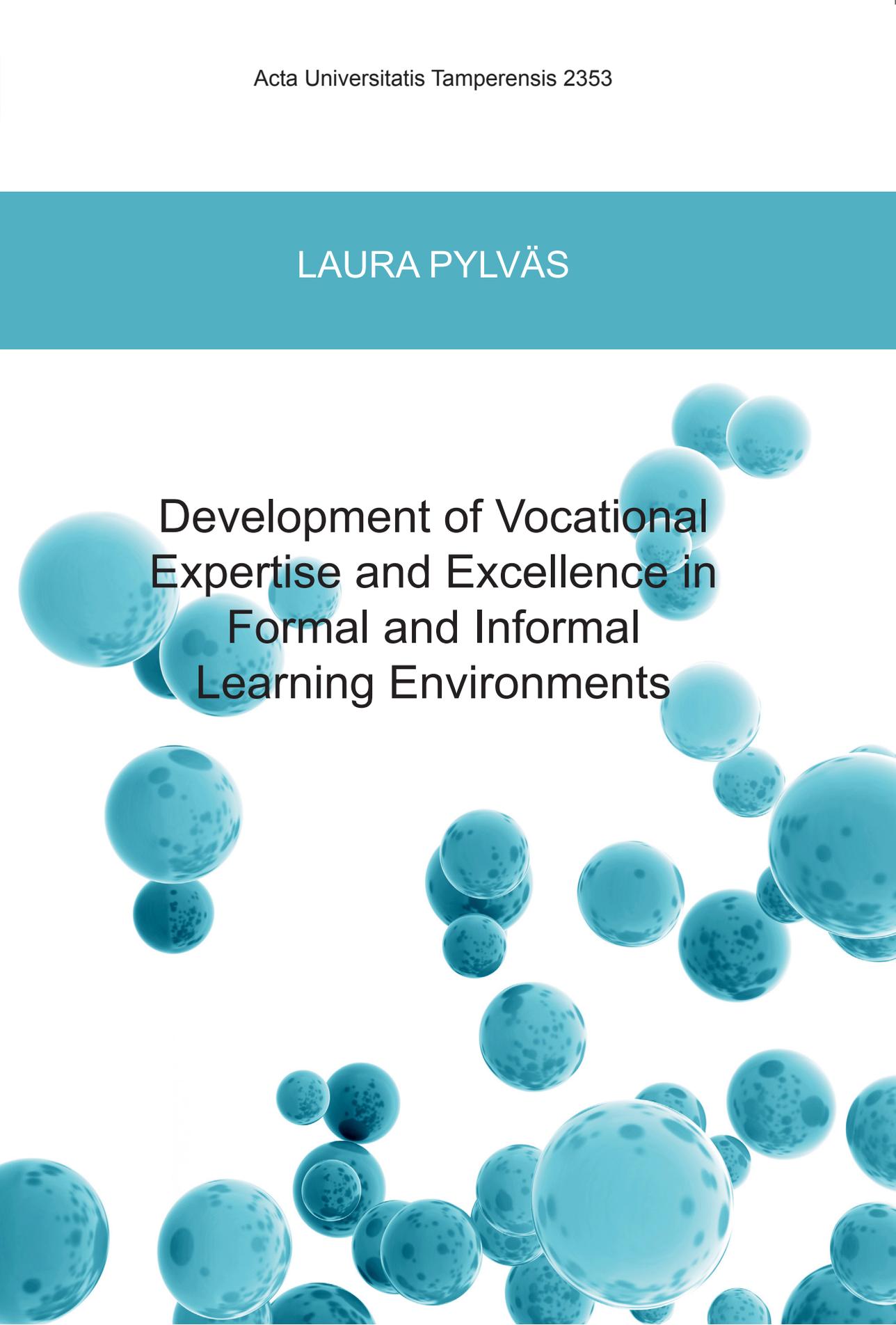


LAURA PYLVÄS

Development of Vocational
Expertise and Excellence in
Formal and Informal
Learning Environments





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ACADEMIC DISSERTATION

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UNIVERSITY OF TAMPERE

LAURA PYLVÄS

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Tampere, February 1, 2018

Laura Pylväs

ABSTRACT

The aim of this doctoral dissertation was to provide knowledge of vocational expertise and excellence and the development of expertise in the context of vocational education and training (VET). The research focused on examining the influence of individual and environmental factors on vocational talent development in formal and informal learning environments. The interview data ($N=119$), collected in the Finnish context, was based on current and former vocational students' and working life stakeholders' self-reported statements from a variety of vocational fields. The article-based doctoral dissertation consists of four publications – Studies I, II, III and IV – on a related set of problems. Study I examined air traffic controllers' perceptions of vocational expertise and vocational pathways and predictors related to vocational excellence. Study II examined WorldSkills Competition achievers' perceptions of vocational expertise and excellence and vocational pathways, along with those of their co-workers and employers. Study III examined apprenticeship training stakeholders' perceptions of vocational expertise and experiences of workplace learning and guidance. Study IV examined the integration of apprentices in their work environment and the development of holistic vocational expertise. The summary of the publications provides a synthesis of the research results.

The findings indicated that individuals with fluent cognitive skills combined to advanced social skills, self-awareness and self-regulation are perceived as vocational experts in modern working life. Strong logical-mathematical skills were shown not only to enable an employee to independently process theoretical and practical knowledge but also to catalyze creative thinking and innovativeness. Instead, interpersonal skills, e.g., social skills and an understanding of human nature, were considered to influence a wide range of work tasks and even seen to compensate for the lack of some other vocational strengths. Most importantly, the findings implied that self-regulatory skills are considered highly significant to the development of one's expertise and excellence. While motivation was shown to influence one's initiative and attitude with regard to self-directed learning, volition and self-reflection played a role in supporting stable professionalism and continuous development of expertise. When measured against expectations of

working life, both institution-based (formal) and work-based (informal) VET were considered to provide the basic vocational skills for a learner to pursue higher levels of vocational expertise in working life. The students participating in vocational skills competitions in the context of institution-based VET, however, had an exceptional opportunity to create extensive professional networks during their studies and strengthen their vocational confidence in order to make the school-to-work transition easier and more efficient compared to the other vocational students. Hence, the findings of this study implied that vocational institutions have good future potential to reinforce students' comprehensive development of vocational expertise and excellence and school-to-work transition by developing learning conditions based on active networking with working life stakeholders. The work-based VET (apprenticeship training), instead, was considered to draw upon an extensive learning environment to facilitate an apprentice's vocational development by offering access to authentic work tasks and collective support by experienced workers. Yet, the lack of time, resources and pedagogical approaches were found to challenge workplace learning by hindering individual guidance and reciprocal workplace learning between apprentices and experienced workers. The workplaces were rather shown to provide fruitful learning possibilities for those apprentices with strong self-regulatory skills and who are capable of engaging in self-directed learning. Overall, the findings implied that vocational institutions are challenged to build stronger networks to working life and to develop workplaces as learning environments in collaboration with working life stakeholders. The perceptions of individual learning emphasized the need for creating learning environments that afford vocational students the space, time and guidance to strengthen their self-regulatory skills during the training.

Keywords: vocational expertise, vocational excellence, development of expertise, vocational education and training, formal learning environments, informal learning environments, self-regulation

TIIVISTELMÄ

Tämän väitöskirjatutkimuksen tavoitteena oli tuottaa tietoa ammatillisen osaamisen ja ammatillisen huippuosaamisen rakentumisesta ja asiantuntijuuden kehittymisestä ammatillisen koulutuksen kontekstissa. Tutkimus tarkasteli yksilö- ja ympäristötekijöiden merkitystä asiantuntijuuden kehittymiselle formaaleissa ja informaaleissa oppimisympäristöissä. Suomen kontekstissa kerätty tutkimusaineisto ($N=119$) pohjautui nykyisten ja entisten ammatillisen koulutuksen opiskelijoiden ja heidän työelämäverkostojensa haastatteluihin useilta eri ammatillisilta aloilta. Artikkeliväitöskirja koostuu neljästä osajulkaisusta – tutkimuksista I, II, III ja IV – joissa esitetyt tutkimusongelmat kytkeytyvät toisiinsa. Tutkimus I tarkasteli lennonjohtajien ammatillisen osaamisen ja urapolkujen rakentumista sekä ammatillisen huippuosaamisen kehittymiseen liittyviä tekijöitä. Tutkimus II tarkasteli WorldSkills –ammattitaitokilpailuissa menestyneiden ammatillisen koulutuksen opiskelijoiden ja heidän työelämäverkostojensa näkemyksiä ammatillisen osaamisen, ammatillisen huippuosaamisen ja urapolkujen rakentumisesta. Tutkimus III tarkasteli oppisopimustoimijoiden näkemyksiä ammatillisen osaamisen rakentumisesta sekä kokemuksia työpaikalla tapahtuvasta oppimisesta ja ohjauksesta. Tutkimus IV tarkasteli oppisopimusopiskelijoiden integroitumista osaksi työyhteisöään ja opiskelijoiden kokonaisvaltaisen ammatillisen osaamisen kehittymistä oppisopimuskoulutuksessa. Väitöskirjan yhteenveto kokoaa keskeiset osatutkimuksissa esitetyt tutkimustulokset.

Tutkimustulokset osoittivat tämän päivän ammatillisen asiantuntijan omaavan vahvat kognitiiviset kyvyt yhdistettynä kehittyneisiin sosiaalisiin valmiuksiin, itsetuntemukseen ja itsesäätelyyn. Loogis-matemaattisten valmiuksien nähtiin tukevan työntekijän itsenäistä teoreettisen ja käytännöllisen tiedon hallintaa sekä luovan edellytykset luovalle ja innovatiiviselle työskentelylle. Interpersoonallisten taitojen, kuten sosiaalisten valmiuksien ja hyvän ihmistuntemuksen, nähtiin sen sijaan vaikuttavan kokonaisvaltaisesti työssä menestymiseen ja toisinaan jopa kompensoivan puutteita muilla ammatillisten valmiuksien alueilla. Erityisesti tutkimustulokset korostivat itsesäätelyn tärkeää merkitystä ammatillisen osaamisen ja ammatillisen huippuosaamisen kehittymisessä. Motivaatio näyttäytyi keskeisenä lähtökohtana yksilön aloitteellisuudessa ja asennoitumisessa itseohjautuvaa

oppimista kohtaan. Pitkäjänteisyyden ja itsearvioinnin nähtiin sen sijaan luovan perustuksen pysyvämmälle ja jatkuvasti kehittyvälle asiantuntijuudelle. Tarkasteltaessa edellä mainittuja työelämän odotuksia yksilön ammatilliselle asiantuntijuudelle, tutkimustulosten perusteella sekä oppilaitosperustainen (formaali) ammatillinen koulutus että oppisopimuskoulutus (informaali) tarjoavat opiskelijalle riittävät valmiudet ammatissa toimimiselle ja edelleen ammatillisen asiantuntijuuden kehittämiseksi työelämässä. Ammattitaitokilpailuihin osallistuneet oppilaitosperustaisen koulutuksen opiskelijat saivat vertaisiinsa nähden poikkeuksellisen mahdollisuuden rakentaa työelämäverkostoja jo opintojen aikana, minkä nähtiin vahvistaneen heidän ammatillista itsevarmuuttaan ja edesauttaneen työelämään siirtymistä. Oppilaitosperustaisen ammatillisen koulutuksen kehittämismahdollisuutena voidaankin tulevaisuudessa nähdä työelämäverkostojen vahvistaminen ja monipuolistaminen, minkä avulla voidaan entistä paremmin tukea opiskelijoiden kokonaisvaltaisen ammatillisen osaamisen kehittymistä ja edesauttaa työelämään siirtymistä. Oppisopimuskoulutuksen vahvuutena nähtiin oppimisympäristön monipuolisuus, mikä tarjoaa opiskelijalle mahdollisuuden kehittää ammatillista osaamistaan autenttisten työtehtävien parissa ja kokeneiden työntekijöiden ohjauksessa jo opintojen aikana. Ajan, resurssien ja pedagogisten lähestymistapojen puute kuitenkin haastoi työpaikalla tapahtuvan oppimisen ideaaleja rajoittamalla erityisesti yksilölliseen ohjaukseen käytettyä aikaa ja vuorovaikutteisuutta. Tutkimustulosten perusteella työpaikat tarjoavatkin hedelmällisen oppimisympäristön erityisesti niille opiskelijoille, joilla on jo entuudestaan hyvät itsesäätelyvalmiudet ja jotka pystyvät sitoutumaan itseohjautuvaan oppimiseen. Kaiken kaikkiaan tutkimustulokset osoittivat, että ammatillisen koulutuksen keskeisenä haasteena on sekä vahvistaa työelämäverkostoja että kehittää työpaikkoja oppimisympäristöinä yhteistyössä työelämäedustajien kanssa. Yksilöllisen oppimisen näkökulmasta ammatillisen koulutuksen oppimisympäristöjen tulisi tarjota opiskelijalle entistä enemmän tilaa, aikaa ja ohjausta kehittää itsesäätelyvalmiuksia opintojen aikana.

Avainsanat: ammatillinen osaaminen, ammatillinen huippuosaaminen, asiantuntijuuden kehittyminen, ammatillinen koulutus, formaalit oppimisympäristöt, informaalit oppimisympäristöt, itsesäätely

TABLE OF CONTENTS

List of original publications.....	13
List of abbreviations.....	15
1 Introduction.....	17
1.1 Research aims	21
1.2 Development of expertise	22
2 Methods.....	30
2.1 Participants.....	31
2.2 Qualitative methods.....	35
2.3 Quantitative methods	38
2.4 Ethical and epistemological considerations	39
3 Overview of studies.....	42
3.1 Study I.....	42
3.2 Study II	44
3.3 Study III.....	45
3.4 Study IV.....	47
4 Main findings.....	49
4.1 Vocational expertise and excellence	49
4.2 Vocational pathways	53
4.2.1 Formal learning environments	54
4.2.2 Informal learning environments	57
5 Discussion.....	62
5.1 Theoretical implications	62
5.2 Practical implications	67
5.3 Limitations	69
5.4 Directions for future research.....	71

Appendices	85
Appendix 1	86
Appendix 2	88
Appendix 3	91
Original publications	99

List of figures and tables

Figure 1 Developmental model of professional and vocational excellence	23
Table 1 A holistic classification of the concept of competence	29
Table 2 Overview of substudies	34
Table 3 Overview of research aims and main findings	61

LIST OF ORIGINAL PUBLICATIONS

This doctoral dissertation is based on the following four jointly authored¹ articles. The articles are referred to in the text by Roman numerals. The articles I, II and III are reprinted with the kind permission of the publishers. The article IV is an author manuscript (in press).

- I Pylväs, L., Nokelainen, P., & Roisko, H. (2015). The role of natural abilities, intrinsic characteristics, and extrinsic conditions in air traffic controllers' vocational development. *Journal of Workplace Learning*, 27(3), 241–263.
- II Pylväs, L., & Nokelainen, P. (2017). Finnish WorldSkills achievers' vocational talent development and school-to-work pathways. *The International Journal for Research in Vocational Education and Training (IJRVET)*, 4(2), 95–116.
- III Pylväs, L., Nokelainen, P., & Rintala, H. (2017). Finnish apprenticeship training stakeholders' perceptions of vocational expertise and experiences of workplace learning and guidance. *Vocations and Learning*. Advance online publication. doi: <https://doi.org/10.1007/s12186-017-9189-4>
- IV Pylväs, L., Rintala, H., & Nokelainen, P. (in press). Integration for holistic development of apprentices' competences in Finland. In S. Choy, G. Warvik, V. Lindberg, & I. Berglund (Eds.), *Integration of vocational education and training experiences: Purposes, practices and principles*. Singapore: Springer.

¹ Laura Pylväs was in charge of the study's conception and design, data collection, data analysis, and interpretation and writing of the manuscript (Studies I, II, III and IV). Petri Nokelainen contributed to the study's conception and design, data collection, and qualitative data analyses (Studies I, II, III and IV), and conducted quantitative analyses and interpretation of the results (Study I). Hilka Roisko contributed to the study's conception and design, qualitative data collection and interpretation of the results (Study I). Heta Rintala contributed to the study's conception and design, data collection, interpretation of the results (Studies III and IV) and the writing up of the results (Study IV). Laura Alhonen (Study II) and Susanna Mikkonen (Studies III and IV) contributed to the data collection.

LIST OF ABBREVIATIONS

ATCO	Air traffic controller
BCM	Bayesian classification modeling
DMGT	Differentiated model of giftedness and talent
DMVE	Developmental model of vocational and professional excellence
MI	The theory of multiple intelligences
VET	Vocational education and training
WSC	WorldSkills Competition

1 INTRODUCTION

Research into vocational education and training (VET) has undergone major developments in recent decades mainly because of its increasing political, social and economic importance (Winch, 2012). For at least the past hundred years, VET research has been largely limited to German-speaking countries and other European countries have lacked an established tradition. Since the 1980s, however, VET research has extended its infrastructure, scope and influence – to varying degrees – to reach all of the countries in Europe. (Mulder & Sloane, 2004.) Nowadays, there are high expectations with regard to VET's education of Europe's future workforce. The disciplines of education and interdisciplinary approaches, in particular, have begun to investigate vocational issues in a more systematic manner. Along with developing research on VET, there has been a growing realization that different countries have developed their VET systems in various ways, and that these differences correspond to their distinctive historical trajectories and cultural dispositions, as well as to their strategies for developing their national economic wellbeing. (Winch, 2012.) At the same time, several global approaches to examining vocational issues have also been arisen.

The earlier emphasis on individual, and mainly formal, learning has now expanded to encompass both formal and informal learning, along with multiple types of learning, such as organizational, group and individual learning (Hager, 2011). The question of change is also taking shape in a variety of forms in terms of educational and learning processes and contexts. Through the concepts of transition, transformation and conceptual change, current research on VET focuses on examining young people and adults who are confronting transitions in their educational paths when moving from one environment to another. (Tynjälä, Stenström, & Saarnivaara, 2012.) Whereas earlier studies situated the learner in specific settings focused on skills and knowledge acquisition (tightly defined and delineated for training), over the past two decades the emphasis has rather been on the need for a multiskilled and flexible workforce able to work anywhere and at any time on a range of tasks (Cairns & Malloch, 2011). Moreover, digitalization and automatization are influencing the nature of work and expertise. The consequences of new technologies include not only a changing emphasis on the significance of

required vocational skills but also the increasing automation of low-skill work tasks and the potential elimination of current work practices. (Nokelainen, Nevalainen, & Niemi, 2017.)

