to develop their digital pedagogical competences). These findings align with prior research indicating that the option to study at any time in any place is the second-most important factor affecting student motivation in digital open badge-driven learning (Brauer, Siklander and Ruhalahti 2017). Flexible study options support self-determined studying; Brauer, Siklander and Ruhalahti, 2017; Gamrat, Bixler and Raish, 2016). Further, the option to self-select the time and place of learning allows the customisation of one's studies (Swanson, 2013).

Second, the *option to customise studies* represents another central principle explaining novice teachers' [SSL 1] eagerness to choose which badges to apply based on their individual requirements and occupational needs. These results are consistent with

earlier findings that study path visualisation provides an interface for customisation (Brauer, Siklander and Ruhalahti, 2017; Casilli and Hickey, 2016; Gamrat *et al.,* 2016; Swanson, 2013). Further, customised study paths arouse interest and maintain students' motivation and engagement as their studies progress (Hidi and Renninger, 2006; Järvelä and Renninger, 2014; Renninger and Bachrach, 2015). Our study indicates positive relationships between *flexible study options* (time and place), *the option to customise studies* and *the option to learn new and up-to-date competences* (study progress); these areas appear to be important for students at advanced levels of professional development. Most of the students at SSL 3 are experienced in-service teachers requiring especially flexible ways of advancing their own knowledge as well as the skills needed in working life. As Kools and Stoll (2016) put it, 'Professional development and learning need to be embedded into the workplace' (p. 40). These teachers appreciate opportunities to continue their professional development in order to deepen their existing competences.

Third, our analysis reveals that gamification is remarkable (cf. Figure 1) in relation to all skill set levels. These findings indicate that gamification is also perceived as positively affecting student achievement. This idea parallels the findings of several previous studies (Buckley and Doyle, 2014; Domínguez et al., 2013; Sailer, Hence, Mayr and Mandl, 2017) noting that gamification enhances human motivation and offers to substantially improve performance in a given task. Brauer, Siklander and Ruhalahti (2017) state that study progress motivates students only to a certain degree, and that inspirational play through gamification encourages students to continue their studies. Indeed, learners can identify progressive challenges and the degree of performance required to trigger badge-driven learning. As Muntean (2011) notes, gamification is a trigger that tells the participant to proceed. Badges explain what students experience, learn and apply in detail. However, our results indicate that gamification, the variety in the extent of required performance, and progressively deeper and more complex challenges (Abuhamdeh and Csikszentmihalyi, 2009; Deterding, 2015; Roberts and Ousey, 2004) especially support both novice and expert-level students. Gamification appears to motivate these two groups even at the very beginning of their pursuits *(*cf. Hamari, Koivisto and Sarsa, 2014; Seaborn and Fels, 2015) when their study paths and the progress in studies would be difficult to understand otherwise. These findings confirm Yildirim's (2017) conclusion that students' attention, motivation and interest are directly correlated with their achievements.

Limitations and Implications

Our study does have limitations. The sample was not completely random in that we selected active teachers as respondents. The sample size was also too small to provide completely reliable results; we cannot exclude the possibility that our findings could be the expression of other latent or unexplored factors related to the phenomenon. Despite the fact that we applied an appropriate sampling plan, these factors may have affected the content with respect to the variables, the descriptive functions, or the generalization of relationships. It is possible that a larger dataset would have provided different results. The first author performed the coding of the sample, and the third author was responsible for the sampling design and the descriptive community analysis (Oksanen et al., 2018). The original survey and the final results were revised using researcher triangulation to increase the validity of findings *(Heale* and Twycross, 2015). We also confirmed the consistency of results and ensured a high reliability of strong correlations by checking the Spearman's rank-order correlation matrix for the five study items.

Inevitably, this study also faces limitations related to the researcher's positioning (see Yin, 2009). The two primary authors of this study were involved in the design and implementation of the Learning Online PDP as well as in the data analysis. Therefore, their assumptions and actions may have influenced the research process, and the results may not be generalizable to other contexts of implementation where the researchers do not influence the proceedings so directly (Barab and Squire, 2004). The reliability of the study could have been enhanced by having a third author independent from the study to analyse the initial data (i.e., someone not working with the PDP). Although two of the authors of this article have been involved in developing the Learning Online PDP from the beginning, our research does not take a stand on the functionality of the educational or technical elements of the investigated PDP. Ultimately, our research in this particular context aims to inspire further studies on the different layers of digital open badge-driven learning.