Interest in workplace learning has grown in recent decades due to the changing face of work and recognition of the workplace as a learning environment (e.g., Fuller & Unwin, 2004a; Illeris, 2003). Because of the changing focus on learning and learning environments, conceptual issues also arise out of new emerging forms of expertise. According to Griffiths and Guile (2003, Guile & Griffiths 2001), learners need to develop the capacity to bring accumulated *vertical* knowledge and skills to bear on new situations, but also to mediate between different forms of expertise and the demands of different contexts, which involves the process of *horizontal* development. Tynjälä's (2013) integrative pedagogical approach also emphasizes that incorporating work-based learning into education requires the development of pedagogical models that consider both the situated nature of learning and generic knowledge on the development of expertise. Based on the various accounts of the components of expertise (Bereiter, 2002; Bereiter & Scardamalia, 1993; Eraut, 1994, 2004; Le Maistre & Paré, 2006), she suggests that professional expertise can be described as consisting of three basic elements that are closely integrated: theoretical knowledge, practical knowledge and self-regulatory knowledge. As for the broadening approaches to vocational expertise, however, there seems to be a gap between the knowledge needed at work and the knowledge and skills developed through formal education (Tynjälä, 2008; see also Collin & Tynjälä, 2003). More research is needed of which extent methodological knowledge, generic skills and general knowledge about an occupation are acquired by students and the chances of theoretical knowledge and practical skills being transferred into the workplace (Eraut, 2004). This research continues the current discussion on vocational development by examining the working life perspective on vocational expertise and excellence, the nature of generic knowledge and skills related to vocational expertise and the acquisition of knowledge, both through institution-based and work-based formal VET. Compared to formal learning, the features of workplace learning have been less intensively studied (Virtanen, Tynjälä, & Collin, 2009). Overall, this research provides better understanding of VET students' development of vocational expertise in school, work and in between.

The main goal of this doctoral dissertation is to deepen our understanding of vocational expertise and excellence and the development of vocational expertise in formal and informal learning environments. The empirical research data is based on current and former vocational students' and working life stakeholders' self-

reported statements collected in the Finnish context. The research builds on a large interview study ($N=119$) carried out in the discipline of educational sciences. The research focuses on examining the influence of individual and environmental factors on vocational talent development. The study applies the classifications of natural abilities (Gardner, 1983, 1993, 1999) and self-regulation (e.g., Kitsantas & Zimmerman, 2002; Zimmerman, 1989, 1998; Zimmerman & Kitsantas, 2005) to identify the most important individual characteristics related to vocational expertise and excellence. Furthermore, the research focuses on environmental conditions by examining the development of vocational expertise in the context of institution-based and work-based VET founded on the socio-constructivist approach, emphasizing that expertise develops from both self-directed practice sessions and external support (Zimmerman, 2006). Based on the earlier talent research (Bloom, 1985; Greenspan, Solomon, & Gardner, 2004), the three stages of talent development are discussed: initial participation (initial interest in a vocational field), perseverance (acquisition of basic and intermediate skills during one's study period), and mastery (building upon acquired skills to develop expertise and to compete at higher levels in working life). The developmental stages point to the transitional nature of education–work pathways which, according to many researchers, relates to whole cohorts of (young) people, covers the full sequence of educational, labor market, and related transitions (starting from the point where educational pathways begin to diverge and ending when young adults have achieved relatively stable labor market positions), including reverse transitions from labor market to education (Raffe, 2008). The socio-cultural approach to learning and guidance illustrate that vocational expertise develops from external support through participation and guidance in everyday interactions in the contexts of education and work (e.g., Lave & Wenger, 1991; Billett, 2001a, 2002, 2014; Filliettaz, 2011).

The research aims to achieve the following objectives:

- to identify individual characteristics related to vocational expertise and vocational excellence;
- to identify individual and environmental factors that influence students' development of vocational expertise in the context of formal and informal learning environments

In addition to economic priorities, the significance of VET research is related to social matters such as individual wellbeing, life satisfaction and societal integration. Recent research (Upadyaya & Salmela-Aro, 2016) has shown that young adults' life

satisfaction predicts their study and work engagement both during their post-comprehensive education and after the transition into higher education or work. In turn, after the transition, study and work engagement predicts young adults' life satisfaction. The annual Youth Barometer (State Youth Council, 2017) measures the values and attitudes of Finnish youth. In 2016, 99% of the 1901 respondents (15–29 years old) considered the possibility of having an interesting job as one of the most important things in their life, but at the same time, an increasing number of young people were also concerned about the state of employment (female 55% and male 41%) and wellbeing at work (female 44% and male 23%). By deepening the understanding of both individual knowledge and skills and environmental conditions related to the development of vocational expertise, the practical aim of this research is to improve the ability of educators and working life stakeholders to strengthen students' motivation and engagement in learning and enhance learning outcomes, both in school and in the workplace. By enhancing individuals' abilities to engage in lifelong learning, practitioners play an important role in supporting students' employability, integration into society and life satisfaction, while also reducing drops-outs and exclusions. Furthermore, while education has an important place in society to support individuals' development of vocational expertise, there is also a need to provide opportunities for one to achieve his or her greatest potential. By choosing vocational students performing at the level of vocational excellence as a target group, the aim of this research is also to point out that much can be learned about vocational expertise and the processes of vocational development by interviewing top experts from different vocational fields. The knowledge accrued regarding vocational excellence can be applied to many VET contexts.

This article-based doctoral dissertation consists of four publications on a related set of problems, supplemented by a summary of the publications. Each of the publications has a separate research focus and study design while also providing a synthesis of the knowledge of the individual and environmental factors related to the development of vocational expertise in the context of VET. *Studies I and II place a special focus on formal learning and vocational excellence.* Study I examines air traffic controllers' (ATCO) perceptions of vocational expertise and vocational pathways and predictors related to vocational excellence. Study II examines WorldSkills Competition (WSC) achievers' and their co-workers' and employers' perceptions of vocational expertise and excellence and vocational pathways. *Studies III and IV have a special focus on workplace learning.* Study III examines apprenticeship training stakeholders' perceptions of vocational expertise and experiences of workplace

learning and guidance. Study IV examines the integration of apprentices in their work environment and the development of holistic vocational expertise.

The summary of the doctoral dissertation provides an overview of the four publications and synthesizes the knowledge presented in the studies. The first chapter introduces the research aims and theoretical framework of the research. The second chapter presents the participants, the applied qualitative and quantitative research methods and the ethical and epistemological considerations. The third chapter includes an overview of the four publications—Studies I, II, III and IV—involved in the doctoral dissertation. The fourth chapter presents the main findings of the study related to *vocational expertise and excellence* and *the development of vocational expertise in the context of formal and informal learning environments*. Finally, the fifth chapter discusses the theoretical and practical implications, limitations of the study and directions for future research. Thereafter is the list of references and appendices. The original publications are placed at the end of the summary.

1.1 Research aims

The aim of this doctoral dissertation is to provide knowledge of vocational expertise and excellence and vocational pathways in the context of formal and informal learning environments. In this study, formal learning environments refer to institution-based VET, while informal learning environments refer to work-based apprenticeship training. The empirical data is based on the current and former vocational students' and working life stakeholders' self-reported statements ($N=119$). The sampling of this interview-based qualitative research is conducted in the Finnish context. The research provides a synthesis of four publications (Studies I, II, III and IV) on a related set of problems.

The research focuses on examining the influence of individual and environmental factors on vocational talent development. The study applies the classifications of natural abilities (Gardner, 1983, 1993, 1999) and self-regulation (e.g., Kitsantas & Zimmerman, 2002; Zimmerman, 1989, 1998; Zimmerman & Kitsantas, 2005) to identify the most important individual characteristics related to vocational expertise and excellence. Furthermore, the research focuses on environmental conditions by examining the development of vocational expertise in the context of institution-based and work-based VET founded on the socio-constructivist approach, by emphasizing that expertise develops from both self-

directed practice sessions and external support (Zimmerman, 2006). Based on the earlier talent research (Bloom, 1985; Greenspan, Solomon, & Gardner, 2004), the three stages of talent development are discussed in this research: initial participation (initial interest in a vocational field), perseverance (acquisition of basic and intermediate skills during one's study period), and mastery (building upon acquired skills to develop expertise and to compete at higher levels in working life). The socio-cultural approach to learning and guidance illustrate that vocational expertise develops from external support through participation and guidance in everyday interactions in the contexts of education and work (e.g., Lave & Wenger, 1991; Billett, 2001a, 2002, 2014; Filliettaz, 2011).

The overall research questions of the summary are as follows:

- RQ1) How is vocational expertise and excellence perceived by current and former vocational students and working life stakeholders?
- RQ2) What kinds of individual and environmental factors influence vocational students' choice of profession and their development of vocational expertise in formal learning environments?
- RQ3) What kinds of individual and environmental factors influence vocational students' choice of profession and their development of vocational expertise in informal learning environments?

1.2 Development of expertise

The research applies the developmental model of vocational and professional excellence (DMVE) (Nokelainen, 2016; Pylväs, Nokelainen, & Roisko, 2015) to investigate the influence of individual and environmental factors on the development of vocational expertise (Figure 1). In this research, the individual factors refer to the features of natural abilities and self-regulation, whereas the environmental factors refer to the features of formal and informal environmental (education, work and non-domain specific) conditions. The model is developed on the basis of earlier empirical research on vocational expertise and excellence (Nokelainen, Stasz, & James, 2013; Nokelainen, 2010; Nokelainen & Ruohotie, 2009; Nokelainen, Korpelainen, & Ruohotie, 2009; Korpelainen, Nokelainen, & Ruohotie, 2009; Ruohotie, Nokelainen, & Korpelainen, 2008; Nokelainen &

Ruohotie, 2002) and exceptional academic achievement (Tirri & Nokelainen, 2011; Nokelainen, Tirri, Campbell, & Walberg, 2007).

The DMVE is comprised of the following components: *natural abilities* (multiple intelligences theory, Gardner, 1983, 1993, 1999), *self-regulatory abilities* (e.g., Zimmerman, 2000; Kitsantas & Zimmerman, 2002; Zimmerman & Kitsantas, 2005), *extrinsic conditions* (e.g., Bloom, 1985; Eraut, 2000; Lave & Wenger, 1991) and *deliberate practice* (Ericsson, Krampe, & Tesch-Römer, 1993). The most frequently cited framework of skills acquisition is the five-stage model (novice, advanced beginner, competence, proficiency and expertise) of Dreyfus and Dreyfus (1986; Dreyfus, 2004). As the DMVE has a special focus on vocational talent development, a specific three-stage model (Bloom, 1985; Greenspan, Solomon, & Gardner, 2004) is applied: initial participation (first attraction to the activity and initiation of formal instruction), perseverance (acquisition of basic and intermediate skills), and mastery (building upon acquired skills to develop expertise and to compete on higher levels). Deliberate practice is placed at the center of skills acquisition as it takes ten years to become an expert in most fields (Ericsson et al., 1993). Later research, however, has shown that the ten-year rule is not absolute: in some fields (e.g., chess, sport) total mastery of the skill takes about six years, while in others (e.g., music, science) it takes 20–30 years of deliberate practice to reach the top level (Ericsson, 2006.)

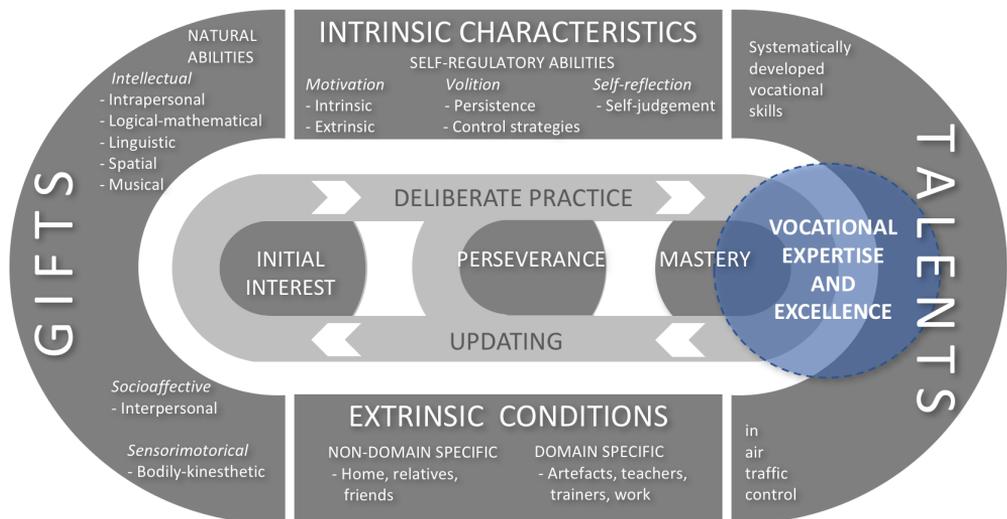


Figure 1. Developmental model of professional and vocational excellence (Nokelainen, 2016; Pylväs, Nokelainen, & Roisko, 2015)

The structure of the DMVE (Nokelainen, 2016; Pylväs, Nokelainen, & Roisko, 2015) is based on Gagné's (2004, 2010) differentiated model of giftedness and talent (DMGT). The model illustrates the process of how inborn gifts develop into talents. The DMGT includes six components: 1) chance (e.g., genetics); 2) gifts (natural abilities: intellectual, creative, socio-affective, sensorimotor); 3) intrapersonal characteristics (motivation, volition, self-management, personality); 4) environmental conditions (milieu, important persons, events); 5) developmental processes (informal and formal learning and practice); and 6) talents (systematically developed skills). Chance is understood to play a predominant role in the DMGT, as it includes both genetic and parental endowments affecting natural abilities and intrapersonal characteristics. Instead, natural abilities and intrapersonal characteristics precede the practice component, as practice is based on the presence of gifts and such intrapersonal characteristics as motivation, volition, and self-reflection. Environmental conditions are less influential than the other components because differences in "normal" environments fail to explain the differences between average and outstanding achievements (Greenspan, Solomon, & Gardner, 2004). Earlier empirical research has shown that gifted individuals with an exceptionally high level of natural ability, self-regulation and auspicious extrinsic conditions (physical, cultural, and sociological milieu, important individuals, activities, accidents) may reach the level of vocational excellence through deliberate practice. Individuals who do not meet all of these conditions may still become competent professionals (vocational expertise) through deliberate practice. (Nokelainen, Stasz, & James, 2013; Nokelainen, 2010; Nokelainen & Ruohotie, 2009; Nokelainen, Korpelainen, & Ruohotie, 2009; Korpelainen, Nokelainen, & Ruohotie, 2009; Ruohotie, Nokelainen, & Korpelainen, 2008.)

Individual factors

In this study, individual factors refer to intrinsic characteristics and applied classifications of natural abilities and self-regulation. The role of natural abilities is examined through the original seven-dimension version of Gardner's (1983, 1993, 1999) multiple intelligences (MI) theory. According to the MI theory, expertise consists of 1) linguistic; 2) logical-mathematical; 3) musical; 4) spatial; 5) bodily-kinesthetic; 6) interpersonal; and 7) intrapersonal intelligence. Martin (2001) suggests that in the workplace learning context, linguistic intelligence refers to an ability to read and produce professional documents and to communicate actively and adaptively with colleagues and clients. Logical-mathematical intelligence is

related to technical awareness and an understanding of hardware and software and objective and logical assessments of problems related to people or products. Musical intelligence is related to attendance to auditory cues, such as the tone, volume and sequence of people, machines or environments. Spatial intelligence involves the use of visual elements not only in work tasks and product or service development, but also in other concrete applications related to workplace productivity or marketing. Bodily-kinesthetic intelligence relates to the motor skills needed to carry out various work tasks, such as an ability to use tools or other equipment efficiently. Interpersonal intelligence is vital in everyday interactions with colleagues and clients, for example, to lead and work within teams and to give constructive feedback. Intrapersonal intelligence refers to a person's self-awareness of one's own feelings, goals, ethics and abilities in changing situations at work.

The concept of *self-regulation* refers to “the process in which self-generated thoughts, feelings and actions are planned and systematically adapted to further one's learning and motivation” (Schunk & Ertmer, 2000, p. 631; Zimmerman, 2000, p. 14). According to Zimmerman (1989, 1990), all learners use regulatory processes to some degree; however, by the systematic use of metacognitive, motivational, and/or behavioral strategies, self-regulated learners proactively seek out information when it is needed and take the necessary steps to master it, even when encountering obstacles. Self-regulated learning is not limited to academic contexts, but can occur wherever learning—whether formal or informal—takes place (Kaplan, 2008). Self-regulatory skills allow learners to modify their performance based on personal characteristics and environmental conditions (Zimmerman, 2000). The theories of self-regulation assume that self-regulated learning involves temporally delimited processes, strategies, or responses that students must initiate and regulate proactively. Instead of describing self-regulated learning as a part of the development stage, it is assumed that a developmental capacity underlies it. (Zimmermann, 2001.) Research has shown that successful learners can monitor and regulate the following triadic elements: volition, motivation and self-reflection (e.g., Kitsantas & Zimmerman, 2002; Zimmerman, 1989, 1998; Zimmerman & Kitsantas, 2005). *Motivational* processes help the learner to formulate decisions and promote decision-making, whereas volitional processes guide one's subsequent implementation of the decision (Corno, 1989). Intrinsic motivation refers to the innate propensity to engage one's interests and exercise one's capacities, and further, to seek out and conquer optimal challenges, whereas extrinsic motivation is connected to extrinsic rewards or environmental controls (Deci & Ryan, 1985). *Volition* includes persistence, the will to learn,

endeavor/effort, mindfulness in learning, intrinsic regulation, and evaluation processes (Zimmerman, 2006). The processes of *self-reflection* enable individuals to evaluate their experiences and thought processes (Bandura, 1986).

Environmental factors

Anchored in social-constructivist theory, this research focuses on the interplay among both individual and environmental factors in the development of expertise. According to Bandura (1999, p. 26) a full understanding of human behavior requires an integrated causal system in which sociostructural influence operate through psychological mechanisms to produce behavioral effects; “in developing their competencies, people need to transform and process diverse sources of information derived from enactive experiences, social guidance and modelling influences, and integrate them into cognitive models that serves as guides for reasoning and action”. Socio-constructivist approach on self-regulated learning emphasizes that expertise develops from both self-directed practice sessions and external support (Zimmerman, 2006). Environmental influences may be even stronger than behavioral or personal ones in some contexts or at certain points during behavioral interaction sequences. For instance, in schools with a highly structured curriculum or a strict code for classroom conduct, many forms of self-regulated learning, such as student planning or self-reward, may be stifled, whereas in schools in which situational constraints are few, such as alternative schools, personal or behavioral factors may be the dominant influence regulating how students function. (Zimmerman, 1989.)

The home environment has been shown to provide especially the structure necessary for early learning (time, valuation, support, resources, and instruction) and work ethic. The social reactions of parents and other individuals in the immediate environment form a child’s original motivation and inspire engagement in the domain. (Bloom, 1985.) Furthermore, cognitive guidance has been considered influential especially in the early phases of skill development (Bandura, 1999). Through the accumulated experience and help of teachers and coaches, a developing individual learns to internalize methods for assessing improvement, monitoring the effects of practice and setting goals (Bloom, 1985; Ericsson et al., 1993). The multilevel sequence of self-regulatory development begins with most extensive social guidance at the first level but systematically reduces as learners acquire self-regulatory skill (Zimmerman, 2013). Moreover, Bandura (1999) emphasizes that people live in a psychic environment that is largely of their own

making. Efficacy beliefs (beliefs in one's own coping capabilities) influence how threats and demands are perceived and cognitively processed; people who believe they cannot control them experience high anxiety and view many aspects of their environment as fraught with danger and risk, whereas people who have a high sense of coping efficacy lower their stress and anxiety by acting in ways that transform threatening environments into benign ones (Bandura, 1999). Moreover, the learner may interpret the failure of a strategy as the result of too little effort and then increase his or her subsequent efforts. He or she may also attribute the failure to a lack of ability when the reaction will most likely be negative in the sense of increasing their efforts. (Weiner, 1974.) Consequently, control of one's thought processes is considered a key factor not only in regulating motivational, affective and cognitive function, but also enabling people to select and create beneficial environments, as well as modify and control them (Bandura, 1999). The ability of efficacy beliefs to affect life paths through selection processes is most clearly revealed in studies of career and development (Lent, Brown, & Hackett, 1994).