Gamification of digital open badge-driven learning seems to improve student performance and learning outcomes substantially (Abramovich, Schunn and Higashi, 2013; Reid et al., 2015). However, earlier qualitative research did not yield information regarding whether or not the effects of gamification are the same for all students (Dichev et al., 2014). In terms of educational implications, we suggest applying gamification and digital badges for the professional development of both pre- and in-service teachers. We also propose that curriculum designers consider the option for flexible study, the option to customise studies and the option to learn new and up-to-date competences triggering digital open badge-driven learning. Additionally, we suggest further studies on digital open badge-driven learning to evaluate the linear combinations of different study groups, gamification, collaboration and the required

forms of evidence. In the context of this study, the variable of the study group was considered noteworthy even if insignificant according to our obtained data. The results suggest an interesting positive relationship with gamification serving as the strongest predictor of study group success even if variety in the extent of required performance is negatively related. In the future, we aim to find out why (if) progressively deeper and complex game-like challenges trigger learning in study groups (Muntean, 2011) without being as efficient as gamification in terms of community building and collaboration.

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"Learning Online" for Vocational Teachers - Visualisation of a Competence-Based Approach in Digital Open Badge-Driven Learning

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Abstract

Vocational education in Finland is based on competence-based qualification requirements. Meanwhile, digital open badges promote competence-based assessment and shared expertise in digital environments. The educational setting supports gamified learning solutions and enhances student motivation. The current study aims to examine how learners experience the competence-based approach in the badge-driven learning process of professional development. The theoretical framework focuses on the concept of instructional badging in the competence-based approach.

Coordinated by the country's northernmost school of profesional teacher education, "Learning Online" is a national professional development program (PDP) of digital pedagogical competences for vocational teachers in Finland. The data were collected in 2017 from in-service trained professional teachers and pre-service students (n=329) of vocational teacher education who had earned digital open badges in a Learning Online PDP. A questionnaire was used to collect both quantitative and qualitative data. The study provides an example of using two different methods to build knowledge describing participants' experiences. The study employed constrained correspondence analysis and phenomenography to analyse participants' different experiences. Both used methods highlight the badge learners' experiences and offer to deepen the existing knowledge of digital open badge-driven learning complementing one other by explaining different aspects of the phenomenon. The results describe the impact of the competence-based approach on teachers' professional development in digital open badge-driven learning.

Keywords: *competence-based approach, digital open badges, professional development, constrained correspondence analysis, phenomenography*

Ammatillisten opettajien "Oppiminen Online" – Osaamisperusteisen lähestymisen visualisointi osaamismerkein ohjautuvassa oppimisessa

Tiivistelmä

Ammatillinen koulutus perustuu Suomessa osaamisperusteisiin ammattitaitovaatimuksiin. Digitaaliset avoimet osaamismerkit mahdollistavat osaamisperusteisen arvioinnin ja asiantuntijuuden jakamisen digitaalisissa ympäristöissä. Osaamismerkein ohjautuva oppiminen tukee pelillistettyjä oppimisratkaisuja ja edistää opiskelijan motivaatiota. Tämän tutkimuksen tavoitteena on tarkastella, miten ammatilliset opettajat kokevat osaamisperusteisen osaamismerkein ohjautuvan oppimisen ammatillisessa osaamisen kehittämisessä. Teoreettinen viitekehys keskittyy oppimista ohjaavien osaamismerkkien myöntämiseen erityisesti osaamisperusteisen oppimisen kontekstissa.

"Oppiminen Online" on ammatillisille opettajille suunnattu kansallinen digipedagogisen osaamisen kehittämisohjelma, jota koordinoi maan pohjoisin opettajakorkeakoulu. Tutkimusaineisto kerättiin syksyllä 2017 ohjelmassa digitaalisia osaamismerkkejä suorittaneilta ammatillisilta opettajilta ja ammatillisen opettajankoulutuksen opiskelijoilta (n=329). Kyse-

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lylomakkeella koottiin sekä määrällistä että laadullista aineistoa, tavoitteena kuvata erilaisilla tutkimusmenetelmillä osallistujien kokemuksia. Määrällinen analyysi tehtiin rajoitettuna korrespondessianalyysina, jonka lisäksi osallistujien erilaisia kokemuksia tarkasteltiin fenomenografisen tutkimusotteen avulla. Molemmat käytetyt menetelmät nostavat esiin ammatillisten opettajien erilaiset kokemukset osaamismerkein ohjautuvasta oppimisesta, ja syventävät täten olemassa olevaa käsitystä selittämällä ilmiön eri osa-alueita. Tulokset kuvaavat osaamisperusteisuuden ilmenemistä osaamismerkein ohjautuvassa ammatillisten opettajien osaamisen kehittämisessä.