Workplaces differ from traditional school-based learning environments that are focused on classroom learning structured by teachers. In socio-cultural theories of workplace learning, learning is a process located within the framework of participation, rather than within the learner, although it does not replace notions of individual learning. (Hager, 2011.) Eraut (2000) argues that aspects of an individual's knowledge accumulated through lifelong learning will always exist and become unique to them, even if an individual is likely to encounter knowledge that is shared among the group in which he or she works. Lave and Wenger (1991) have proposed that learning happens in everyday interactions and through participation in communities of practice. Learning occurs as part of a process in which learners move from away from being peripheral participants to becoming full members of the communities of practice. Furthermore, the contribution of individual assistance and support by more experienced co-workers seems to provide a significant basis for learning at work (Billett, 2001a; Virtanen, Tynjälä, & Eteläpelto, 2014). Without a solid theoretical basis and receiving guidance from experts, student learning at work may remain unsystematic and incidental (Virtanen & Tynjälä, 2008). Eraut (2000, 2004) suggests that instead of considering workplace learning as informal or incidental, it should be seen as non-formal, encompassing different levels of intention to learn. Alternatively, according to Billett (2002, 2014), one can even regard all learning experiences as intentional because they aim to ensure the continuity of social and work practices.

Billett (2000, p. 274) elaborates on guided learning as “an activity in which more experienced workers use techniques and strategies to guide and monitor the development of the knowledge of the less skilled workers and to encourage them to engage in knowledge construction processes”. Learners are usually assigned a designated workplace trainer, along with other colleagues, experts and workplace managers who interact with them while they engage in their work tasks. However, workplace guidance is often seen from a collective perspective, as the nominated trainers are not the only ones providing learners with guidance. (Chan, 2014; Collin & Valleala, 2005; Corney & Plessis, 2010; Evanciew & Rojewski, 1999; Gurtner, Cattaneo, Motta & Mauroux, 2011; Mikkonen, Pylväs, Rintala, Nokelainen, & Postareff, 2017; Onnismaa, 2008; Reegård, 2015; Smith, 2000; Tanggaard, 2005.) Sharing knowledge and skills among colleagues, regardless of their age and status is considered essential to the development of expertise (Fuller & Unwin, 2004a; Onnismaa, 2008). Reciprocal relationships between all members of work communities help to build mutual trust and respect (Fuller & Unwin, 2004a; Nielsen, 2008; Onnismaa, 2008). A sense of equality and community at work are considered important factors in learning a profession (Collin & Valleala, 2005; Fuller & Unwin, 2004a). Pedagogical skills influence the ways in which experienced workers are able to share their knowledge and provide opportunities for apprentices to participate in productive tasks at work (Filliettaz, 2011).

During the second half of the twentieth century, the theoretical construct of competence was introduced in various domains and a competence-based approach to education gained much interest, in particular to better integrate education and work (Mulder & Winterton, 2017). Competence refers to individual’s potential capacity to deal with job-related situations and tasks according to certain formal or informal criteria set by someone else (Ellström, 1997). Following this, qualification is seen as a competence that is required by the work and implicitly or explicitly determined by individual qualities (Ellström, 2001). Mulder (2011, 2014) has defined trichotomy of approaches of the concept of competence: competence and behavioristic functionalism (stresses the importance to specifically determine the discrepancies between actual and desired competence): competence as integrated occupationalism (visible in the present qualification frameworks and competence-based education approaches in which it is stressed that knowledge, skills and attitudes should be integrated in the curriculum, teaching, learning and testing); and competence as situated professionalism (indicating that competence only gets meaning in a certain context). Hytönen, Palonen, Lehtinen and Hakkarainen (2016, p. 366) apply a concept of *adaptive expertise*, referring to “a professional’s personal

efforts aimed at deliberately improving his or her professional competence, seeking alternative solutions for existing professional practices and becoming an active knowledge-building and networking actor in his or her professional field in order to reach the highest levels of professional competence”. An alternative perspective is to conceptualize competencies as characteristics of organizations and consider that human competencies are one of the resources available to organizations. However, the empirical support for core competencies at the organizational level significantly lags behind the theoretical development. (Garavan & McGuire, 2001.) According to Winterton (2009), the fragmentation of the concept is evident, for example, in the formation of the European Qualifications Framework, which views competence narrowly and emphasizes learning outcomes over competence. Considering the different approaches to competence, Le Deist and Winterton (2005) and Winterton (2009) have created a holistic view of competence (Table 1) that allows one to embrace the concept in global terms. The holistic classification of competence includes four components in the areas of occupational vs. personal and conceptual vs. operational competences. Cognitive competence consists of knowledge and understanding, functional competence consists of skills (i.e., practical know-how), and social competence consists of the competencies related to behavior and attitudes. Metacompetence differs from the others in that it aims to encourage the acquisition of the other competences (“learning how to learn”).

Table 1. A holistic classification of the concept of competence (Le Deist & Winterton, 2005, p. 39)

	OCCUPATIONAL	PERSONAL
CONCEPTUAL	Cognitive competence	Metacompetence
OPERATIONAL	Functional competence	Social competence

The concepts of multidimensional, individual-level *competence* and professional *expertise* have the same meaning in the sense that they are both referring to expertise at work (Evers & van der Heijden, 2017). In Study IV, however, the competence approach permits examining the research results related to vocational expertise (Studies I, II and III) as Mulder suggests (2011, 2014), in terms of integrated occupationalism that is visible in the present qualification frameworks and competence-based education approaches emphasizing the integration of knowledge, skills and attitudes into the curriculum, teaching, learning and testing.

2 METHODS

This doctoral dissertation provides a synthesis of four publications on a related set of problems. This chapter introduces the participants, qualitative and quantitative methods, and ethical and epistemological considerations related to Studies I, II, III and IV. Overall, the research participants comprise current and former vocational students and working life stakeholders ($N=119$). The qualitative data is based on the participants' self-reported statements that have been collected by using interviews as a research method. Quantitative Bayesian analyses were applied in Study I to support the descriptive qualitative analysis.

The research focuses on examining vocational expertise and excellence and the development of expertise in the context of formal and informal learning environments. Studies I, II, III and IV place a special focus on three vocational contexts: air traffic management, vocational skills competitions and apprenticeship training. The sample has been collected within Finnish institution-based and work-based (apprenticeship training) VET. The research questions are as follows:

- RQ1) How is vocational expertise and excellence perceived by current and former vocational students and working life stakeholders?
- RQ2) What kinds of individual and environmental factors influence vocational students' choices of profession and the development of vocational expertise in formal learning environments?
- RQ3) What kinds of individual and environmental factors influence vocational students' choices of profession and the development of vocational expertise in informal learning environments?

Studies I, II, III and IV are provided as individual articles at the end of the summary.

2.1 Participants

Study I

The work of air traffic controllers (ATCOs) covers air traffic control, air traffic advice, flight information, and emergency procedures with the aim of expediting air transport and maintaining aviation discipline (Costa, 1995). They simultaneously control aircraft taking off and landing and make observations of the work environment with the help of various kinds of information technology equipment (Finavia, 2013). Interviews with 28 ATCOs (Table 2) were conducted in 2011 in four Finnish airports and included interviewees from both provinces ($n=7$, 25.0%) and cities ($n=21$, 75.0%). The work tasks differ between the one- or two-person air traffic control units in the provinces and the units comprising several employees and posts found in larger cities. These airports were selected to represent different types of airports (and ATCO job profiles) in Finland. The selection of interviewees within the target units was random, as participation in interview sessions was based on the ATCOs' pre-determined work shifts. The research data also included the interviewees' aptitude test scores and training records. Most of the interviewees ($n=25$, 89.3%) had been working in air traffic control for at least six years. Half of the interviewees ($n=14$, 50.0%) had another professional qualification and all the interviewees ($n=28$, 100.0%) had previous work experience in another professional field. A little more than half of the group had been familiar with aviation before undergoing ATCO training, either through private piloting ($n=6$, 21.4%) or piloting military aircraft ($n=9$, 32.1%). After graduating from ATCO training, most of the interviewees ($n=22$, 78.6%) were placed in provincial airports. The minority ($n=6$, 21.4%) was placed in a larger city, Helsinki-Vantaa Airport (usually as a result of exceptional training performance).

In this study, the division between ATCOs performing at the level of expertise ($n=9$, 32.1%) and excellence ($n=17$, 60.7%) was made by a panel of experienced operative superiors. The classification was made based on ATCOs on-the-job performance. As all operative ATCOs have extensive knowledge and expertise (e.g., Costa, 1995), the panel used the following criteria to judge the merits of the participants: 1) safe working (low number of critical incident reports); 2) effective air traffic control (aim at the maximum capacity); 3) overall perception of air traffic services; 4) understanding of the guidelines and regulations; 5) self-initiative and commitment. This job performance-related information (missing $n=2$, 7.1%) was

concealed from the researchers until the qualitative content analysis of the interview data had been completed.

Study II

In Study II, the data (Table 2) includes interviews with Finnish WorldSkills Competition medal or diploma winners ($n=18$) who have since entered working life (1–15 years of work experience), and their co-workers ($n=17$) and employers ($n=16$) from the same workplace. The WSC achievers interviewed participated in the WSC between 1997–2011 and earned either gold, silver or bronze medals, or a diploma (for being awarded more than 500 points). Based on the high standards of the WSC's evaluation process, in this study WSC achievers are considered to perform at a high level of expertise. To account for the differences between vocational fields, the interviewees were chosen to represent three different trades designated by the researchers: 1) customer service; 2) manual labor; and 3) technical work.

In the biennial international WSC, vocational upper secondary education students (18–23 years) from over 60 countries demonstrate their vocational competence in more than 40 skills areas (e.g., health care, hairdressing, and robotics). The WSC is the largest skills competition in the world, where young professionals compete for the world title. (WorldSkills International, 2010.) Each competitor receives a score (from 0 to 600 points) from a panel of international experts based on his or her performance during the four-day competition. The competitors are selected to participate in the WSC based on their success in the national (Taitaja) skills competition, or through training providers' contacts with vocational institutions or companies (SkillsFinland, 2017). In Finland, the competition training system is coordinated by the non-profit organization Skills Finland and supported by the Finnish Ministry of Education and Culture and the Finnish National Board of Education. The training is implemented in co-operation with vocational education, training providers (expert coaches, team leaders, panelists) and industry (e.g., sponsors, materials, equipment). The training period is mostly individualized and carried out in vocational institutions and workplaces. However, it also includes other collaborative practice (e.g., national team camps) (SkillsFinland, 2017). The content of the training is based on the earlier skills competition tasks that follow the VET requirements of vocational qualifications and specialist qualifications and the perceptions of experts from different countries. The training is included with the components related to vocation-

specific skills and knowledge as well as psychological and physical preparation and competition-related issues (Saarinen, 2010). The training starts approximately one year before the competition is held.

Studies III and IV

The interview data for Studies III and IV (Table 2) was collected in 2015 in two vocational fields: the social and health care services sector (five workplaces) and the technology sector (five workplaces). The sample ($N=40$) consisted of apprentices ($n=10$), their co-workers ($n=10$), workplace trainers ($n=10$) and employers ($n=10$). In Finland, approximately 70–80% of apprenticeship training takes place in the workplace and is based on a fixed-term employment contract. Fixed-term employment contracts ensure salaries based on collective agreements. Workplace learning is complemented by theoretical studies organized by vocational institutions. The education provider (educational institution or apprenticeship office) signs a contractual agreement with the employer on the educational program, ensures that the qualification requirements are attainable, and that the workplace has sufficient personnel with vocational skills, education and work experience to nominate a responsible trainer or instructor for each student. (Act [787/2014] amending the Act on Vocational Education [630/1998].)

The data was collected at 10 workplaces in 2015. The researchers selected the workplaces and apprentices by using a student register that contains information on Finnish apprentices and apprenticeship training organizers. Based on the European Union's (2015) definition of small and medium-sized enterprises (SMEs) and staff headcount, the target organizations represented small enterprises (which employ fewer than 50 persons) and medium-sized enterprises (which employ fewer than 250 persons), corresponding to the sizes of the Finnish enterprises involved in apprenticeship training. To take into account the variation between vocational fields, work environments (e.g., job description) and employees (e.g., socio-demographic information), the data was chosen to include interviewees from the social and health care services sector and the technology sector (construction, metalwork and machinery). The sampling criteria were applied to maximize variety in the participants' genders. Moreover, the average age of the participants in the social and health care services sector was $M=33.0$ ($SD=7.7$), and $M=24.8$ ($SD=3.3$) in the technology sector, which makes the sample representative with respect to the Finnish context. In 2014, 80% of apprentices were over 25 years old (Kumpulainen, 2016). The co-workers interviewed were chosen by the employers

interviewed: the selection criterion was that the employee selected had been working with the apprentice involved in this study.

Table 2. Overview of substudies

Participants (N=119)		Age M (SD)	Gender, male n (%)	Gender, female n (%)	Work experience M (SD)
Study I (n=28)	Air traffic controller, (n=28)	37.0 (6.4)	20 (71.4)	8 (28.6)	15.6 (7.3)
Study II (n=51)	WorldSkills achiever, (n=18)	29.4 (5.0)	11 (61.1)	7 (39.9)	8.7 (4.1)
	Co-worker, (n=17)	32.0 (7.4)	9 (52.9)	8 (47.1)	12.2 (7.0)
	Employer, (n=16)	29.4 (5.0)	9 (56.3)	7 (43.8)	24.0 (8.6)
Study III, Study IV (n=40)	Social and health care services, Apprentice (n=5)	33.0 (7.7)	1 (20.0)	4 (80.0)	7.9 (2.5)
	Social and health care services, Co-worker (n=5)	39.6 (12.1)	1 (20.0)	4 (80.0)	11.9 (5.7)
	Social and health care services, Workplace trainer (n=5)	46.4 (10.1)	2 (40.0)	3 (60.0)	20.4 (6.4)
	Social and health care services, Employer (n=5)	54.6 (6.5)	1 (20.0)	4 (80.0)	33.0 (7.0)
	Technology, Apprentice (n=5)	24.8 (3.3)	4 (80.0)	1 (20.0)	5.9 (2.9)
	Technology, Co-worker (n=5)	43.0 (10.6)	5 (100.0)	0 (0.0)	25.8 (8.4)
	Technology, Workplace trainer (n=5)	40.6 (11.5)	4 (80.0)	1 (20.0)	21.4 (14.0)
	Technology, Employer (n=5)	56.0 (6.5)	5 (100.0)	0 (0.0)	36.6 (10.3)
Total (N=119)	All participants	38.8 (9.9)	72 (60.5)	47(39.5)	18.6 (10.0)

2.2 Qualitative methods

Semi-structured interviews served as the main research method used in Studies I, II, III and IV. The method offers some leeway to follow up on angles deemed important by the interviewee, while it also enables the interviewer to focus the conversation on issues considered important to the research (Brinkmann, 2014). The interview instruments (see appendices 1, 2, and 3) were developed based on the earlier research modeling vocational expertise and excellence and empirically tested research instruments (Nokelainen, Stasz, & James, 2013; Nokelainen, 2010; Nokelainen & Ruohotie, 2009; Nokelainen, Korpelainen, & Ruohotie, 2009; Korpelainen, Nokelainen, & Ruohotie, 2009; Ruohotie, Nokelainen, & Korpelainen, 2008; Tirri & Nokelainen, 2011; Nokelainen, Tirri, Campbell, & Walberg, 2007; Nokelainen & Ruohotie, 2002).

The research consists of three sets of interview data: data I (Study I, $n=28$), data II (Study II, $n=51$) and data III (Studies III and IV, $n=40$). The interviews were conducted in 2011 (data I), 2013–2014 (data II) and 2015 (data III), and lasted from 60–90 minutes (data I), 70–90 minutes (data II) and 20–60 minutes (data III, the large dataset was also used in other studies). All participants were interviewed individually in the workplaces with the permission of their employer. The interview instruments applied included some sections that were common to all participants and some unique sections asked of each target group. The interviews started with demographic questions, e.g., age, gender, work experience, work experience in the current job, education, job description, and educational background. The interview instruments used in the three data collection varied with regard to their emphases and target groups. However, they also included several common themes and questions. Questions such as “How would you characterize an employee who succeeds well in your field of vocation?” and “How do you consider vocational education to have prepared you for working life?” were included in the semi-structured interviews. The thematical components of the semi-structured interview instruments were the following:

Data I (Study I): Air traffic controllers

- Vocational expertise and excellence
- Vocational education: initial interest, study experiences, and study success
- Working life: working life experiences, work performance, and career success

Data II (Study II): Finnish WSC medal or diploma winners, their co-workers and employers

- Vocational expertise and excellence
- Vocational education: initial interest, study experiences, and study success
- Working life: working life experiences, work performance, and career success
- WSC experiences (Finnish WSC medal or diploma winners)

Data III (Studies III and IV): Apprentices, their co-workers, workplace trainers and employers (technology sector and social and health care services)

- Vocational expertise
- Vocational education: initial interest, study experiences, and study success
- Workplace learning/training: learning, guidance, and future expectations

The qualitative interview data analysis took the form of a qualitative (thematic) content analysis of the textual empirical data. Content analysis of data is highly systematic (Schreier, 2014). It can be defined as a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns (Hsieh & Shannon, 2005). The semi-structured interviews were recorded and transcribed into text data that was managed using NVivo software: organizing data sources, managing coding and using numerical counts. The unit of analysis distinguished for coding was a meaningful piece of text in the interview transcript such as a word, sentence or short narrative (Krippendorff, 2012; Schreier, 2014). As one of the most critical phases of the content analysis is meeting the requirement of mutual exhaustiveness and exclusiveness (e.g., Schreier, 2014), all relevant aspects of the transcript were intended to cover a category. Moreover, any unit of analysis to be used in qualitative analysis was coded only once under one main category to ensure coding consistency.

The aim of the analysis was to create categories that describe the topic of the research. Thematic criteria served to divide the text material into units that would fit the coding frame (Schreier, 2014). The “keyness” of the theme is not necessarily dependent on quantifiable measures. A theme captures something important about the data in relation to the overall research question. Consequently, the aim of the analyses in this research was not to provide a rich thematic analysis of the entire data set, but rather a more detailed and nuanced account of one particular theme, or group of themes (e.g., “the role of the work community in learning processes”),

within the data. (Braun & Clarke, 2006.) The coding frame was based on categories (e.g., “mental support and guidance” or “learner’s self-directedness”) and mainly followed the principles of inductive analysis (Schreier, 2014). An inductive approach means that the themes identified are data driven, even if researchers cannot free themselves of their theoretical and epistemological allegiances. Further, thematic analysis conducted within a constructionist framework goes beyond the semantic content of the data (e.g., reporting of individual experiences, meanings and the reality of participants from an essentialist/realist perspective). At the latent level, it also seeks to theorize the socio-cultural contexts (e.g., participation in work community) and structural conditions that enable the individual accounts that are provided. (Braun & Clarke, 2006.)

The categories related to vocational expertise were built by following the directed (or deductive) analysis approach based on the existing theories (Hsieh & Shannon, 2005; Schreier, 2014) of MI developed by Gardner (1983, 1993, 1999), and self-regulation (e.g., Kitsantas & Zimmerman, 2002; Zimmerman, 1989, 1998; Zimmerman & Kitsantas, 2005). The unit of analysis, which is a meaningful piece of text in the interview transcript (e.g., “The most important thing is to stay motivated. To be good or even better than before.”) was assigned a code relating to a theoretical concept (e.g., “intrinsic goal orientation”). Theoretical thematic analyses tend to provide less rich description of the data overall but more a detailed analysis of some aspect of the data (Braun & Clarke, 2006). The kind of reasoning that is used in Bayesian analyses (see chapter 2.3) can be considered as abductive: Bayesian networks are used to compute posterior probability of alternative explanations given a set of empirical observations (Pearl, 1988), but not based on an existing theory.

When some important characteristic separates people into groups, one or more groups can also be selected as units of analysis (Patton, 1987). In this study, the sampling units consisted of both coding units (main categories and subcategories) and the demographic groups of participants (e.g., apprentices, co-workers, workplace trainers and employers). However, instead of conducting a comparative analysis or drawing in-depth conclusions on the differences between the groups of interviewees, the demographic groups of participants were included in the research data to develop a comprehensive understanding of vocational expertise and vocational pathways. Furthermore, the variation between vocational fields, workplaces (e.g., job description) and employees (e.g., socio-demographic information) were explicitly acknowledged to ensure the representativeness of the data to identify non-occupational factors related to the research topic. The

saturation point in sampling was based on the idea of social representativeness: instead of observing the number of participants and generalizing the findings to apply to other cases as well (e.g., all workplaces), the aim of the study was instead to extensively observe the relations between the variables of describing the general structures of the topic that can be related to other cases (Gobo, 2004).

2.3 Quantitative methods

The quantitative analyses were applied in Study I to support the descriptive qualitative analyses. A specific technique, Bayesian classification modeling (BCM, see Nokelainen, 2008), was used to select the most probable predictors of an ATCO's vocational excellence (RQ2: What are the differences in characteristics between the air traffic controllers representing vocational expertise and those representing vocational excellence? RQ3: Does air traffic controllers' performance during training or in the entrance examination predict vocational excellence in working life?) and to increase the research validity of qualitative methods in a confirmatory way. Qualitative content analysis (see Section 2.2) was applied to examine latent and more context-dependent meanings (Schreier, 2014). Bayesian methods (e.g., Bernardo & Smith, 2000) were applied in this study as they work robustly with small samples and allow for the use of nominal indicators (textual or numerical data) and prediction with the model derived from the empirical evidence (Nokelainen, 2008; Nokelainen & Silander, 2014).

The input data matrix for BCM contained the following variables: 12 characteristics variables (such as "intrinsic goal orientation," "volition," and "control beliefs"), and three performance variables ("job performance," "entrance examination success," and "study success"). The numerical values for the 12 characteristics variables were based on the code frequencies from the preceding theoretical concept analysis. For instance, if a participant had mentioned "intrinsic goal orientation"-related information three times during the interview, his value (code frequency) for that variable would be 3. The "job performance" variable had two textual values assigned by an external panel ("expertise" and "excellence"). The "entrance examination success" variable had also two values based on final ranking in the tests ("good"=others and "excellent"=top 40%). The "study success" variable represents overall study success during ATCO training (5=excellent, 1=poor). BCM was used with a data mining approach to search for a model that contains the most probable predictors (RQ2: 12 characteristics

variables; RQ3: “entrance examination success” and “study success” variables) for the class variable (RQ2 and 3: “job performance”). The classification accuracy of the model is provided and compared to the baseline classification accuracy (i.e., classifying the cases without the model). All computations were performed using the B-Course computer program (see Myllymäki, Silander, Tirri, & Uronen, 2002).

2.4 Ethical and epistemological considerations

Ethical considerations were taken into account from the beginning of the research. The research follows the ethics guidelines of the Finnish Advisory Board on Research Integrity (TENK): Ethical principles of research in the humanities and social and behavioral sciences emphasize caution in three main areas: 1) respecting the autonomy of research subjects; 2) avoiding harm; and 3) privacy and data protection. Participation in the research was voluntary and based on informed consent. The participants were introduced to the research in good time to consider their participation and offered a sufficient amount of information (e.g., on the research topic, autonomy of the research subjects, length of the interview, publication procedures, data storage, etc.) to make a decision on whether to participate. The participants were also offered the possibility to ask questions about the research in the interview situation, or by contacting the researcher after the interview. The interviews were held at the workplace, during working hours, with the permission of the employer.

Considering the topic of the research, care was especially taken to avoid causing financial and social harm to participants by ensuring the ethical principles concerning privacy and data protection were followed. All the participants were interviewed individually. Moreover, as many of the employees and employers interviewed were working in the same company, information security and anonymity protocols were carefully designed to prevent the study from having any negative impacts on the relationships between the participants. Data protection forms the most important area of privacy protection regarding the collection and processing of research data and the publication of results (TENK, 2017). In order to ensure the confidentiality of the data, any information that could have been used to identify the participants has been omitted when reporting and publishing the results. Data protection was done systematically and cautiously when handling and storing confidential information. All printed material is stored in locked premises at the University of Tampere and electronic material is securely stored electronically.

Only the researchers involved in the research have access to the data and all follow the same ethical principles. Overall, the interviewees were treated with due respect during each phase of the research process.

The key principles of research ethics discussed are treated as fundamental for qualitative research. However, in addition to these external constraints on the selection of methods and strategies in which researchers engage, research ethics can be interpreted in a broader sense to include all of the values that are relevant to the pursuit of inquiry. (Traianou, 2014.) The researcher also needs to take into account epistemic values and virtues that facilitate the production of knowledge, such as the goal and importance of research, methodology and limitations of the research, all of which are discussed and reflected upon throughout this research. This research can be positioned under social constructionism, a discipline rooted in the ontological perspective that all of our understandings and knowledge are socially constructed and that we create our own reality through social interactions, relationships and experiences (Berger & Luckmann, 1966; Gergen, 1996). The epistemological perspective of reality and meaning is premised on the notion that individuals hold knowledge and meaning in their minds, but that these are not themselves individual in nature. Instead, they are derived from social interactions and constantly negotiated (Gergen, 1996). From a research point of view, it affects how we analyze the findings of prior research in the field and how we shape future research (Spencer, Pryce, & Walsh, 2014).

A socio-constructionist paradigm is based on the belief that *reality* is subjective and contextual, and *knowledge* is actively constructed by the researcher and participant, who exert a mutual influence on one another (Spencer, Pryce, & Walsh, 2014). Within the context of qualitative research, the use of the interview in research enables participants—be they interviewers or interviewees—to discuss their interpretations of the world in which they live, and to express how they regard situations from their own point of view. An interviewer may try to be systematic and objective; however, the constraints of everyday life will be a part of whatever transactions he or she initiates. (Cohen, Manion, & Morrison, 2000.) The socio-cultural approach focuses on both the cultural and social origins of mental functioning (Kallio & Marchand, 2012). According to the socio-cultural discipline, the on-going process of learning through participation is dependent on context (Vygotsky, 1978; Dewey, 1916). For instance, workplace learning and performance are considered to be significantly shaped by social, organizational, cultural and other contextual factors (Hager, 2011).

Furthermore, the research partly adopts a social cognitive orientation to examine the nature of expertise. Classical (behavioral) theories of learning have originally been rooted in the belief that the main laws of learning are common to all living beings and that they are acquired, maintained and modified by the basic mechanisms of learning (Kallio & Marchand, 2012). Later, the focus of socio-cognitive research shifted toward the separate, but interdependent, contributions of personal, behavioral and environmental influences that direct researchers to study bi-directional relationships between social and cognitive events (Bandura, 1986). Cognitivism acknowledges the role that environmental conditions play in facilitating learning; however, the “active” nature of the learner is approached by focusing on the mental activities of the learner that lead up to a response and acknowledges the processes of mental planning, goal-setting, and organizational strategies. Cognitive theories focus on the conceptualization of students’ learning processes and address issues of how information is received, organized, stored, and retrieved by the mind. (Shuell, 1986.) Learners’ thoughts, beliefs, attitudes and values are also considered to be influential in the learning process (Winne, 1985). The development of cognition, however, is considered to take place through internalizing social interactions, and knowledge is constructed by and distributed among individuals and groups as they interact with one another. As experiences are shared, learning and knowledge emerge from this participation in social interaction. (Russ-Eft, 2011.)

3 OVERVIEW OF STUDIES

This chapter summarizes the main foci and findings of the individual studies involved in this research. *Studies I and II place a special focus on formal learning environments and vocational excellence.* Study I considered ATCOs' perceptions of vocational expertise and vocational pathways and predictors related to vocational excellence, and Study II examined WSC achievers' and their co-workers' and employers' perceptions of vocational expertise and excellence and vocational pathways. *Studies III and IV place a special focus on workplace learning.* Study III examined apprenticeship training stakeholders' perceptions of vocational expertise and experiences of workplace learning and guidance, and Study IV examined the integration of apprentices in their work environment and the development of holistic vocational expertise. Studies I, II, III and IV in detail are provided as individual articles at the end of the summary.

3.1 Study I

The aim of the study I was to describe the characteristics and predictors related to ATCOs' vocational expertise and excellence in the Finnish context. The study analyzed the role of natural ability (gifts), intrinsic characteristics (self-regulatory abilities), and extrinsic conditions (domain- and non-domain-specific factors) in ATCOs' vocational development. The features related to ATCOs' developmental pathways were examined, from initial interest in the work field to perseverance in acquiring a vocational skill during the training period, and mastery of the skill in working life. Moreover, the study investigated whether ATCOs' performances during training or in the entrance examination was related to their on-the-job performances in working life. The study provides insight into the acquisition of vocational expertise and excellence in highly skilled and safety-critical vocations.

Research questions:

- (Study I RQ1) *What characteristics and environmental factors determine air traffic controllers' initial interest in this field of work, their perseverance in acquiring a vocational skill, and their mastery of the skill?*
- (Study I RQ2) *What are the differences in characteristics between the air traffic controllers representing vocational expertise and those representing vocational excellence?*
- (Study I RQ3) *Does air traffic controllers' performance during training or in the entrance examination predict vocational excellence in working life?*

The findings indicated that logical-mathematical skills and self-regulatory skills are considered to be ATCOs' most important vocational characteristics in addition to their interpersonal, intrapersonal, and spatial skills. The main differences between the ATCOs representing vocational expertise and those representing vocational excellence were related to self-regulation, as motivation and volition in particular proved to be somewhat stronger in the latter group. According to the interviewees, some differences between the ATCOs' levels of intrapersonal skills (understanding of one's own skills, capacities, and feelings) also develop in working life. The results of the study confirmed that the role of human factors—self-regulation in particular—was considered significant even in an automation technology-based vocational field.

The quantitative research results indicated that success in the entrance examination or during the training period do not predict vocational excellence in working life. Qualitative analyses supported the finding. During their studies, the structured training program was considered to ensure that all ATCOs have the basic vocational skills to perform in working life. However, the development of ATCOs' vocational expertise or excellence was rather seen as a process occurring in the working context, where new information is assimilated into old routines and knowledge by analyzing one's own performance. The most important factors that were considered to strengthen perseverance in acquiring mastery of a skill in working life were interesting, challenging, and varied work tasks, an interest in aviation, and strong professional pride and commitment. The importance of external factors such as leadership (human resource management, feedback, opportunity to influence), working environment (physical and social environment),

educational possibilities, professional benefits (salary and working hours), and career progression possibilities were also emphasized by ATCOs.

3.2 Study II

Study II investigated WSC achievers' and their co-workers' and employers' perceptions of vocational expertise and school-to-work pathways in the Finnish context. The study analyzed the role of natural ability (gifts), intrinsic characteristics (self-regulatory abilities), and extrinsic conditions (domain- and non-domain-specific factors) in former VET students' vocational development. It focused on features related to their developmental pathways from initial interest in the work field to perseverance in acquiring a vocational skill during the training period and mastery of the skill in working life. Furthermore, the goal of Study II was to provide information about the advantages and disadvantages of work-based WSC training in relation to traditionally implemented VET.

Research questions:

(StudyII RQ1) How is vocational expertise perceived by the former WorldSkills Competition achievers in relation to the perceptions of their co-workers and employers?

(StudyII RQ2) What kinds of school-to-work pathways describe the former WorldSkills Competition achievers in relation to those of their co-workers?

(StudyII RQ3) What kind of influence has the WorldSkills Competition and training experience had on achievers' vocational development and pathways in relation to vocational education?

The findings showed that the WSC achievers and their co-workers and employers shared a common view on the most important vocational characteristics, including both natural ability and self-regulatory skills. Bodily-kinesthetic skills (manual skills) and logical-mathematical skills (contextual knowledge) were seen as the foundation for performing well in a vocational field. All groups emphasized the importance of interpersonal skills; possessing good social skills was even seen as a way to compensate for weakness in some other areas. Moreover, self-regulatory skills, volition, motivation and self-reflection were

acknowledged as characteristics that are vital to one's vocational expertise and vocational development. The WSC achievers differed from their co-workers by placing a greater emphasis on the importance of cognitive skills (understanding overall work processes, creative thinking and quick and independent problem-solving skills).

The results showed some differences between the WSC achievers' and their co-workers' experiences in their school-to-work vocational pathways. When reflecting on their studies, most of the WSC achievers—but only a few of their co-workers—described their academic success as better than average. Study success was related to strong self-regulation, such as internal motivation towards the vocational field and volition (a conscientious and hard-working attitude), coupled with volition in deliberate practice (individual active studying and advanced studying skills). Most of the WSC achievers acknowledged the importance of both formal education and WSC to the development of their vocational excellence. The advantages provided by the WSC and training were particularly related to crossing the boundaries between student life and working life, thereby providing the student with an opportunity to create extensive professional networks and strengthen their vocational confidence in order to make the school-to-work transition easier and more efficient.

3.3 Study III

Study III examined apprenticeship training stakeholders' perceptions of vocational expertise and experiences of workplace learning and guidance in the Finnish context. The study analyzed the role of natural ability (gifts) and intrinsic characteristics (self-regulatory abilities) in apprentices' vocational development. Furthermore, the study investigated apprentices' participation in their work community, learning and knowledge acquisition within and between the contexts of education and work, and the processes of guided workplace learning.

Research questions:

(StudyIII RQ1) How is vocational expertise perceived in apprenticeship training?

(StudyIII RQ2) How is workplace learning experienced in apprenticeship training?

(Study III RQ3) What factors support and hinder guidance in apprenticeship training?

The study indicated that individuals with strong logical-mathematical skills (e.g., problem solving skills) combined to advanced interpersonal skills (e.g., social skills, communication skills), interpersonal skills (e.g., self-awareness) and self-regulation are perceived as vocational experts. Moreover, the study implied that self-regulation has a significant impact on developing vocational expertise. The importance of motivation emerged in several phases of the training. At the very beginning of their careers, apprentices were directed by motivational traits when choosing their career paths. Later, motivation was shown to influence apprentices' attitudes and initiative in work-based learning. Volition, such as exactness and carefulness, calmness, concentration and organizational skills, was recognized as important when performing work tasks. Self-reflection and questioning work routines leading to greater self-awareness were also recognized as part of one's vocational skills. Apprentices were considered to need strong self-regulation skills in order to become engaged in the learning process and to become active members of their work community. In turn, the experiences of the most challenging cases, or those who dropped out of apprenticeship training, were related to a lack of self-regulation and poor personal management.

The study indicated that workplaces are widely acknowledged as learning environments. The stakeholders involved in the apprenticeship training saw the potential for authentic work environments to offer apprentices the ability to develop vocational knowledge and skills that will lead to employment. Workplace learning is believed to afford an incomparable opportunity to learn by doing in authentic and diverse environments, thereby connecting theory to practice. The processes of learning, however, were mostly focused on the practical and theoretical knowledge gained in the workplace, whereas the theoretical knowledge gained in a vocational institution was considered to play either a minor or an invisible role. Even if theoretical studies completed in a vocational institution were considered useful for apprentices, they were not widely acknowledged as beneficial to either their work practices or the vocational development of other employees. The opportunities for shared knowledge building and reciprocal learning were also considered limited.

The experiences of the implementation of guidance were focused on observing other employees and on task-related defining questions. Only a few examples of more interactive guidance were recognized. The collective orientation to guidance

also proved to cause some confusion and led to inconsistency with regard to areas of responsibility. Overall, the biggest factors hindering guidance in the workplace seemed to be the lack of time, resources and pedagogical approaches. Thus, the apprentices were expected to be self-directed and assertive in order to seek out help and guidance. The need and desire for closer collaboration with vocational institutions with relation to pedagogical approaches to working life was underlined by the workplace stakeholders.

3.4 Study IV

Study IV examined the integration of apprentices in their work environment. Study focused on investigating the status of apprentices, their access to work communities and received guidance, and the co-operation and connection between workplaces and education providers. Moreover, the study examined the development of occupational and personal competences into holistic vocational expertise in the context of apprenticeship training.

Research questions:

(StudyIV RQ1) How does a student integrate into the social environment and work practices in apprenticeship training?

(StudyIV RQ2) What competences are integrated with students' holistic development of vocational expertise in apprenticeship training?

The study showed that co-operation between workplaces and educational institutions in an effort to promote learning are still limited in the context of Finnish apprenticeship training. In work communities, apprentices were treated as equal employees and assigned tasks with responsibility. Being an equal employee in the workplace meant shouldering a lot of responsibility, autonomy and independence. Even if the apprentices considered that they had received sufficient support and guidance in the workplace, the organizational perspective highlighted a lack of time, resources and knowledge to support collaborative working and goal setting, as well as reciprocal learning. Institutional education provided another community of practice for the apprentices, but membership was rather peripheral as the connection between workplaces and education providers was limited mostly

to administrative matters (e.g., contracts) at the beginning of the apprenticeship training. When applying the characterization of different approaches to learning through work (Guile & Griffiths, 2001; Griffiths & Guile, 2003), Finnish apprenticeship training seemed to rather represent the traditional model of learning through work, viewing work experience as separate from the educational institution, or the experiential model keeping work experience and theoretical studies distinct from each other but still acknowledging the need for partnerships to support student development. Integration of apprentices into their social environment and work practices supported the acquisition and participation metaphors of learning whereas the knowledge creation metaphor of learning, supported by the connective model (that is considered to represent an ideal balance between formal and informal learning), was invisible or not explicitly applied in the workplaces (e.g., Guile & Griffiths, 2001; Tynjälä, 2009; Tynjälä, 2013; Paavola, Lipponen, & Hakkarainen, 2004).