Avainsanat: *osaamisperusteisuus, digitaaliset avoimet osaamismerkit, osaamisen kehittäminen, rajoitettu korrespondessianalyysi, fenomenografia*

Introduction

The emergence of the competence-based approach in professional development has reached several disciplines and educational settings. Educators and trainers across the world have recommended the adoption of competence-based education for various disciplines and curricula (c.f. Boritz & Carnaghan, 2017; Fan, 2017; Zaytseva, 2017). The competence-based approach seeks "to increase the rigour and relevance of the curriculum, move students beyond a focus on the memorisation and regurgitation of scientific facts, and better enable them to understand scientific principles and apply them to the practice" (Malone & Supri, 2012, p. 241). The concept of competence itself may be understood as an aspect of the description of human activity (Ashworth & Saxton, 1990) or as an achievement acquired through training and development (McClelland, 1973; 1998). Both approaches emphasise a descriptive interpretation of the competence, regardless of how the knowledge and skills are acquired. It has become necessary to study the competence-based approach in the current digital pedagogical framework because there is a growing demand for personalised and customised professional development responding to local challenges and unique professional needs.

Broadly speaking, e-assessment can be understood as any evaluation event that utilises a computer (Jordan, 2013). Emergent technologies provide evolving solutions to support assorted and authentic assignments through e-portfolios, games and simulations (JISC, 2010); such solutions appear not only on online learning environments but also on advanced learning management systems. As Jordan (2013, p. 99) puts it, the "blurring of the boundaries between teaching, assessment and learning" enables a design of e-assessment that evaluates and describes individual competences in a more nuanced manner than ever before. Microcredentials, such as Mozilla Open Badges, allow the competence-based recognition of excellence in smaller fractions (Davies, Randall, & West, 2015) than conventional credentialing. Digital open badges help to identify and recognise competences so that knowledge and skills become visible and useful for the work community. The competence-based approach offers the op-

portunity to draw up the competences required while aiming to support efficient identification and recognition of the skills and knowledge achieved; visualising the gap between existing and desired competences seems to help learners proceed efficiently towards intended learning outcomes and offers support for a competence-development continuum (Brauer, Korhonen, & Siklander, 2017; Hodge & Lear, 2011). The competence-based assessment process occurs on open badge management systems not originally designed to support learning activities (Brauer & Siklander, 2017). However, the process has proven successful in enhancing motivation and learning outcomes (Brauer, Siklander, & Ruhalahti, 2017). The current study aims to examine how learners experience the competence-based approach in a badge-driven learning process for professional development.

Theoretical Framework

Theoretically, this study draws on recent research into digital open badge-driven learning (Brauer, Ruhalahti, & Hallikainen, 2018; Brauer & Siklander, 2017; Brauer, Siklander, & Ruhalahti, 2017). The theoretical framework hinges on the concept of instructional badging (Ahn, Pellicone, & Butler, 2014; Gamrat, Bixler, & Raish, 2016; Reid, Paster, & Abramovich, 2015) in the context of the competence-based approach.

Instructional Badging

In its simplest form, the architecture of digital open badges consists of a graphical image, a badge name, and issuer identification data. An information-rich "skills" badge includes additional meta-data comprised of the required knowledge and expertise criteria as well as a description of the evidence required in evaluating a competence (Abramovich, Schunn, & Higashi, 2013). In addition to the instructional metadata for digital open badges, the concept of instructional badging also can be defined as an assessment process in the badge management system related to badge applications and their approval/rejection process (Brauer, Korhonen, & Siklander, 2017). Brauer and Siklander (2017) explain the instructional badging process on an open badge management system in terms of assessment and feedback provided for the learner during the badge application process. Brauer, Korhonen and Siklander (2017) found one desired realisation of online scaffolding when applying Salmon's Five Stage Scaffolding Model (2003) to digital open badge-driven learning, explaining the fourth stage of knowledge construction as the ongoing process of instructional badging. This process includes feedback, advice and scaffolding from the educators and trainers attached to the digital open badge-driven learning.

In general, information-rich digital badges and open badge management systems provide broader opportunities for learning than conventional credentialing on learning management platforms (Brauer & Siklander, 2017; Casilli & Hickey, 2016). Digital open badges are complex by nature and the design process of the badge-driven learning should be equally multifaceted to engage their full potential (Brauer, Siklander, & Ruhalahti, 2017). The heart of digital badge-driven learning is the badge application process and competence-based assessment, which involves a demonstration of the competence acquired (Brauer, Siklander, & Ru-

halahti, 2017; Reid et al., 2015). The criteria-based badge constellation provides a visual representation of layered badges, metabadges and the final badges of mastery (Brauer, Korhonen, & Siklander, 2017). The design of the constellation and families of connected badges relates to the intended learning outcomes defined in the curricula, aiming to encourage desirable behaviours by prompting and rewarding the learner for work towards required competences (Brauer et al., 2018; Brauer, Siklander, & Ruhalahti, 2017; Gamrat et al., 2016; Reid et al., 2015). Stacked and layered badges provide practical visual aids to learners (Brauer, Korhonen, & Siklander, 2017; Smith, 2015) seeking to self-evaluate existing competences and plan studies ahead; the clear and consistent badge criteria tie the learner's guidebook together, suggesting how to proceed towards intended learning outcomes (Brauer, Korhonen, & Siklander, 2017).