Competence-based education has attracted much interest in the field of VET (Mulder & Winterton, 2017). In the study IV, the holistic classification of the concept of competence (Le Deist & Winterton, 2005) were applied as a theoretical framework to further examine vocational students' and working life stakeholders' perceptions of work competences. The participants acknowledged the importance of developing both occupational *cognitive competence* (knowledge and understanding) and *functional competence* (practical know-how) in authentic learning environments—that is, in the workplace. Moreover, the findings emphasized the significance of personal *social competence* (social behavior and attitudes) and *metacompetence* (the acquisition of other competences, or “learning how to learn”). An interesting finding was that the personal competences were considered to precede the development of occupational competences. Based on earlier research (Nokelainen, Kaisvuo, & Pylväs, 2017), personal-level competences are closely related to self-regulatory skills and interpersonal skills.

4 MAIN FINDINGS

The aim of the research is to provide knowledge of vocational expertise and excellence and the development of vocational expertise in the context of formal and informal learning environments. This chapter presents the main findings of the research. The first section analyzes the participants' perceptions of vocational expertise and excellence (Studies I, II, III and IV). The second section discusses the current and former vocational students' choices of profession and the development of vocational expertise in the context of institution-based VET (Studies I and II). The third section analyzes the vocational students' choices of profession and the development of vocational expertise in the context of work-based VET, apprenticeship training (Studies III and IV). Table 3 (p. 61) presents an overview of the main research results and findings at the end of the chapter.

4.1 Vocational expertise and excellence

This section of the results discusses the individual characteristics related to vocational expertise and excellence. The participants' perceptions of vocational skills areas are classified based on the theoretical classification of natural abilities (Gardner, 1983, 1993, 1999) and self-regulatory skills (e.g., Zimmerman, 2000; Kitsantas & Zimmerman, 2002; Zimmerman & Kitsantas, 2005). In reference to Gardner's MI theory (1983, 1993), evidence of the original seven dimensions of natural ability was extracted from the data to examine the importance of individual intelligences to one's vocational expertise.

The findings indicated that *logical-mathematical skills* are considered to be one of the most fundamental of all natural abilities to one's vocational expertise. In this study, logical-mathematical skills represented both theoretical and practical occupational knowledge (e.g., technical knowledge, legislation and security information) and identified as generic expertise such as fluent mathematical skills (especially in the technology sector), problem-solving and reasoning capabilities.

Some employees need more ready-made solutions; other employees are able to assess different alternatives, even in a short time. (Study I, ATCO)

Creativity was one of the vocational characteristics highlighted in many of the interviews, particularly by the WSC achievers. Even if creativity was included along with the artistic and visual skills (spatial skills) needed in such vocations as floristry and hairdressing, it was more often related to the type of creative thinking that may inspire a person to create something new, such as a new idea or method of working. Thus, creativity was closely connected to logical-mathematical skills (e.g., problem-solving skills and innovativeness). Thirdly, regarding logical-mathematical skills, the findings also highlighted the importance of information processing, such as perceptive skills (e.g., situational awareness and anticipation of upcoming situations), multi-tasking skills (e.g., ability to concentrate on many things at the same time), and learning skills (e.g., ability to assimilate new information fluently).

All the interviewed groups emphasized the significance of *interpersonal skills* as an important element of vocational expertise. Several aspects of interpersonal skills were brought up in the interviews. Firstly, interpersonal skills were related to communication (e.g., customer service and team-working skills) and pedagogic skills (e.g., teaching skills and mentoring skills). On the other hand, interpersonal skills were described as part of one's responsive personality (e.g., energetic and positive attitude, open-mindedness, encouragement, and in some cases as indicative of an extroverted personality). The third approach to interpersonal skills emphasized an understanding of human nature, demonstrated through flexibility, care of others (listening and presence) and empathy (respect for people). In some cases, interpersonal skills were even seen to compensate for the lack of some other vocational strength, such as manual skills.

Socially talented individual. In my opinion it is the most crucial thing as we are so close to people's lives [...] One can do things mechanically, perform medical treatments mechanically correctly. But, if a person, our client, feels that she has not been met with kindness, we certainly have a problem. (Study III, employer)

The other natural abilities discussed in the study (*bodily-kinesthetic skills, linguistic skills, spatial skills and musical skills*) rather emphasized the differences between the occupational tasks and interviewees. For instance, ATCOs were considered to need strong linguistic skills (e.g., language skills and verbal communication) and spatial skills (three-dimensional skills) to perform in working life, whereas manual work in the technology sector was considered to require bodily-kinesthetic skills (e.g., sufficient muscular strength, physical condition and manual dexterity). Moreover, one employee in the social and health care sector considered the benefits of having musical skills in working life.

The findings strongly indicated that *self-regulation* positively influences the development of vocational expertise, and further, the development of vocational excellence. The participants of the research specified multiple capacities related to self-regulation that they consider an important part of vocational expertise. The findings emphasized the importance of internal motivation and interest in the field of vocation and in the work tasks. Moreover, the interviewees considered the willingness to learn to promote initiative and a positive attitude towards the vocation and work tasks. Certain external motivational factors were also considered to have an influence on one's professional choices and to support vocational development. External motivation was related to such factors as ambition (e.g., enhancing the level of performance and competition) and expectations regarding career progression (e.g., professional status). On the other hand, external motivational factors were related to conditions regarding the study environment (e.g., curriculum and structured/authentic learning environments) and the work environment (e.g., employment situation, salary and working hours).

While motivation was considered to form the foundation of vocational expertise, volition was considered to play a role in furthering the process of learning from initial interest towards continuous development of performance and stable professionalism. Volitional expertise was included alongside such characteristics as perseverance, exactness and carefulness, calmness, concentration and organizational skills. In the context of safety-critical air traffic control, volition was considered one of ATCOs' most important vocational characteristics: determination and perseverance were the basis of problem-solving and decision-making as one needs to be able to trust one's own skills in high-pressure circumstances. In addition, ATCOs' safety-critical work was considered to require such volitional skills as exactness, carefulness and time management skills in order to meet the official requirements of air traffic control. Furthermore, concentrating on air traffic control requires not only volition and sustainability, but also the ability to switch vitality from peak periods to quiet traffic periods.

And perseverance and patience is needed in everything, because if there are any problems or other hassles, it takes time to make sense of it. Perseverance is needed, at least. (Study II, co-worker)

Self-reflection was related to analyzing and questioning work routines. Self-reflection was congruent with *intrapersonal skills* describing one's understanding and reflecting on one's own expertise and feelings. The desired goal of the reflection process was the enhanced self-awareness of one's own learning, professionalism and the understanding of vocation-specific areas of expertise. The descriptions of

self-reflection also showed some variation between the different vocational fields. In the field of social and health care services, employees reported dealing with sensitive situations and getting feedback from customers and colleagues that require both questioning and self-awareness. By contrast, in ATCOs' safety-critical work, self-reflection was emphasized as the most important quality needed to manage and tolerate stress in the high-pressure work situations encountered in working life. The ATCO interviewees underlined the importance of resistance to pressure in decision-making through the ability to 1) make quick decisions; 2) take responsibility for the decisions; and, 3) mentally process the stress after an unsatisfactory performance. Active self-reflection and practice, leading to the creation of routines, was considered to increase the level of performance in the field of air traffic control.

Two of the studies (I and II) placed a special focus on the development of vocational excellence. Based on the findings, to become a top expert one needs to have sufficient vocation-specific skills to apply the skills in practice while also being competent enough to regulate his/her own performance. The development of occupational knowledge emphasized the importance of logical-mathematical skills (e.g., understanding overall work processes, creative thinking and quick and independent problem-solving skills). In particular, to perform at the level of vocational excellence, a person was considered to need the ability to create, innovate or solve problems independently.

Excellence, instead [compared to expertise], requires more logical thinking, to be able to apply everything one has ever seen, heard or done. Such skills and adequate work experience help one to become a top expert. (Study II, WSC achiever)

Some employees need more ready-made solutions; other employees are able to assess different alternatives, even in a short time. (Study I, ATCO)

The findings of Study I indicated that the main differences between the ATCOs representing vocational expertise and those representing vocational excellence were related to self-regulation. Based on qualitative content analyses, motivation and volition proved to be stronger among the employees representing vocational excellence. The findings implied that the employees representing vocational excellence had a stronger internal motivation than the employees representing vocational expertise. Volitional differences between the ATCOs were related to exactness, carefulness, time management skills and perseverance in practice. Furthermore, according to Bayesian analysis, volition appeared to be slightly higher among the employees representing vocational excellence. The results are in accordance with previous research on air traffic control. Yeo and Neal (2008) have

studied factors related to changes in subjective cognitive effort during simulated air traffic control tasks showing that participants with high levels of conscientiousness were self-disciplined and committed to their goals. Moreover, Yeo, Loft, Xiao and Kiewitz (2009) showed a positive relationship between mastery-approach (i.e., intrinsic motivation to master a specific skill) and performance in an air traffic control task. Due to highly selective entrance tests, however, all operative ATCOs are considered highly qualified experts in their vocational field in this research. Thus, the findings showing differences between the two groups divided according to vocational expertise and excellence need to be carefully considered in the field of air traffic control.

In Study II, the results also showed some differences between the WSC achievers and their co-workers. Similar factors influenced both the WSC achievers' and their co-workers' choice of career; however, during their studies, their vocational pathways diverged in the sense that most of the WSC achievers—but only a few of their co-workers—described their academic success as better than average. Study success was related to strong intrinsic self-regulatory characteristics, such as internal motivation towards the vocational field and volition (e.g., a conscientious and hard-working attitude), coupled with engaging in deliberate practice (perseverance in individual active study and advanced study skills).

Overall, all research participants shared a similar view of the most important vocational characteristics. In addition to a variety of logical-mathematical skills, the multiple capacities related to self-regulation were considered as part of one's vocational expertise, particularly one's vocational excellence. The findings of this research align with the earlier research as recent theories of vocational expertise acknowledge the importance of integrating theoretical, practical and self-regulatory knowledge in the development of professional expertise and vocational competence (e.g., Bereiter, 2002; Eraut, 2004; Tynjälä, 2013). Furthermore, the findings underlined the social aspects of working life and the importance of interpersonal skills. The findings imply that individuals with fluent cognitive skills combined to advanced social skills, self-awareness and self-regulation are perceived as vocational experts in modern working life.

4.2 Vocational pathways

The findings related to the development of vocational expertise follow the three identified stages of talent development (Bloom, 1985; Greenspan, Solomon, &

Gardner, 2004): initial participation (first attraction to the vocational field), perseverance (acquisition of basic and intermediate skills in VET), and mastery (building upon acquired skills to develop expertise and to compete on higher levels at work). This section of the results identifies the most influential individual and environmental factors in the development of vocational expertise based on the participants' perceptions and experiences of formal learning environments in the context of institution-based VET (Studies I and II) and informal learning environments in the context of apprenticeship training (Studies III and IV).

4.2.1 Formal learning environments

The findings indicate that both individual and environmental factors have an influence on vocational students' initial interest in their vocational field. Family and friends were shown to be the greatest influences on vocational students' choices of profession, thus supporting Bloom's (1985) argument that parents make the talent field accessible and desirable to their children and that the home environment provides the structure necessary for early learning. The data shows that the students' decisions were guided by such factors as family members' professional backgrounds (e.g., profession history and attitudes towards professions/education) and the immediate family environment (e.g., available equipment and access to authentic work experiences). In addition to familial influence, the participants' decisions to apply to their chosen field of vocation were also based on their personal interest and motivation in the area. A few of the interviewees had found their career path through work experience (e.g., workplace training in secondary school or non-military service) or a vocational school tour.

[Mother] came from a family of farmers, so manual skills have always been there. My uncle developed patents for some agricultural stuff, so it surely comes from there somewhere. In fact, I can see the same thing now in my own two sons; somehow they are more technically oriented. (Study II, WSC achiever)

Moreover, some of the interviewees had chosen their career based on their study success or educational offerings. One-quarter of the ATCO interviewees were interested in professional benefits such as salary, working hours, professional status, and work stability. The potential to cross over into a new career, the general employment situation (such as the state of the economy and unemployment rates), and the concise curriculum were also brought up as motivational factors for applying for ATCO training.

The findings underlined the significance of certain individual factors—in particular self-regulation—to the development of expertise during training. According to the former vocational students in the field of air traffic control, vocational studies require motivation and volition to maintain perseverance while studying. The WSC achievers also greatly emphasized their internal motivation toward working in the vocational field and their enthusiasm for vocational education throughout their studies. Most of the WSC achievers, along with some of their co-workers, considered themselves to be more successful than average students. They actively studied not only in a formal setting, but also in their spare time. Some of them described themselves as conscientious and hard-working students, and the others underlined how their advanced study skills helped them to succeed in their studies. These findings support earlier research on the importance of deliberate practice to talent (or vocational) development and its connection to such factors as engagement and motivation (Ericsson et al., 1993).

Yes, I was different from others. If I think back on our class, then yes, I certainly was the only one who studied from morning until evening. Maybe I differed in the sense that I had a strong will to learn. (Study II, WSC achiever)

ATCOs' perseverance during the study period also strongly relied on environmental conditions, more specifically, on the structured curriculum. The intensive and tight study schedule was considered practical and well organized and therefore simple to follow. The role of the teachers, with their expertise and enthusiasm, and supportive social atmosphere were also acknowledged to play a role in motivating and supporting students' learning in a formal learning environment. The theoretical part of the studies, however, was considered challenging, as a lot of detailed information has to be learned in a short time without applying it in practice. The ATCOs' transition from school to work was balanced by supply and demand. As the intake of new students is only approximately 2–3% of applicants (Finavia, 2013), employment of all ATCOs is mostly ensured. According to the interviewees, most of the ATCOs are placed in provincial airports after graduating. Only a minority is placed in a larger city, Helsinki-Vantaa Airport (usually based on exceptional training performance).

Good exercises, good devices and teachers. The integrated whole [of the curriculum] supported. (Study I, ATCO)

One's success is much depended on whether a teacher is good, and the topic is interesting. (Study I, ATCO)

Study environmental conditions were not as greatly emphasized by the WSC achievers, their co-workers and employers. The role of VET was mainly seen in terms of providing a student with certain basic skills to use at the beginning of their career, based on the assumption that the rest of their knowledge and skills will be acquired on the job. Some of the former vocational students and employers, however, expressed their discontent with current formal learning environments and VET curricula. The criticism was concerning teachers' outdated knowledge (lack of recent work experience and further education), obsolete technology and devices, as well as weak or theoretically oriented curricula. The employers were especially worried about the lack of students' commercial expertise (business skills) that was considered crucial in any vocational field.

Most of the WSC achievers acknowledged the importance of both formal education and WSC training to the development of their vocational excellence. As opposed to ATCOs, the vocational pathways of the WSC participants after graduation were not yet determined during VET. Thus, the importance of the environmental conditions afforded by the formal learning environment emphasized the working life connections during the study period and the advantages provided by the WSC were related to crossing the boundaries between student life and working life.

For sure, the biggest factor is the contacts. But the fact is that the contacts were earned through my success in vocational competitions. Let's put it this way: if I were to become unemployed for some reason, I would find a new job through these contact networks, and very quickly. (Study II, WSC achiever)

The findings indicated that compared to the other vocational students, the WSC achievers had an exceptional opportunity to create extensive professional networks during their study period and strengthen their vocational confidence in order to make the school-to-work transition easier and more efficient.

Following the acquisition of knowledge in VET, the findings underlined the significance of self-regulation for the development of expertise in working life. In the context of air traffic control, active self-reflection and practice leading to the creation of routines were considered to increase the potential for success in working life. Success in working life was seen as a result of one's efforts and based on one's understanding of one's own skills, capacities and feelings. ATCOs' interest in aviation, as well as their strong professional pride and commitment, was one of the most important factors in strengthening their perseverance when mastering a work skill. The target group of WSC achievers described their career development in working life as better than average more often than their co-

workers. This was supported by more than half of the employers who acknowledged the exceptionally high level of expertise of the interviewed WSC achievers working in their organizations. Their higher level of vocational expertise was mentioned along with their strong self-regulatory skills (motivation, volition and self-reflection). Those co-workers of the WSC achievers who also felt that they had superior expertise to average employees acknowledged the importance of their strong self-regulatory skills.

The participants of Studies I and II also discussed the environmental conditions that they consider important to their work motivation and ambitions. Workplace affordances such as sufficient resources, possibilities for further education, compensation and career opportunities were considered to support employees' continuous vocational development. In particular, the ATCOs emphasized the importance of environmental factors like interesting, challenging and varied work tasks, leadership (human resource management, feedback, opportunity to influence), working environment (physical and social environment), educational possibilities, professional benefits (salary and working hours), and career progression possibilities. By contrast, the WSC achievers and their co-workers discussed broadly the importance of lifelong learning as well as their ambition to learn and their motivation to develop professionally. They were interested in engaging in further education, working in international environments and on international projects, as well as progressing in their career within the target organization or even becoming an entrepreneur.

4.2.2 Informal learning environments

The apprentices' choices of career were directed by both individual and environmental factors. The interviewed apprentices' vocational careers had, in most cases, been inspired by a personal interest in their chosen vocational field or upon the recommendation of family or friends. A few more interviewees in the technology sector acknowledged the influence of their social environment on their chosen field of vocation, while several interviewees from the health and social services trade described also the role of their earlier experiences in the working field on their choice of profession. In addition, apprenticeship training as a mode of education had an influence on the apprentices' career choices. Work-based learning was considered to afford them the possibility of 'learning by doing' in order to connect theory and practice. Moreover, some of the apprentices'

discussions were related to their preferences for the study methods of apprenticeship training. Apprenticeship training was also seen as a practical way of training while earning a living. In particular, the interviewees from the social and health care services sector discussed their domestic reasons for choosing apprenticeship training, along with its accompanying financial benefits. Some of the interviewees had chosen apprenticeship training based on their study success or education offerings.

The findings emphasized the importance of certain individual characteristics—in particular self-regulation and interpersonal skills—in the development of vocational expertise during apprenticeship training. Strong self-regulation and social skills were shown to play a crucial role in helping a learner become involved in learning processes and to act as an active member of a work community. Good social skills were even seen as a way to compensate for weakness in some other areas of expertise. Moreover, according to Zimmerman (1989, 1990), learning processes were based on motivation, the idea that the outcomes of one's efforts are sufficiently attractive to self-regulate. In the context of work-based VET, the importance of motivation emerged in several phases of the training. At the very beginning of their careers, apprentices were directed by motivational traits when choosing their career paths. Motivation was also recognized and acknowledged (e.g., recruitment criteria) by the employer interviewees in several fields of industry. During the study period, motivation was shown to influence learners' attitudes and initiative in continuing the development of their work performances and vocational expertise. Also, the quality and intensity of guidance in the workplace was shown to be conditional on an apprentice's motivation and initiative. To get the support needed to develop vocational expertise, apprentices were expected to be not only motivated, but also self-directed and confident enough to ask other employees for their help and guidance. Thus, the findings indicate that in the context of informal learning environments, motivation is considered one of the most significant prerequisites for the development of expertise.

Active and initiative. Those come to my mind. Of course, the most important thing is that you want to develop. That's how you achieve results, and how you develop the best and the most effectively. (Study III, apprentice)

It is a lot to do with yourself. Sometimes we have those apprentices who are forced to do things. They don't really cope in here. (Study III, co-worker)

Volition, such as exactness and carefulness, calmness, concentration and organizational skills, was recognized as important when performing work tasks. Self-reflection and questioning work routines leading to self-awareness were also

recognized as important skills to have in the context of apprenticeship training. The lack of self-regulatory skills was seen to have a negative influence on vocational development (e.g., explained student drop-outs).

The findings indicated that workplaces were widely acknowledged as learning environments by the apprenticeship training stakeholders. Learning by doing combined with vocational studies was considered the best way of learning a profession. Becoming involved with the work processes in authentic and diverse environments was another of the perceived benefits of workplace learning. The participants' perceptions of learning through work also supported the framework of participation, suggesting that learning a vocation is essential in participative everyday interactions (see Lave & Wenger, 1991). Thus, the colleagues immediate sharing the responsibility for a learner's participation and providing individual assistance created the most significant environmental conditions for the apprentices' development of expertise.

The findings implied, however, that currently there are environmental factors forming the basis of apprentices' development of expertise at workplaces that both help and hinder their progress. Firstly, workplace guidance was actualized by offering novice workers observation and task-related support. Yet, according to the working life stakeholders, intentional workplace learning seems to demand more time, resources and knowledge regarding collaborative working and reciprocal learning that workplaces are able to afford. Certain ambiguities were also observed in areas of responsibility with regard to providing guidance to apprentices. Secondly, the processes of learning were mostly focused on practical and theoretical knowledge gained in the workplace, whereas the knowledge gained during the institutional period of training was shown to play rather a minor role.

I don't know if they really bring any new expertise to the workplace. I think the flow of know-how is more from us to the apprentices, rather than them bringing us something new. (Study III, workplace trainer)

Even if vocational studies were considered useful for apprentices, they are not currently acknowledged as beneficial to actual workplace practices or supportive of reciprocal learning.

While institution-based and work-based VET both focus on the acquisition of basic and intermediate vocational skills, apprentices are confronting the requirements of working life already during the training while working with experienced workers. From the perspective of working life stakeholders, the benefit of workplace learning was rooted in opportunities to engage apprentices within the target organization. Moreover, the findings indicated that employers,

workplace trainers and co-workers regarded apprentices as competent and productive employees even during their training. Particularly in the field of social and health care, apprentices were described as equal workers and members of the work community, enjoying direct access to productive work requiring co-operation with multiple actors. Apprentices mostly also considered themselves to be equal employees and full participants within the work community. Only two apprentices in the technology sector saw themselves as trainees in relation to the work community and the industry. Being an equal employee in the workplace meant shouldering a lot of responsibility, autonomy and independence. Accordingly, the high expectations of employees also resulted in a lack of support, guidance and instruction given to apprentices. Some apprentices in social and health care retrospectively stated that more guidance would have been welcome, especially at the beginning of their apprenticeship training. In the technology sector, however, apprenticeship training was also seen as a model for learning, where masters pass their knowledge and skills on to novices. Apprentices were considered newcomers who were on a lower level in the hierarchy and needed to learn and earn a higher position through their participation in simple, low-risk tasks. Table 3 provides an overview of the research aims and main findings discussed in this chapter: the main characteristics related to vocational expertise and excellence, and individual and environmental factors considered influential regarding vocational pathways in formal and informal learning environments.

Table 3. Overview of research aims and main findings

Research aim: To identify individual characteristics related to vocational expertise and <i>vocational excellence</i> .					
Natural abilities			Self-regulation		
<ul style="list-style-type: none"> - <i>Logical-mathematical skills</i> - Interpersonal skills - Intrapersonal skills 			<ul style="list-style-type: none"> - <i>Internal motivation</i> - <i>Volition</i> - Self-reflection 		
Research aim: To identify individual and environmental factors that influence vocational students' development of expertise in the context of formal learning environments.					
Initial interest		Education		Working life	
Individual	Environmental	Individual	Environmental	Individual	Environmental
<ul style="list-style-type: none"> - Internal motivation - Previous work experience - Previous study success 	<ul style="list-style-type: none"> - Familial influence - Professional benefits - Educational offerings 	<ul style="list-style-type: none"> - Internal motivation - Volition 	<ul style="list-style-type: none"> - Curriculum - Teachers' expertise - Social environment - Authentic learning environments - Working life connections 	<ul style="list-style-type: none"> - Internal motivation - Volition - Self-reflection 	<ul style="list-style-type: none"> - Social and physical environment - Job description - Leadership - Further education - Career possibilities - Professional pride and ambition - Professional benefits
Research aim: To identify individual and environmental factors that influence vocational students' development of expertise in the context of informal learning environments (apprenticeship training).					
Initial interest			Education/Working life		
Individual	Environmental	Individual	Environmental	Individual	Environmental
<ul style="list-style-type: none"> - Internal motivation - Previous work experience 	<ul style="list-style-type: none"> - Familial/social influence - Authentic learning environments - Financial benefits - Educational offerings 	<ul style="list-style-type: none"> - Internal motivation - Volition - Self-reflection - Interpersonal skills 	<ul style="list-style-type: none"> - Participation in work community - Guidance (individual and collective) - Integration of theory and practice 		

Note. Differences between vocational expertise and vocational excellence are marked with italics.

5 DISCUSSION

Plenty of new ideas and directions have been set out to explore concepts such as work, place, learning and education (Cairns & Malloch, 2011). This study continues the discussion in the discipline of education and in the field of VET research by building on a new theoretical approach and extensive empirical data ($N=119$ interviews) to investigate the development of vocational expertise. The aim of this doctoral dissertation was to provide knowledge of vocational expertise and excellence and the development of expertise in the context of formal and informal learning environments. The research has focused on examining the influence of both individual characteristics (natural ability and self-regulation) and environmental factors (immediate environment and formal and informal learning environments) on vocational expertise during the three stages of talent development (Bloom, 1985; Greenspan, Solomon, & Gardner, 2004): initial participation (first attraction to the activity and initiation of formal instruction), perseverance (acquisition of basic and intermediate skills), and mastery (building upon acquired skills to develop expertise and to compete on higher levels). The socio-constructivist approach to natural ability and self-regulation affords an opportunity to accurately examine the role of generic vocational knowledge and skills in relation to the current requirements of working life. By following the modernist agenda on the socio-constructivist and socio-cultural theories of learning, the study provides topical knowledge of the environmental factors supporting and hindering the development of vocational expertise in the context of formal and informal learning environments. This chapter reviews the theoretical implications, practical implications and the limitations of the research. The final section discusses directions for future research.

5.1 Theoretical implications

The theoretical implications of the research derive from the identification of the most acknowledged generic knowledge and skills in modern working life. As vocational expertise manifests in a variety of forms of knowledge and skills, it is

examined through the lens of the original seven-dimension version of Gardner's (1983, 1993, 1999) MI theory. In particular, the findings have emphasized the importance of logical-mathematical skills and interpersonal skills for one's vocational expertise and identified several aspects of knowledge and skills related to them. According to Moran and Gardner (2006), the power of Gardner's MI theory in work contexts can be strengthened through an examination of the ways the intelligences interact in individuals or within teams. A variety of potential combinations create different patterns to allow for a wider array of competences and performances to arise as one intelligence can mediate and constrain, compensate or catalyze another (Moran & Gardner, 2006). The results introduced instances of certain intelligences interacting with one another. Creativity was one of the vocational characteristics highlighted in many of the interviews and is considered important in today's working life. Logical-mathematical skills and problem-solving skills, instead, seemed to catalyze the type of creative thinking and innovation that was used to describe successful students and employees. Such a catalyzing effect was considered to inspire a person to create something new, such as a new idea or method of working. Moreover, several aspects of interpersonal skills were brought up in the interviews regarding understanding and communicating with people. In some cases, interpersonal skills were considered to compensate for the lack of some other vocational strengths, such as manual skills. Overall, the findings of the research support Moran and Gardner's (2006) thesis that instead of only defining intelligences, what also matters is how varying levels of different intelligences interact within a particular situation or job. Furthermore, when considering that the amount of information processing required is usually more than one person can even handle, the notion of a single individual possessing all-purpose intelligence needs to be reconsidered (Moran & Gardner, 2006). Based on the empirical findings of this research, further research on the measuring of intertwined and shared intelligences is needed to serve the interests of the future theoretical development of vocational expertise and generic knowledge and skills.

Recent theories on vocational expertise discuss integrating theoretical, practical and self-regulatory knowledge (e.g., Bereiter, 2002; Eraut, 2004; Tynjälä, 2013). The second theoretical implication of this study derives from the findings identifying the various capacities underlying self-regulation and the importance of those capacities in all stages of talent development. Motivation was shown to influence one's attitude and initiative in self-directed learning, both during institution-based and work-based VET, along with the interest in continuing to develop professionally in working life. While motivation was considered to form the basis

of the development of expertise, volition advanced the process of learning from initial interest towards continuous development of performance and stable professionalism. Volition was included with such intrinsic characteristics as perseverance, exactness, concentration and control of time and tasks. Self-reflection was congruent with intrapersonal skills describing one's understanding and reflecting on one's own expertise and feelings. Questioning work routines was considered to develop self-awareness. The findings implied that the main differences between those participants representing vocational expertise and those representing vocational excellence were strongly related to their self-regulatory skills, in addition to their cognitive abilities. In the context of work-based VET, the level of self-regulation was also considered to shape vocational students' environmental conditions (e.g., resources, guidance, learning tasks and work environments). While an apprentice's strong self-regulation ability may increase and improve the learning affordances available to them, a low level of self-regulation may decrease and weaken them. Thus, when addressing the issue of self-regulation, the findings of the research have strengthened its role as a vital component of one's vocational expertise.

The research has identified environmental factors that influence one's vocational development in different phases of talent development. Firstly, the findings imply that vocational students' choices of profession are often based on their personal interest but are also significantly directed by external support and the opinions of individuals in their immediate environment, that is, family and friends. During the study period, the role of institution-based VET was seen as providing a student with certain basic skills to use at the beginning of their career, based on the assumption that the rest of their knowledge and skills would be acquired on the job. The cases of WSC participants, however, strongly indicated that extensive working life experiences and contacts available from as early as the study phase have positive effects on vocational pathways, in particular school-to-work transition and career opportunities and success. Hence, the findings of the study imply that vocational institutions have good future potential to reinforce students' comprehensive development of vocational expertise and excellence and school-to-work transition by developing learning conditions based on active networking with working life stakeholders. The development of expertise in the context of work-based VET, instead, was considered to draw upon an extensive learning environment to facilitate an apprentice's vocational development by offering access to authentic work tasks and collective support by experienced workers. Workplaces were widely acknowledged as learning environments and the perceptions of the

current students and working life stakeholders supported the framework of participation proposing that informal learning happens in everyday interactions and through participation in communities of practice (e.g., Lave & Wenger, 1991). However, one of the biggest factors currently hindering the availability of guidance and support in the workplaces seems to be the lack of time, resources and pedagogical approaches. The workplaces were rather shown to provide fruitful learning possibilities for those apprentices with strong self-regulatory skills and who are capable of engaging in self-directed learning. Moreover, the opportunities for shared knowledge building and reciprocal learning, which have been shown to support workplace learning (Billett, 2001a; Filliettaz, 2011; Fuller & Unwin, 2004a; Gurtner et al., 2011), were considered limited in the context of apprenticeship training. Overall, when measured against expectations of working life, both institution-based and work-based VET were considered to provide the basic vocational skills for a learner to pursue higher levels of vocational expertise in working life. However, the findings also implied that vocational institutions are challenged to build stronger networks to working life and to develop workplaces as learning environments in collaboration with working life stakeholders.

One commonality between vocational pathways in institution-based and work-based VET was that the development of vocational expertise and excellence was greatly dependent on individual processes. Following the theories of self-regulation, learning eventually happens when students become proactively engaged with learning and carry out specific learning practices both independently and socially in informal and formal instructional contexts (e.g., Zimmerman, 1990, 2001). The findings of the present research indicated that by having motivation, volition and effective learning strategies to practice, and the ability to constantly reflect on one's performance, one was able to develop sufficient vocational expertise, and in some cases, even achieve a level of excellence. Moreover, the results implied that those individuals who were strongly motivated to develop their vocational expertise seemed to get their hands on important contacts, resources and learning processes. The theoretical implication derives from the findings showing that the development of vocational expertise and excellence, as well as available environmental conditions, are closely connected to an individual's regulation of learning. The perceptions of individual learning emphasize the need for creating learning environments that afford vocational students the space, time and guidance to strengthen their self-regulatory skills during the training.

This research has applied the developmental model of vocational and professional excellence (DMVE) (Nokelainen, 2016; Pylväs, Nokelainen, & Roisko,

2015) to investigate the influence of individual and environmental factors on the development of vocational expertise and excellence. The DMVE recognizes the widely acknowledged classification of natural ability (Gardner, 1983, 1993, 1999). This intrinsic component of the model takes notice of innate fields of giftedness that scholars in the field of giftedness and talent studies have developed and tested over several decades. The results are based on qualitative analyses and demonstrate descriptive and profound knowledge in each area of giftedness. However, by embedding the segregated psychological framework into the contexts of education and work, intrinsic characteristics may be displayed in a format that conceals the complexity of expertise. Overall, nevertheless, the model allows for a contribution to be made to the current debate on the individual-oriented learning theory by focusing on the learning processes of *reflective individuals* who bring themselves to their learning tasks, and thus, their strategies and approaches are mediated by their beliefs, values, histories and prior socialization (Marsick, 2009). The DMVE takes into account the dynamic nature of expertise by embracing the importance of self-regulation and deliberate practice in development processes. Furthermore, the research increases the empirical support for a cyclical phase model of self-regulation and develops context-specific information by a qualitative analysis of individuals' functioning in VET learning environments (see Zimmerman, 2013). Theory building that focuses on qualitative research can be considered especially valuable in the development of informal learning theory because of the rich, contextual information it generates. Context, e.g., relationships, organizational factors and knowledge management, greatly affect individuals' learning practices and choices as well as triggers for learning, resources and environmental influences (Marsick, 2009).

Studies I and II place a stronger focus on individual factors and the contribution with regard to environmental factors is limited to the role of key actors and educational structures. Studies III and IV incorporate more profound insights from the two different, and often distinguished, cognitive and socio-cultural paradigms. Overall, the research represents current theoretical perspectives on learning and work that are most often discussed in social and cultural terms. Notions of participation are often confined to human interactions, focusing on social relations and cultural forces, and the ways in which humans “use” tools or move through “contexts”. It also means the acceptance of such differential categories as individual/organization, informal/formal and individual/collective learning (Fenwick, 2010). Fenwick (2010), however, advocates a *sociomaterial* approach to better understand and research workplace learning in the future. He

refers to a pervasive shift suggesting that the material world should also be treated as continuous with, and in fact embedded in, the immaterial and the human. Sociomaterial perspectives (e.g., Engeström, 2001; Fuller & Unwin, 2004b) challenge the givenness of fundamental distinctions between human and non-human, and prompts a call to examine the dynamic process of materialization—including material and discursive practices—through which things emerge and act in what are indeterminate entanglements of local, everyday practice. This perspective can be considered to have enormous implications for understanding work life and processes of learning. (Fenwick, 2010.)

5.2 Practical implications

This research provides an insight into both current and former VET students' and working life stakeholders' conceptualizations of vocational expertise. To meet the future needs of working life, the working life stakeholders' perspectives should be considered during VET curriculum design and when devising pedagogical solutions. The research has identified the components of vocational expertise that emphasize the importance of generic knowledge and the skills valuable in any context of working life. Firstly, the research suggests that by supporting the development of logical-mathematical skills, such as problem-solving skills, one's creative thinking and innovation abilities improve—both of which are currently recognized skills in working life. Furthermore, not only does fluent cognitive processing inspire and enable a student or an employee to develop their work practices, but it also helps them to manage wider areas of responsibility. The research has also discussed the social aspects of learning and expertise. Knowledge and skills such as communication, pedagogic skills, responsiveness, humanity and an understanding of human nature were shown to help a learner engage in the available study and work environments.

Most importantly, the research has discussed the significance of self-regulatory skills in vocational pathways. As one's self-regulatory ability seems to both form the basis for individual learning processes and influence the availability of environmental learning conditions, the study highly recommends that vocational teachers pay attention to pedagogical solutions enhancing students' regulation of learning. Furthermore, bringing the knowledge of self-regulatory processes to workplaces seems to be even more topical; the working life expectations for students' regulatory skills seem to be even higher, right from the beginning of

apprenticeship training, than the expectations for occupational knowledge and skills. It is important to take this discrepancy into account, especially when increasing the amount of work-based VET that is suitable for young students. The findings are in alliance with Samppala's (2017) recent research indicating that both vocational students' and their supervisors' conceptions of workplace learning emphasize professional competencies and self-regulation skills that are rather connected to individual features of learning than to cooperative learning. She also underlines that it is essential to recognize these learning theoretical orientations, in particular the importance of social interaction and supervision in a working community, as well as cooperation crossing the boundaries of school and the workplace. In this study, the two extreme cases illustrated the role of self-regulation in working life. In highly skilled and safety-critical vocations, such as air traffic control, regulatory skills were considered a determinant of the maintenance of a high level of performance and vocational excellence, whereas the experiences of drop-outs or other problematic incidents during VET were related to a lack of self-regulation. To enhance students' motivation in work and control over their own learning from the earliest stage of talent development, and further, to influence their work performance and wellbeing in the long run, new pedagogical ways of training and strengthening students' regulation of learning are needed in VET and working life.

The research also serves to widen our understanding of the environmental conditions supporting and hindering the development of vocational expertise in the context of formal and informal VET. When compared to the expectations of working life, the findings indicated that both institution-based and work-based VET provide the basic vocational skills to pursue higher levels of expertise in working life. In the context of institution-based VET, the learning conditions reinforcing students' development of vocational expertise and excellence and school-to-work transition were related to active networking with working life stakeholders and experienced workers. Thus, the research implies that vocational institutions have good future potential to support students' comprehensive development of vocational expertise by diversifying the available learning environments and strengthening the connections to working life experts. By contrast, the current implementation of work-based apprenticeship training indicates that the lack of time and resources sets restrictions on employees to develop systematic and intentional workplace learning skills. Moreover, even if workplaces were widely acknowledged as learning environments affording opportunities for authentic learning experiences and vocational development, the

findings imply that apprentices and working life stakeholders need to better understand the development of vocational expertise, different actors' roles (responsibilities and prospects) in learning processes, and pedagogical tools to enhance workplace learning. Norontaus (2016) also found in her research that even if the effectiveness and performance of apprenticeship training in companies is good, the quality of the training varies to some extent. For example, the implementation commencement and provision of apprenticeship training often rely on forward-looking individuals who have had positive experiences with apprenticeship training. The main obstacles are often related to a lack of communication and information, failure to recognize the potential for training, the training culture of companies and unclear ideas and understanding of apprenticeship training. Moreover, the implementation of apprenticeship training for young people is hindered by factors related to employment relations and finances, aspects involved in a young person's stage of development and several pedagogical and ethical issues (Norontaus, 2016). Consequently, there is a need to acknowledge the current challenges and imbalances in and between the students and practitioners involved in work-based VET: the apprentice (who lacks the knowledge and skills needed for the regulation of learning), the vocational institution (the peripheral role and influence on the pedagogical approach of workplace learning) and working life stakeholders (who lack knowledge of areas of responsibility and pedagogical issues related to modern workplace learning). In this study, an encouraging finding was that the working life stakeholders interviewed were interested in engaging in greater collaboration with vocational institutions. The research suggests considering and redefining the areas of responsibility within a wide range of stakeholders in the context of apprenticeship training to support intentional workplace learning and integrate learning environments more closely in order to support apprentices' development of holistic vocational expertise.