On a flexible study path, learners have options for customisation to meet their individual requirements for professional development and their actual needs in working life. This personalised study path for professional development may consist of selected badges from different badge families (Gamrat et al., 2016); badges may be associated with metadata, including evidence of competence in different forms (Casilli & Hickey, 2016). Further, the metadata attached explains the social context in detail (Gamrat et al., 2016) so that badge earners can collect credentials from various sources and institutions (Casilli & Hickey, 2016). In addition, personalisation and customisation should support the opportunity to produce evidence that can be introduced immediately in your own work" (Brauer, Siklander, & Ruhalahti, 2017). These predeterminations challenge the designers of badge criteria to describe the required evidence in the form of a tangible task encouraging learners to apply their acquired skills and knowledge in practise. The thorough competence-based approach suggests that learners consider the constellation of instructional badges and metabadges as "a personalised digital pathway of learning" (Brauer & Siklander, 2017, p. 192) that offers them the opportunity to visualise (Smith, 2015) and structure their studies (Ahn et al., 2014; Davies et al., 2015; Gamrat et al., 2016). This learning goes beyond the essential competences desired and moves towards lifelong learning and professional development.

Method

We adopted two very different methods for exploring the learners' different experiences in order to create a study design with a 360° view on badge-driven learning in competence-based vocational teacher education and professional development. Based on quantitative and qualitative data, the study may provide insight into using different methods to describe participants' different experiences of phenomenon. In general, multivariate methods provide a visual representation of a complex set of relationships (Borgatti, 1997). As such, we conducted a constrained correspondence analysis to analyse the quantitative data, with the expectation of describing the phenomenon. Phenomenographic approach was used to identify variation in participants' experiences.

Research Question

To view teachers' professional development on a larger scale, we need to study

their experiences and the contexts and processes of competence development accordingly (Ganser, 2000; Fielding & Schalock, 1985; Villegas-Reimers, 2003). This study sought to examine competence-based digital open badge-driven learning through the experiences of professional in-service and pre-service teachers. The key research question is as follows: how learners experience the competence-based approach in the badge-driven learning process of professional development? Further, the aim is to compare the results obtained by these two methods and increase our understanding of the phenomenon under investigation.

Context and Participants

The study context is Finnish higher education, particularly the competence-development continuum of professional teachers focusing on the identification and recognition process of digital pedagogical competencies in the professional development program (PDP) called "Learning Online". Digital open badges visualise the requisite skill sets (I-III) as the badge criteria follows national guidelines based on the UNESCO ICT competency framework for teachers (UNESCO, 2011). The participants plan and customise their personal study path and apply for competence-based digital badges by providing a required demonstration or evidence of the competence in question. Further, digital open badge-driven learning offers to facilitate the professional development process through a gamified massive open online course (MOOC) (Brauer, Siklander, & Ruhalahti, 2017). In this system, scaffolding takes place in the open badge management system, and badges serve as the simplest components of game design elements (Brauer & Siklander, 2017; Deterding, 2015).

Participants (n=329) were Finnish professional teachers and students of vocational teacher education, both men (n=77) and women (n=252) with higher education degrees from different disciplines and various working life experiences. Participants utilised the same Learning Online badges, badge management and easy-access openly-licensed learning materials (Brauer, Korhonen, & Siklander, 2017). 214 of the participants had completed the teacher's pedagogical qualifications. Nearly all participants had more than two years of experience in their professional field of work. More than a quarter of the respondents had been working for more than 20 years in their field. Their experience with digital pedagogy – measured by achieved digital open badges – ranged from less than 10 badges (n=94) to 45 (n=26). 132 of the respondents achieved the minimum requirement of 10 badges for pre-service teachers. The youngest respondents were under the age of 30, and the elders reached the age of 60. 221 respondents were working at the time of the study. Participants represented all disciplines of vocational education; most respondents came from backgrounds of social studies, healthcare and sports (n=77) as well as natural sciences (n=13). Because there were several pre-service teachers in the respondent population, almost half of the respondents lacked teaching experience.

The majority of the participants (see Table 1) represented pre-service teachers from two different schools of professional teacher education. The groups differed in that SG1 had a pre-set (compulsory) set of badges to complete; all other groups were

free to seek the badges of their choice. The second largest group of participants were in-service teachers for whom Learning Online was originally designed as a learning environment funded by the Finnish National Agency for Education. Less than 10 percent of the respondents studied in some another PDP, but completed also the Learning Online badges, which were open to anyone interested in developing digital pedagogy and vocational training. More than a fifth of the participants were self-developing their competences and did not belong to any formal reference group.

Table 1. The Participant's Reference Groups

Group	Abbreviation	N	Percent
Pre-service teacher/institution 1, fixed badges to complete	SG1	134	40,73 %
Pre-service teacher/institution 2, open badge-seeking path	SG2	64	19,45 %
In-service teachers trained by organisers of Learning Online	SG3	40	12,16 %
In-service teachers trained by another PDP funded by the Finnish National Agency for Education	SG4	11	3,34 %
In-service teachers in any other PDP	SG5	13	3,95 %
None of the above	SG6	67	20,37 %

Data

Quantitative and qualitative data were collected in the autumn of 2017 using an online questionnaire. The Finnish questionnaire was sent to all e-mail addresses (n=1246) used to apply for a badge from Learning Online from 2014-2017. Misspelled addresses and duplicates were filtered (e.g., john.smith@gmil.com was deleted and replaced with john.smith@gmail.com). In addition, the contact information of teacher trainers and tutors was removed. A total of 329 responses were received from 1100 potential participants. It is likely that some (n=1100) did not receive the questionnaire because their emails and student IDs cease to be valid after graduation. Webropol statistics showed that half (n=561) of the recipients opened the questionnaire, and 329 responded. Participants were provided with a description of the study and informed the uses that will be made of the data. Only the first author had access to the survey software tool and the personal identification data. All data were anonymised (including institutions and individuals) before analysis. The identifying information will be deleted when the study is complete.

In addition to quantitative multiple-choice questions (cf. Figure 1), the questionnaire contained open questions to maximize the data (Bowden & Green, 2010) and to capture a diversity of expression describing the phenomenon. The following open questions were asked: 1) Why and how does the competence-based approach and digital badges activate teachers' competence development? 2) What were the best and worst aspects of digital open badge-driven learn-

ing? 3) What else would you like to tell us about your study experiences related to competence-based digital open badges? Large number of participants may be considered high compared to previous phenomenographic studies suggesting that 10 to 15 participants is sufficient for capturing variation (Åkerlind, 2008; Trigwell, 2000). The qualitative open questions provided 52 pages of data.

Constrained Correspondence Analysis

We conducted a statistical multivariate method, constrained correspondence analysis (CCA), also known as canonical correspondence analysis (Oksanen, 2012), in order to analyse the quantitative data. The CCA was computed using R package vegan (Oksanen et al., 2017). Statistical multivariate methods include several options for operating multiple variables (Johnson & Wichern, 2002; Rencer, 2002) as well as summaries of large data sets (Ding, 2006; Oksanen, 2012). In this study, we intentionally reduced the number of variables to reveal the simplified structures of the underlying phenomenon (Hardoon, Szedmak, & Shawe-Taylor, 2004). The CCA was conducted using the nine background variables (sex, age, province, study group, skills set level, occupation, field of education, working experience, teacher qualification) explaining the chosen variables in the competence-based approach (n=15). The results were drawn in a limited 2-dimensional space in correspondence to the given data.

Phenomenographic Analysis

A phenomenographic approach was used to analyse the qualitative data and describe qualitatively varying ways of experiencing the target phenomenon (Marton, 1981). To begin, we familiarised ourselves with the data by reading it repeatedly. The first phase of the analysis focused on identifying participants' ways of experiencing the phenomenon in general terms. Descriptive categories by comparing and contrasting the identified similarities and differences in expressed meanings we developed. In the second phase, logical relationships within and between categories based on consistently occurring themes in order to represent the various ways of experiencing the competence-based approach in digital open badge-driven learning were formed (Åkerlind, 2005). A collective meaning was developed and named through ongoing comparison of descriptive categories (Kettunen, Sampson, & Vuorinen, 2015). We avoided labelling meanings until final hierarchical construction because it could limit further development of categories (Bowden, 2005; Kettunen & Tynjälä, 2017). The final phase of the analysis focused on ensuring that the categories of description met the three quality criteria defined by Marton and Booth (1997): (a) all categories describe clear variations in experiencing the phenomenon; (b) a hierarchical relationship is seen between the different categories in delivery; and (c) a limited number of description categories is presented. The logical relationships represented in the final categorisation reflect collective rather than individual experiences (Kettunen et al., 2015).

Table 2. Share of Inertia

	Inertia	Proportion	Rank
Total	0.0357	1.0000	
Constrained	0.0026	0.0731	8
Unconstrained	0.0331	0.9269	14

Table 3. The Permutation Test for CCA under the Reduced Model

	Df	Chi-square	F	Pr(>F)
Study Group (SG)	5	0.0016	1.2410	0.008
Skills Set Level (SSL)	3	0.0010	1.5208	0.010
Residual	148	0.0331		

Results

The Results of the Constrained Correspondence Analysis

Sherry and Henson (2005) remind us to be mindful of the risk of interpreting insignificant functions. We used permutation tests (Table 3) to ensure the statistical significance of the relationships between variables and demographics. Two of nine explanatory variables were statistically significant (< 5% risk level). We tested the significance using permutation tests (999 permutations): Study Group (SG, 6 levels) and Skills Set Level (SSL, 4 levels). The unconstrained axis shared the major proportion of inertia (Table 2). The eigenvalues of the first (CCA1) and second (CCA2) constrained axis were 8.738e-4 and 5.777e-4. The eigenvalues of the unconstrained axis were 8.613e-3 and 4.825e-3, respectively.