5.3 Limitations

It is acknowledged that certain limitations may have affected the research findings. Firstly, the data variation creates limitations when it comes to drawing comparative or in-depth conclusions between the examined target groups. The study is based on the self-reported statements of the participants regarding vocational expertise and excellence and vocational pathways. However, the participants represent various vocational fields and workplaces and differ in their educational

backgrounds (e.g., the highly selective air traffic control degree program in contrast to the other VET degree programs). From a broader perspective, by choosing the Finnish context to examine the research topic, it certainly needs to be acknowledged that some of the factors are more or less specific to Finnish VET and working life. Some variation also existed between the study designs applied in the substudies that may have influenced the emphases placed on the findings. Further research focusing on specific vocational fields or other countries would yield more extensive information about the topic of research.

The research is strongly based on a qualitative approach. The aim of the analysis was to create conceptually and empirically grounded categories related to the analytical context and rooted in sufficiently relevant empirical material to reflect the topic of the study (e.g., Dey, 1993). The advantage of the thematic analysis is that the data allow for a wide range of analytic options, but at the same time, it has no specific guidelines in place for higher-phase analysis. It has limited interpretative power beyond mere description if it is not used within an existing theoretical framework that anchors the analytic claims that are made. (Braun & Clarke, 2006.) The trustworthiness of the analysis was strengthened by presenting the reader with what was communicated in the interviews (e.g., authentic interview transcriptions) and describing how the analysis was implemented in and integrated with the analytical context. NVivo offered a reliable tool to manage the extensive coding process. The sophisticated software was used in organizing data sources, managing coding and using numerical counts. It also enabled all the researchers involved in the study to keep track of the coding and analysis processes. However, as the results are based on the interviewees' subjective and contextual knowledge, the possibility of there being different interpretations, verbalizations or even misunderstanding between the interviewees and the researcher must be taken into account. Since the manuscripts were proofread by an anonymous outsourcing service, there may also be some linguistic differences in the interpretation.

Bayesian methods (e.g., Bernardo & Smith, 2000) were applied in Study I to increase the research validity of the qualitative methods in a confirmatory way. Bayesian classification modeling was used to select the most probable predictors of vocational excellence (RQ2 and 3). Bayesian methods work with small samples and allow for the use of nominal indicators (textual or numerical data) and prediction with the model derived from the empirical evidence (Nokelainen, 2008; Nokelainen & Silander, 2014). The number of participants ($n=28$) in the study, however, was rather small, thereby limiting the generalization of the results to the target population ($N=300$). The BCM analysis is based on a technique that is not

sensitive to missing values (BCM). However, missing data in the ATCOs' aptitude test scores, training records, and employee assessments added uncertainty to the results related to RQ3.

Studies I and II place a special focus on the development of vocational excellence. The division of participants into employees performing at the levels of expertise and excellence, is systematic and based on external expert evaluations. The division between ATCOs (Study I) performing at levels of expertise and excellence was made by a panel of experienced operative superiors on the basis of ATCOs' on-the-job performances. The WSC achievers (Study II) interviewed participated in the WSC between 1997–2011 and earned either gold, silver or bronze medals, or a diploma (for being awarded more than 500 points). Having been vetted by the WSC's high-standard evaluation process, the WSC achievers were considered to perform at the high level of expertise. Yet, the study design focusing on the two groups of achievers and other employees is not infallible. In both studies, the external evaluations were based on the subjective perceptions of the panel members. Furthermore, the external evaluation in Study II concerned only the WSC achievers and not the other former vocational students interviewed. Thus, instead of comparing the target groups, the aim of the research was rather to provide information about the experiences of those individuals that have been evaluated as performing at a level of excellence according to reliable criteria.

5.4 Directions for future research

Future studies in the field of VET will need to illuminate the range and weight of different aspects of cognitive, emotional and social factors in expertise development. Such studies have the potential to influence learners' regulation of learning that the findings of this study, among other studies, have shown to comprehensively support the development of vocational expertise. Education plays a significant and extensive role in promoting the skills of control and regulation, especially during young adulthood. The large and accepted longitudinal study (Moffitt et al., 2011) following a cohort of 1,000 children from birth to the age of 32 years has shown that childhood self-control can predict multiple indicators of health (e.g., risk for depression, alcohol and drug problems), wealth (e.g., financial situations and money management), and crime (e.g., criminal convictions) across three decades of life. Self-control was considered an umbrella construct that bridges the related concepts and measurements (e.g., impulsivity,

conscientiousness, self-regulation, delay of gratification, inattention-hyperactivity, executive function, willpower, intertemporal choice) from different disciplines of research. The differences between children with self-control predicted their adult outcomes approximately as well as low intelligence and low social class origins. Furthermore, the findings indicated that the children who improved their self-control between childhood and young adulthood had better outcomes by the age of 32. (Moffitt et al., 2011.) The study illustrates the fundamental role of self-control from very early childhood until adulthood and calls attention also to VET operating between the phases of development. In order to prevent students from dropping out and being excluded from education and the job market, and to support their development of expertise regardless of such influencing factors as their initial levels of intelligence and/or social class, further research on students' regulation of learning is needed in the future. In particular, the longitudinal approach to vocational students' development of self-regulation is interesting. Further knowledge is needed to determine how the processes of regulation are being developed as students transition from secondary school to VET and towards working life. As collaborative working requires regulatory learning skills to co-construct shared task representations, shared goals and shared strategies (Järvelä & Hadwin, 2013), fruitful research on the regulation of learning focuses not only on understanding self-regulation, but also co-regulatory skills and processes. Until now, research on different aspects of cognitive and social factors has attracted more interest from scholars in educational sectors other than vocational contexts.

Relevant research on career development processes includes knowledge of students' developmental needs and tasks at various ages, the intervening cognitive variables as well as the social-contextual factors (e.g., family support) that may facilitate or hamper students' transition to work (Lent, Hackett, & Brown, 1996). The findings of this research have shown that the social reactions of parents and other significant individuals in the immediate environment often influence a vocational student's initial interest in their chosen vocational field. More knowledge is needed, however, on how vocational students view themselves as learners during their studies and how their knowledge and self-regulatory learning skills are established with relation to their home and study environments. According to Weiner (1974), the learner may interpret the failure of a strategy as the result of too little effort and then increase his or her subsequent efforts. He or she may also attribute the failure to a lack of ability when the reaction will most likely be negative in the sense of increasing effort. Haimovitz and Dweck (2016) consider that it is a parental belief that translates into concerns and behaviors are

perceived by children and shape their own beliefs. Parents who believe failure is a debilitating experience have children who believe they cannot develop their intelligence. They react to their children's failures by focusing more on their children's ability or performance than on their learning. Moreover, Dweck (2015) reminds that it might be exceedingly difficult also for educators to create an ideal atmosphere for growth for their students if they themselves do not believe that all students can grow their intellectual ability, if their praise, evaluation, and reward practices are focused on current ability rather than the development of ability over time, or if they do not believe in growth for themselves and are not rewarded for their own growth (Dweck, 2015). Instead, if students are encouraged to see intellectual ability and personal characteristics as something that can be developed over time with effort, good strategies and help from others, this can also affect their resilience following both academic and social challenges (Yeager & Dweck, 2012; Yeager, Trzesniewski, Tirri, Nokelainen, & Dweck, 2011). This research has emphasized the significance of self-regulatory strategies in study or work success. In future research, it is worthwhile to further analyze vocational students' mindsets and efficacy beliefs and how they form the basis for the regulation of learning and the development of vocational expertise. According to Yeager and Dweck (2012), psychological interventions can actually change students' mindsets, thereby indicating the potential role also for educators to improve students' mindsets. By developing both vocational students' learning strategies and their beliefs in their own learning, educators may not only improve their working life prospects, but also better foundations to pursue further education, e.g., higher education, which has lately been a subject of discussion.

The re-conceptualization of vocational expertise will continue to attract the interest of scholars in the future. To set common aims for education, the conceptualizations of vocational expertise need to be further investigated. Cognitive psychology has come to characterize expertise associated with the development of individuals' cognitive structures that can be applied in resolving problems with a domain of knowledge. This is useful for understanding and identifying the attributes required for performance in goal-directed activities. Furthermore, recent theorizing emphasizes that the organization and construction of knowledge is socially and culturally constituted, and consequently, the premise behind expertise is that it is developed through participation in social practice. (Billett, 2001b.) Billett (2001b), however, argues that developing expertise requires more than a focus on cognitive and socio-cultural tools; expertise needs to be considered situationally because it is related to the circumstances of the enactment

of the vocational expertise as it is at the situational level that the goal-directed vocational activities are shaped, albeit influenced by historical and socio-cultural lines of development. Accordingly, this study has shown that there were parallels between the participants' (students, employees and employers) perceptions of vocational expertise; however, it has also revealed some discrepancies. In future research, it would be worthwhile to continue investigating the variety of approaches to expertise (e.g., by different types of organizations and target groups) at the situational level. The alignment between employees' and organizations' expectations and values may not only affect employees' work performance but also their well-being and engagement. For instance, Mauno, Ruokolainen, Kinnunen and De Bloom (2016) have examined emotional labor among Finnish nurses; their results implied that those nurses who experienced that they were able to work ethically (high work ethic feasibility) in a situation of high emotional labour reported higher levels of work engagement than those nurses who felt that they were not able work ethically (low work ethic feasibility) in this stressful situation.

Furthermore, the concept of competence (particularly as it applies in the working life context) is multifaceted, and researchers hold several different views of it. Competence-approach aims to prepare students more effectively in order to lead to superior performance, to overcome the barriers between education and work and to align educational programs in vocational, professional and higher education to the needs of labor markets and society. (Mulder & Winterton, 2017.) However, the research has so far emphasized the dissimilarities between these views rather than made an attempt to formulate a unified concept (Winterton, 2009). For instance, the significance of generic competences (e.g., social competence and metacompetence) in relation to occupational competences provides an important perspective on the conceptualization of vocational expertise (Le Deist & Winterton, 2005; Winterton, 2009; Nokelainen, Kaisvuo, & Pylväs, 2017; Pylväs, Rintala, & Nokelainen, in press) in future research.

Finally, future research on VET will need to deepen existing knowledge on VET learning environments—informal learning environments, in particular. The results of this research indicate that working life connections and workplaces as authentic learning environments have several positive influences on students' vocational pathways. Further research is needed, however, on interactions between the fields of education and work, e.g., integration of practical and theoretical knowledge and skills and role differentiation of vocational teachers and work communities. The current trend of bridging education and working life and transferring learning from the classroom to the workplace demands not only self-

regulated learners, but also active practitioners to enhance the dialogue between education and the workplace. The challenge, especially for workplace training, is to simultaneously provide a broad vocational qualification while also being sufficiently specialized and tailored to blend in with the learning affordances and needs of the workplace (Stenström & Virolainen, 2014). According to Tuomi-Gröhn, Engeström and Young (2003), the best way to learn a vocation is to become engaged in real-life processes as early as possible during one's studies, and that educational institutions need to prepare their teachers and students to work as boundary crossers between the worlds of school and work. The role of teachers in workplaces as representatives of formal education and as educational experts is acknowledged in several areas of this research (e.g., regulation of learning and reciprocal learning) and in previous research (e.g., personalized learning/training, see Haapakorpi & Virtanen, 2015), although it has yet to be either defined or organized. Experienced employees in workplaces seem to be in need of pedagogical tools and greater understanding of how to adduce and articulate the tacit knowledge that they possess and that novice workers pursue. Along with new research topics and approaches, new research methods, such as observation, may offer different insights into informal learning environments. Overall, future research on VET needs to place a stronger focus on the diversity of learning environments in order to strengthen its collaboration and dialogue with working life.

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APPENDICES

Appendix 1

STUDY I: INTERVIEW INSTRUMENT

Date:

Interview started/ended:

Duration of interview:

Name:

E-mail:

Gender:

Age:

Air traffic controller work experience in years:

Total work experience in years:

1. Please tell us about your educational background.
2. Please tell us about your past and current job assignments.
3. Please tell us about your hobbies.
4. Recall your studies; what do you consider to have been the key factors to ensuring your success?
5. Now that you have work experience, evaluate which areas of study (or advanced skills) have proven to be the most useful in your working life.
6. During your studies, what do you think was the reason in overcoming a particular challenge?
7. If you failed to overcome a particular challenge during your studies, what do you think was the reason?

8. What are the most important characteristics of a professional air traffic controller?
9. In working life, what do you think was the reason in overcoming a particular challenge?
10. If you failed to overcome a particular challenge in working life, what do you think was the reason?
11. What kinds of issues have influenced: 1) your initial interest in this profession; 2) your perseverance during training; and 3) your achievement of the highest level of competence in your field (i.e. graduation as an air traffic controller)?
12. What are the factors that affect your interest in maintaining your own professional skills?
13. What do you think are the most important features of an employer?
14. Did you differ from other students in your cohort during your studies? If so, how?
15. Did you differ from other students in your cohort when you graduated and transitioned to working life? If so, how?
16. How has your career progressed in comparison to those of other people of the same age? Are you satisfied with your current position?
17. Did you easily find a job after you graduated with which you were (are) satisfied?
18. Do you have any additional comments?

Appendix 2

STUDY II: INTERVIEW INSTRUMENT

Date:

Interview started/ended:

Duration of interview:

Name:

Organization:

E-mail:

Gender:

Age:

Education:

Vocational skills competitions:

Taitaja/year/placement/vocational field:

EuroSkills/year/placement/vocational field:

WorldSkills/year/placement/vocational field:

Other/year/placement/vocational field:

Current job:

Other areas of responsibility:

Work experience:

Total years of work experience:

Total years of leadership experience:

Total years of teaching experience:

<i>WorldSkills achiever</i>	<i>Co-worker</i>	<i>Employer</i>
1. Please tell us about your previous and current job assignments.	1. Please tell us about your previous and current job assignments.	1. Please tell us about your previous and current job assignments.
2. How did you initially become interested in this vocational field?	2. How did you initially become interested in this vocational field?	
3. How would you describe your work?	3. How would you describe your work?	2. What is the job of [a plumber/hair stylist ...] like?
4. How did vocational studies prepare you for a profession?	4. How did vocational studies prepare you for a profession?	3. How do you think vocational studies prepare young people for this vocational field?
5. Please identify the personal characteristics/qualities of a person who performs exceptionally well in this job.	5. Please identify the personal characteristics/qualities of a person who performs exceptionally well in this job.	4. Please identify the personal characteristics/qualities of a person who performs exceptionally well in this job.
6. Did you differ from the other students during your vocational studies?	6. Did you differ from the other students during your vocational studies?	
7. Did you differ from the other students when entering working life?	7. Did you differ from the other students when entering working life?	5. Did you see any differences in the work of [WorldSkills achiever] when compared to other graduates when he/she started to work for this company?
8. After graduation, did you easily find a job with which you were/are you satisfied? How would you describe your career progress when compared to other people of the same age?	8. After your graduation, did you easily find a job with which you were/are you satisfied? How would you describe your career progress when compared to other people of the same age?	6. How do you find the career development of [WorldSkills achiever] when compared to other employees of the same age?
9. Are you satisfied with your career development?	9. Are you satisfied with your career development?	

<i>WorldSkills achiever</i>	<i>Co-worker</i>	<i>Employer</i>
10. What are the key features of your “dream job” or your ideal employer?	10. What are the key features of your “dream job” or your ideal employer?	
11. What are your expectations for the future?	11. What are your expectations for the future?	
12. What size of a company do you prefer to work in?	12. What size of a company do you prefer to work in?	
13. Do you think that WorldSkills competitions and training experience brought any added value to your work (in addition to vocational studies)?		
14. Please identify the skills/expertise of a person who performs this job well enough/adequately	13. Please identify the skills/expertise of a person who performs this job well enough/adequately	7. Please identify the skills/expertise of a person who performs this job well enough/adequately
15. Please identify the skills/expertise of a person who performs this job excellently	14. Please identify the skills/expertise of a person who performs this job excellently	8. Please identify the skills/expertise of a person who performs this job excellently
16. Do you think you can identify excellent performance in students, or does this not develop until later in their working life?		
Anything else you would like to add or comment?		

Appendix 3

STUDIES III and IV: INTERVIEW INSTRUMENT

Date:

Interview started/ended:

Duration of interview:

Name:

Age:

E-mail:

Phone number:

Organization:

Field of vocation:

Current job assignment:

(Employers) Size of the organization:

(Apprentices) Vocational institution:

(Apprentices) Vocational education/adult education:

Total years of work experience in current job:

Total years of previous work experience:

Total years of work experience:

(Workplace trainers) Total years of workplace trainer experience:

Apprentice

Co-worker

Workplace trainer

Employer

Part 1: Vocational expertise

1. How did you initially become interested in this vocational field?

1. How did you initially become interested in this vocational field?

1. How did you initially become interested in this vocational field?

2. What kinds of vocational plans and goals do you have for the future?

2. What kinds of vocational plans and goals do you have for the future?

2. What kinds of vocational plans and goals do you have for the future?

3. How did you decide to participate in apprenticeship training?

How did you find this job?

1. How did you become interested in apprenticeship training?

How did you choose [the apprentice] to work for your organization?

4. How do you think apprenticeship training prepares young people/adults for this vocational field?

3. How do you think apprenticeship training prepares young people/adults for this vocational field?

2. How do you think apprenticeship training prepares young people/adults for this vocational field?

5. What is your job like? What kinds of skills do you need to perform/succeed in your work?

3. What is your job like? What kinds of skills do you need to perform/succeed in your work?

4. What is your job like? What kinds of skills do you need to perform/succeed in your work?

3. What is your job like? What kinds of skills do you need to perform/succeed in your work?

6. How would you evaluate your vocational expertise and development? Have you been given more responsibility at work?

4. How would you evaluate your vocational expertise and development?

5. How would you evaluate your vocational expertise and development?

<i>Apprentice</i>	<i>Co-worker</i>	<i>Workplace trainer</i>	<i>Employer</i>
		6. Has working as a workplace trainer developed your own vocational expertise?	
7. What kinds of expertise have you contributed to your workplace?	5. What kinds of expertise has the apprentice contributed to your workplace?	7. What kinds of expertise has the apprentice contributed to your workplace?	4. What kinds of expertise has the apprentice contributed to your workplace?
8. When you succeeded in an important situation in your working life, what did you think was the reason for that?		8. Do you remember any important situations in which you were successful as a workplace trainer? Could you give an example? What did you think was the reason for that?	
9. When you failed in an important situation in your working life, what did you think was the reason for that?		9. Do you remember any important situations in which you struggled as a workplace trainer? Could you give an example? What did you think was the reason for that?	
10. How do you learn the best? What has facilitated your learning?	6. How do you learn the best?	10. How do you learn the best?	
11. What has hindered your learning? What do you do if you are not progressing in your learning?			