We included fifteen questions based on earlier research into digital open badge-driven learning (Brauer & Siklander, 2017; Brauer, Siklander, & Ruhalahti, 2017) and instructional badging (Ahn et al., 2014; Gamrat et al., 2016; Reid et al., 2015). The coordinate values of the 15 study items for CCA plot (CCA1 and CCA2) were rescaled by multiplying the original coordinate values by 10 in order to make the CCA plot more interpretable. Figure 1 illustrates the relationships between the fifteen study items and the attached gradient vectors of categories SSL and SG as simply as possible to aid interpretation. The Spearman's rank order (correlation matrix of the fifteen study items) also confirmed the distributions of the values of the five-point Likert scale by the groups of the participants.

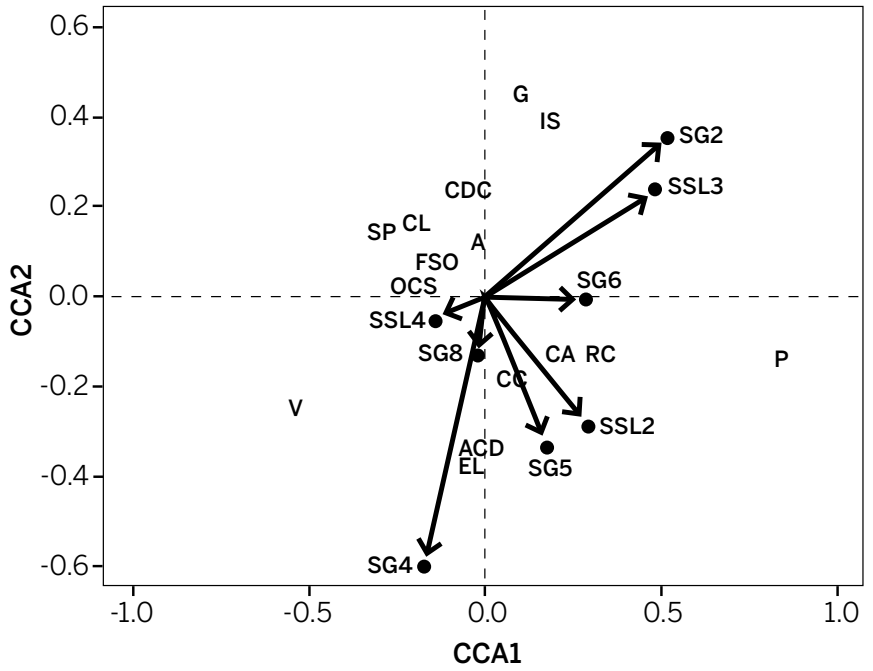

Figure 1. Constrained correspondence plot with reduced dimensionality. Symbols for the categories presenting background variables: SG=Study Group (cf. Table 1) and SSL=Achieved Skills Set Level I-III; and online questionnaire's multiple-choice questions: A=applications in working life, ACD=activate competence development, CA=competence-based approach, CC=competence development within the community, CDC=competence development continuum, CL=competence-based learning, EL=enhanced learning, FSO=flexible study options (time and place), G=the PDP is gamified, IS=independent self-evaluation of existing competencies, OCS=option to customise studies, P=public sharing, RC=recognition of community's competences, SP=option to learn new and up-to-date competences (study progress), V=the variety in extent of required performance

The Results of the Phenomenographic Analysis

Data analysis revealed five distinct categories of description reflecting participants' ways of experiencing the competence-based approach in digital open badge-driven learning (Table 4).

Description of the Categories

In the first category, the competence-based approach in digital open badge-driven learning was experienced as a compulsory performance. Participants here expressed *negative* attitudes towards digital open badge-driven learning. They didn't expect *any added value* in digital open badge-driven learning and considered the model just as another means for testing

and *grading*. Provided learning materials *were not used* and participants expressed that they were *not provided* with scaffolding. Participation was experienced as an obligation, badge applications were "*compulsory*", and participants felt they were being *forced* to use the badges. Their situational motivation was to meet the *mandatory* requirements.

In the second category, participants experienced competence-based approach in digital open badge-driven learning as completing learning assignments. They expressed *concerned* attitudes and felt insecure about providing a demonstration of competence online; further, they felt concerned about sharing their collected badges publicly (which was not required). Participants considered badges to be external *rewards*, and digital badging was a useful tool to *track the progression* of their studies. The option to "test" existing competences in the form of a badge application attempt was highly appreciate like also the possibility to look for learning materials after suggestions for remediation, which created a *forced need* for learning. The scaffold-

Table 4. In-Service and Pre-Service Teachers' Ways of Experiencing the Competence-Based Approach in Digital Open Badge-Driven Learning

	CATEGORIES				
DIMENSIONS OF VARIATION	**Compulsory Performance**	**Completing Learning Assignments**	**Supporting Professional Competence Development**	**Supporting Individual and Customised Learning**	**Building a Learning Community**
Attitude	Negative	Concerned	Neutral	Positive	Enthusiastic
Significance of Digital Badges	No added value	Reward	Encouragement	Achievement	Appreciation
Digital Badging in Practice	Grading	Tracking progression	Development planning	Competition	Shared expertise
Learning Materials	Not used	Forced need	Systematic	Comprehensive	Advanced
Scaffolding	None	Imitative learning	Differentiation	Scaffolding	Peer support and peer scaffolding
Performance	Compulsory	Selective	Progressive	Customised	Applying
Emotions	Forced	Joy	Enthusiasm (badges)	Enthusiasm (team)	Addiction
Situational Motivation	Mandatory	Identification and recognition	Practical	Gaming	Promoting competences

ing provided other than badging was considered *imitation learning* as the teacher showed learners what to do, and the learners "just pushed the buttons". The ability *to select* from a variety of assignments, and learning gave participants *joy*. In general, the *identification and recognition* of competences was found as a motivational process.

They also were eager to learn how they could meet the requirements and were willing to plan accordingly.

The third category describes the competence-based approach in digital open badge-driven learning as supporting professional competence development. In this category, attitudes towards badge-driven learning were *neutral*, and digital badging provided *encouragement*. Participants found the competence-based badge criteria functional for *development planning*, as it allowed them to identify the individual competences needed in working life. Learning materials were utilised *systematically* and learners were motivated to find up-to-date pedagogical models, instructions on technical solutions and practical tips. They also were eager to learn how they could meet the requirements and were willing to plan accordingly. The individual's role became manifest as a professional interested in learning new things and willing to update personal competences. Outside of the OBF, the students were supported by *differentiation*, varying instructional strategies, by conventional means like email. This category revealed a preference for *progressively* deeper and more complex challenges. Here participants expressed sense of *enthusiasm* towards badges even if situational motivation was *practical.*

The fourth category describes the competence-based approach in digital open badge-driven learning as supporting individual and customised learning. Participants expressed *positive* attitudes towards competence-based badge-driven learning. They had great expectations of this "new way of learning" and found significance in visualising the competences achieved. They experienced a strong need for *achievement* and were enthusiastic about the *competition* to collect all the badges and reach the highest level. Participants were *comprehensive* in using learning materials and looked at all available sources, sometimes several times. They considered the option to *customise* studies highly motivational. Here participants were satisfied with the *scaffolding* related to the badge application process and found it inspirational. They felt the provided instructions were accurate. However, they did not reach out for peer advice, even if they were *enthusiastic* about the team spirit and team game. Here participants just enjoyed *gaming*.

In the last category, the competence-based approach in digital open badge-driven learning was experienced as building a learning community. Participants express *enthusiasm* for the badges. These had *appreciation* towards the competences achieved and found it essential to have independent self-evaluation of existing competencies. They also enjoyed choosing the level of competences to share with others. Participants sought to build learning communities and *shared expertise*. They appreciated the learning mate-

rials provided, but searched for *advanced* supplemental information from different sources. Here learners were likely to get inspired by *peer scaffolding and peer support*. The possibility to apply new skills and knowledge in work was expressed crucial. Further, the visualisation of competences were found to be essential on a personal level, supporting *addiction* to competence development instead of gaming while providing an option to *promote competences* to employers.

Relationships between the Categories

In category 1, where digital open badges were experienced as a *compulsory performance*, there was little or no positive potential or impact in competence development. In the second category, badges were considered to be tools and rewards or external mechanical structures, albeit helpful ones. Category 3 a straightforward and practical approach to badge-driven learning was described. Key factors of this approach visualise skills and knowledge in the form of competence-based badge criteria, mastery badge-constellations and meta-badges. This stage is the first to recognize badges' ability to support *professional development*. Participants are able to identify the individual competences needed in working life and to plan accordingly. The following stage (category 4) offers to support *individual and customised* study options, representing the triumph of gamification in *learning*. Gaming and achievements motivate participants towards the highest possible skills achievement. At this level, action is based on a strong goal orientation, experienced as a need to succeed and win with the team. In the most complex category (category 5), digital badging offers to support the competence-based approach ideally suited for success. Here participants express personal responsibility for competence development and seek to *learn and collaborate in a learning community*. They rely on their peers for scaffolding and advice and are the most likely to apply new competences at work. They express enthusiasm for the badges, not for gamification but for competence development. Badges provide them a map for personalised professional development and a vision of new career opportunities.

Discussion

Both used methods highlight the badge learners' experiences and offer to deepen the existing knowledge of digital open badge-driven learning. Quantitative analysis provides a circle of six variables that participants considered essential in the competence-based approach in digital open badge-driven learning: A=applications in working life, CA=competence-based approach, CC=competence development within the community, FSO=flexible study options, OCS=option to customise studies, RC=recognition of community's competences. Like Brauer, Siklander and Ruhalahti (2017), we found that participants experienced the *option to customise studies* and *flexible study options* as important in digital open badge-driven learning. They also found significant the *possibility to apply new competences in working life* in advance (SSL1 and SG1 coordinates situated at the origin). Overall, we are able to conclude that the visual badge-constellation promoted *independent self-evaluation of existing competences* and *identification of individual competences needed in working life*, therefore *enhancing learning and efficient professional development*; however, it was not as efficient as gamification.

The two approaches of the recent study align with earlier research (Brauer, Siklander, & Ruhalahti, 2017; Abramovich et al., 2013; Reid et al. 2015). For example, Brauer et al., 2018 concluded that gamification particularly engages novice and expert level learners. Based on our quantitative findings, *gamification prompts learners* (SG2, SSL3) to continue their studies (Abramovich et al., 2013; Reid et al., 2015) towards the highest possible skills level, especially when they have the option to personalise their study path entirely. This finding is line with Muntean (2011), recognising gamification as a trigger to student progress. Success here seems to relate to the ability to self-evaluate existing competences through the visual constellation of badge criteria (Ahn et al., 2014; Davies et al., 2015; Gamrat et al., 2016; Smith, 2015).

Quantitative findings indicate that professional teachers are more interested in shared expertise and professional development within the working or learning community than becoming involved with the individual competence-based learning and assessment process. Phenomenographic results reveal a way of experiencing digital open badge-driven learning as building a learning community. In general, digital open badge-driven learning seems to enhance professional teachers' perceptions of the competence-based approach in practice. Both approaches indicate that, through public sharing, badges may enhance professional development within working communities; the competence-based approach supports identification and recognition of the different competences achieved (Casilli & Hickey, 2016). In addition, statistics indicate that competence-based digital badges help teachers to plan competence development as a continuum. However, based on the CCA, learners did consider publicizing badges as significant for their professional development.

Limitations and Practical Implications

The study design challenged us in combining two very different methods. The findings of the *phenomenographic analysis provided a wider range of variation in experiences*. The approach allowed us to hear a variety of different, relevant voices, including both negative and enthusiastic tones. To develop a competence-based approach in digital open badge-driven learning, we need to understand both the voice of the few and the voice of the many. In parallel, the methods offer us an enriched view of the different learner profiles experiencing competence-based digital badging, complementing one other by explaining different aspects of the phenomenon. Nonetheless, involving both approaches in the same study challenged us to produce a clearly-structured descriptive and interpretive text.

CCA was originally introduced as a method of plant ecological research (Oksanen et al., 2017). The technique is an extension of correspondence analysis, that allows evaluating different dimensions of the phenomenon. Brauer et al. 2018 applied it for the first time in educational research in 2018. Simultaneously Venuleo, Ciavolino, Vernai, Marinaci and Calogiuri (2018) have applied the method in society and human studies. Already in 1986 Ter Braak explained reciprocal averaging in related canonical correspondence analysis as "a popular ordination technique that extracts continuous axes of variation from species occurrence or abundance da-

ta. Such ordination axes are typically interpreted with the help of external knowledge and data on environmental variables". Multivariate methods are considered mathematically elegant and descriptive; consequently the results may be difficult to interpret (Spicer, 2005). For this reason, the method may not suitable for testing strong hypotheses. In essence, all data were confirmed through researcher triangulation.

Other challenges include the minimisation of the researcher's personal perspective in building reliability in the phenomenographic approach. It should be noted that one of the authors was involved in developing the Learning Online PDP; however, this research does not take a stand on the functionality of the investigated PDP. All themes and categories were probed with the third author, after the first author had analysed them. In addition, logical relationships were not confirmed until categorisation was final (Åkerlind, 2005).

As a practical implication, we suggest that the competence-based approach and digital open badge-driven learning in professional development be applied in ways that ensure customisation and flexibility, which is important to all learners. Assignments should relate to the required evidence for a competence and offer in-service teachers the option to apply the task in their own work; for pre-service students, assignments should provide simulations of challenges in working life. Additional research is needed on designing advanced competence-based digital open badge-driven programs. We also suggest further studies into the negative orientation towards digital open badge-driven learning. Finally, it would be beneficial to further consider the communal aspect of this tool in terms of social and collaborative learning.

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