<i>Apprentice</i>	<i>Co-worker</i>	<i>Workplace trainer</i>	<i>Employer</i>
Part 2: Guidance			
12. What is good guidance like?	7. What is good workplace guidance like?	11. What is good workplace guidance like?	
13. How have you been taught new things and guided in the workplace?	8. What kinds of things do you teach or guide the apprentice? In what kinds of contexts? And how?	12. What kinds of things do you teach or guide the apprentice? In what kinds of contexts? And how?	5. What kinds of things do you teach or guide the apprentice? In what kinds of contexts? And how?
14. Do you receive enough guidance? What kinds of issues influence whether you receive any help or guidance? In what areas would you like to receive more/less guidance?	9. How much do you work with the apprentice?	13. How much effort are you able to put into guiding the apprentice? Do you have time enough for guidance?	6. How much do you work with the apprentice?
	10. What kinds of skills and knowledge does a workplace trainer need?	14. What kinds of skills and knowledge does a workplace trainer need? What kinds of pedagogical expertise do you have? Do you think you need some more expertise for the task?	7. What kind of employee is suitable to work as a workplace trainer?
	11. Have you faced any problems when guiding an apprentice? How have they been solved?	15. Have you faced any problems when guiding an apprentice? How have they been solved?	8. Have you faced any problems when guiding an apprentice? How have they been solved?

<i>Apprentice</i>	<i>Co-worker</i>	<i>Workplace trainer</i>	<i>Employer</i>
		16. What kinds of issues challenge the processes of providing guidance?	

Part 3: Responsibilities

15. Who is mainly responsible for your guidance?	12. Whom do you think is responsible for guiding the apprentice at work?	17. Whom do you think is responsible for guiding the apprentice at work?	9. Whom do you think is responsible for guiding the apprentice at work?
16. Who else is helping and guiding you? Who provides you with vocational skills and knowledge? Whom do you ask for help if you face problems?	13. Who participates in providing guidance to apprentices in the workplace? Have you agreed on the areas of responsibility?	18. Who participates in providing guidance to apprentices in the workplace? Have you agreed on the areas of responsibility?	10. Who participates in providing guidance to apprentices in the workplace? Have you agreed on the areas of responsibility?
		19. How did you become a workplace trainer?	11. How do you decide who should be a workplace trainer?

Part 4: Work community

17. How do you see your own position in the work community? Do you consider yourself a student or an employee?	14. What do you consider the apprentice's position to be within the work community?	20. What do you consider the apprentice's position to be within the work community?	12. What do you consider the apprentice's position to be within the work community?
18. How are you treated in the work community?	15. How does the presence of an apprentice influence the work community's actions?	21. How does the presence of an apprentice influence the work community's actions?	13. How does the presence of an apprentice influence the work community's actions?

<i>Apprentice</i>	<i>Co-worker</i>	<i>Workplace trainer</i>	<i>Employer</i>
<p>19. How much do you communicate with the other apprentices?</p> <p>Do you feel like you are part of a student community?</p>			
<p>20. How does meeting other students support your studies?</p> <p>What have you learned from them?</p>			
<p>21. Do theoretical studies support your work? If so, how?</p>			
<p>22. Do the training coordinator and vocational teachers participate in guiding you in the workplace?</p>		<p>22. How much do you co-operate with the training coordinator and vocational institution? How is it working?</p> <p>In what instances would you contact the workplace coordinator/ vocational institution?</p>	<p>14. How much do you co-operate with the training coordinator and vocational institution? How is it working?</p>
		<p>23. Do you think the division of responsibilities is clear between the workplace, vocational institution and workplace coordinator?</p>	<p>15. Do you think the division of responsibilities is clear between the workplace, vocational institution and workplace coordinator?</p>

<i>Apprentice</i>	<i>Co-worker</i>	<i>Workplace trainer</i>	<i>Employer</i>
		24. What kinds of support or guidance do you receive in the workplace?	16. What kinds of support would you like to have for apprentice guidance from vocational coordinators and vocational institutions?
		25. What kinds of support or guidance do you receive in the workplace?	17. What kinds of support or guidance does one receive in the workplace? What kinds of support would be needed?
Anything else you would like to add or comment?			

ORIGINAL PUBLICATIONS

**The Role of Natural Abilities, Intrinsic Characteristics, and
Extrinsic Conditions in Air Traffic Controllers' Vocational Development**

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Abstract

Purpose – The purpose of this paper is to apply the Developmental Model of Vocational Excellence (DMVE) in the domain of air traffic control and to describe the characteristics and predictors related to air traffic controllers' (ATCO) vocational expertise and excellence. Based on DMVE, the study analyses the role of natural abilities (gifts), intrinsic characteristics (self-regulatory abilities) and extrinsic conditions (domain and non-domain specific factors) in ATCOs' vocational development.

Design/methodology/approach – The target population of the multiple case study consisted of ATCOs in Finland ($N=300$), of which 28 were interviewed. The interviewees represented four different airports. Initially, three key personnel interviews were conducted to validate the structured theme interview instrument that was subsequently used for the 28 interviews. The data set also included the ATCOs' aptitude test scores and training records. Employee assessments were used to determine their on-the-job performance level (expertise vs excellence). The research questions were examined using theoretical concept analysis. The qualitative data analysis was conducted with content analysis and Bayesian classification modelling.

Findings – The findings indicate that cognitive skills, self-reflection, volition and goal-orientation are considered to be ATCOs' most important vocational characteristics in addition to interpersonal, intrapersonal and spatial skills. The main differences between the ATCOs representing vocational expertise and those representing vocational excellence were related to self-regulation; motivation and volition in particular proved to be somewhat stronger in the latter group.

Research limitations/implications – It was acknowledged that there are limitations in the present study. First, the four airports were not selected randomly. Although they represent different types of airports (and ATCO job profiles) in Finland quite well, future studies should include comparative aspect to airports in other countries. Second, the number of participants ($N=28$) in the study was quite

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small, limiting generalization of the results to the target population ($N=300$). Future research on this domain should be extended to include also quantitative measurements, allowing more generalizable results. Third, although the analysis for the research question 3 was based on a technique that is not sensitive to missing values (BCM), missing data in ATCOs' aptitude test scores, training records and employee assessments added uncertainty to the results.

Practical implications – ATCOs' highly controlled and pre-defined work presents a challenge to work motivation, which is seen as one of the determining factors in safety in air traffic controlling (ATC). In the future, more emphasis should be placed on the prerequisites of professional development such as leadership (human resource management, feedback, employees' opportunity to influence), working environment (physical and social environment), educational possibilities and career progression, as well as professional benefits (salary and working hours).

Originality/value – Although ATC is a fairly studied topic since 1970s, most studies related to ATCOs have concentrated on training, learning on the job, cognitive capacity and processing and stress tolerance. This study extends the emerging research in the field on self-regulation by adopting DMVE to investigate its role, alongside natural abilities and domain and non-domain specific factors, to vocational talent development in different skill acquisition stages.

Keywords – Self-regulation, Vocational training, Air traffic controller, Multiple intelligences theory, Vocational excellence, Vocational expertise

Paper type – Research paper

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Introduction

Air traffic has been steadily increasing during the past decades [1]. The thousands of flights that are made every day around the world are stretching the capacity of airports and making air traffic an increasingly complex system to manage. Air traffic controllers' (ATCO) work covers air traffic control, air traffic advice, flight information and emergency procedures with the aim of expediting air transport and maintaining aviation discipline (Costa, 1995). They simultaneously control aircraft taking off and landing and make observations of the work environment with the help of various kinds of information technology equipment (Finavia, 2013). Changes in air traffic controlling (ATC) are setting new expectations for ATCOs' life-long learning and emphasizing a need for research into human factors. Even if the ATC system relies more and more on automation, human factors have an essential role in maintaining the efficiency and safety of air traffic control (Jha *et al.*, 2011).

Several characteristics cause complexity, uncertainty and dynamicity, making the work vulnerable to human error (Ryymin *et al.*, 2011; Teperi, 2012). First, it is vital that individual controllers are not subjected to physical or mental overload due to high traffic density and complexity (Kirwan, 2001). They need to constantly change specified and regulated operating methods to maintain high safety standards and minimize economic costs of aeronautical activities. Second, researchers have found that the automation of work generally requires multivalent planning ability, understanding of complex situations and problem-solving skills (Costa, 1995). In addition, as a result of automation, monotonous and strictly formalized and standardized work models have become more common, which highlights the importance of self-regulation, motivation and meaningfulness of work (Ruohotie, 1994; Wickens *et al.*, 1997).

The purpose of this study is to apply the Developmental Model of Vocational Excellence (DMVE, Nokelainen *et al.*, 2013; Nokelainen, 2014) in the domain of ATC and to describe the characteristics and predictors related to ATCOs vocational expertise and excellence. More specifically, the study analyses the role of natural abilities (gifts), intrinsic characteristics (self-regulatory abilities) and extrinsic conditions (domain and non-domain specific factors) in ATCOs' vocational

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development. The model is empirically tested with an interview data collected from 28 Finnish ATCOs and analyzed with both content analysis and Bayesian methods. This study extends earlier research into vocational excellence (Korpelainen *et al.*, 2009; Nokelainen *et al.*, 2009; Nokelainen, 2010, 2014) by giving an insight into the acquisition of vocational excellence in highly skilled and safety-critical vocations. The study relates to the emerging research on self-regulation in ATC (Yeo and Neal, 2008; Yeo *et al.*, 2009) by investigating of the role of intrinsic characteristics (self-regulation) to vocational talent development. It is also related to earlier research and discussion of ATCOs' tasks, qualifications and professional identity (Ackerman *et al.*, 1995; Hopkin, 1995; Wickens *et al.*, 1997; Palukka, 2003) by adopting a new theoretical framework for analyzing the role of gifts (natural abilities), intrinsic characteristics (self-regulatory abilities) and extrinsic conditions (domain and non-domain specific factors) in ATCOs' vocational development. By focusing on these factors during different skill acquisition stages, this study bridges gaps in the existing literature and provides new information on human factors in ATC.

We further investigate if these factors are related to ATCOs on-the-job performance. In this study, the work-related performance has two levels: "expertise" and "excellence". Due to highly selective entrance tests (Wickens *et al.*, 1997), all operative ATCOs are considered experts in their vocational field [2]. However, as stated earlier, it is important to recognize factors that are related to ATCOs professional growth and ability to work throughout their career. Individuals who have performed exceptionally well over a long period of time represent vocational excellence in this study. Participants of this study were classified into these two categories by a panel of experienced operative superiors. To address the research goal, the following research questions were formulated:

RQ1) What characteristics and environmental factors determine air traffic controllers' initial interest in this field of work, their perseverance in acquiring a vocational skill, and their mastery of the skill?

RQ2) What are the differences in characteristics between the air traffic controllers representing vocational expertise and those representing vocational excellence?

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RQ3) Does air traffic controllers' performance during training or in the entrance examination predict vocational excellence in working life?

This paper begins with introducing the theoretical framework consisting of the components related to vocational talent development. The next section describes the methods of the study, and is followed by the results of the interview data analysis. Finally, the results and their theoretical and practical implications are discussed.

Theoretical framework

Gagné's (2004, 2010) Differentiated Model of Giftedness and Talent (DMGT) distinguish the two usually intertwined concepts of giftedness and talent. The DMGT contains six components:

- (1) chance (e.g. genes);
- (2) gifts (natural abilities: intellectual, creative, socio-affective and sensorimotorical);
- (3) intrapersonal characteristics (motivation, volition, self-management, personality);
- (4) environmental conditions (milieu, important persons, events);
- (5) developmental process (informal and formal learning and practicing); and
- (6) talents (systematically developed skills).

Nokelainen and his colleagues have studied professional excellence in the context of mathematics (Finnish and US Academic Olympiad teams, see, Nokelainen *et al.*, 2007; Nokelainen and Tirri, 2010) and vocational excellence in the context of World Skills Competitions (Finnish, UK and Australian teams, see, e.g. Nokelainen, 2014, 2010; Nokelainen *et al.*, 2009, 2012, 2013; Ruohotie *et al.*, 2008). Based on Gagné's DMGT, the Developmental Model of Vocational Excellence (DMVE, Nokelainen, 2014) illustrates the process of developing natural abilities (gifts) into vocational and professional skills (talents). Intrinsic characteristics (self-regulation) and extrinsic conditions (domain and non-domain related factors) help

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or hinder this process, which requires learning (and constantly updating) the skills through deliberate practice. The model in Figure 1 has been constructed on the basis of DMVE. It illustrates the theoretical framework applied in this study to analyze ATCOs vocational excellence.

Natural abilities

In this study, we use Gardner’s (1983, 1993, 1999) Multiple Intelligence (MI) theory to investigate the natural abilities (gifts) component of the model of vocational excellence (Figure 1). We apply the original seven-dimension version of the MI theory:

- (1) linguistic;
- (2) logical – mathematical;
- (3) musical;
- (4) spatial;
- (5) bodily-kinesthetic;
- (6) interpersonal intelligence; and
- (7) intrapersonal intelligence.

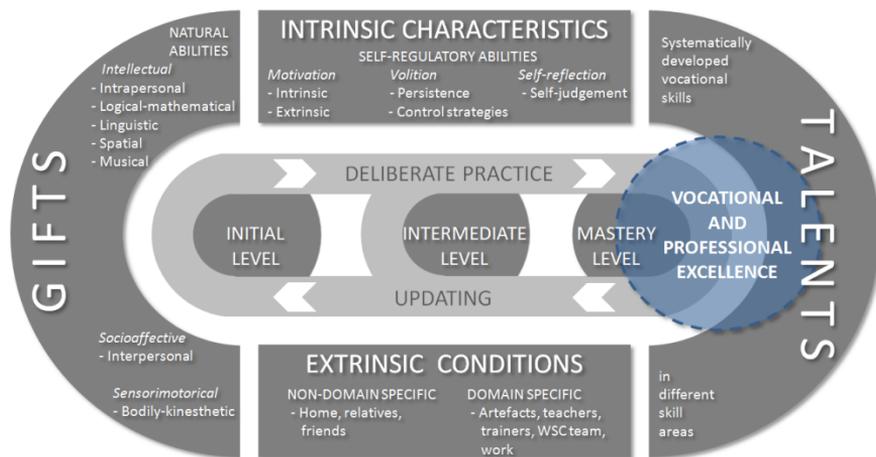


Figure 1. Vocational excellence in air traffic control (adapted from Nokelainen, 2014)

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This domain-specific model of intelligence has been criticized to underestimate the role of general processes (intelligence as a general construct, e.g. Cattell, 1963) in intellectual development (Demetriou and Kazi, 2006). However, based on an overarching theory of cognitive organization and development, Demetriou et al. (2011) state that intelligence has both of these natures. Domain-specific intelligence is, indeed, present in one component of their theory, namely, “special structural systems” that “constitute a set of mental processes that interface with several environmental domains” (p. 603). This is also in line with the holistic approach of DMGT (Gagné, 2004, 2010) to exceptional talent development.

Intrinsic characteristics

In this study, we have applied Zimmerman’s model of self-regulation to investigate the intrinsic characteristics component of the model of vocational excellence (Figure 1). The term “self-regulation” refers to the process by which self-generated thoughts, feelings and actions are planned and systematically adapted as necessary to affect one’s learning and motivation (Schunk and Ertmer, 2000; Zimmerman, 2000). Research has shown that successful learners can monitor and regulate these triadic elements: volition, motivation and self-reflection (Kitsantas and Zimmerman, 2002; Zimmerman, 1989, 1998; Zimmerman and Kitsantas, 2005). Similarly, Demetriou *et al.* (2011) see self-regulation as an essential component of the consciousness system in their integrated model of the architecture and development of the mind.

Motivational processes help the learner formulate decisions and promote decision-making, whereas volitional processes guide the subsequent enactment of the decision (Corno, 1989). According to Ruohotie (2005), it is especially intrinsic goal orientations (emphasizing competence development) that are connected to vocational excellence. Volition includes persistence, the will to learn, endeavor/effort, mindfulness in learning and intrinsic regulation and evaluation processes, as well as various control strategies (e.g. allocation and control of resources, as well as emotional attentiveness and motivational control strategies) and methods of processing knowledge. In the research examining ATCOs’ work, sustained attention has been termed “vigilance”. An expanded view of vigilance

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refers to detection, discrimination and diagnosis of unusual conditions, as well as speed of response (Wickens *et al.*, 1997).

According to Bandura (1986), processes of self-reflection make it possible for individuals to evaluate their experiences and thought processes. Self-reflection is congruent with intrapersonal skills describing, one's understanding and reflecting of one's own skills, capacities and feelings. Self-reflection leads to attribution interpretations, whereby an individual interprets the reasons for success or failure. According to Weiner (1974), individuals are constantly searching for understanding of why an event has occurred. The learner may interpret the failure of a strategy as the result of too little effort (control beliefs) and then increase his or her subsequent efforts. He or she may also attribute the failure to a lack of ability (efficacy beliefs) when the reaction will most likely be negative in sense of increasing efforts. However, both attribution interpretations (control and efficacy beliefs) can lead to both positive and negative self-reactions, as they are under one's own control. An increase in the sense of control strengthens one's tolerance of stress and commitment to the task and helps the learner to identify the best learning strategies in a given situation (Zimmerman, 1998; Zimmerman and Kitsantas, 1997). Positive reactions fortify intrinsic goal-orientation and positive interpretations of oneself as an employee, such as beliefs in one's own competencies and opportunities (Nokelainen *et al.*, 2007).

Extrinsic conditions

The third component in the model involves external factors related to the development of vocational talent (Figure 1). First section consists of domain-specific individuals (colleagues, trainers, superiors, etc.) and factors (artifacts, expectations related to career, etc.) that are directly related to the development of talent. The second section consists of individuals (parents, other relatives, neighbors, fellow students, etc.) and factors (media, books, films, music, etc.) that are indirectly related to the development of vocational talent (Greenspan *et al.*, 2004; Nokelainen, 2014). Based on Connell *et al.* (2004), we analyze the operation of these factors through intrinsic and extrinsic motivation.

Earlier research has shown that the role of both teachers and trainers is important in all of the early stages of vocational development (initial interest,

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training, mastery). Intrinsic goal orientation proved to be more important than extrinsic goal orientation in the development of interest in a vocational field and mastery of the skill. During the training, extrinsic goal orientation was reportedly more important than intrinsic goal orientation. Greenspan *et al.* (2004) have reported similar findings in their studies of the arts. The results also showed that when the mastery level was achieved, securing future employment and challenging job opportunities becomes one of the most essential factors (Nokelainen, 2014).

Deliberate practice

According to a social-cognitive view of self-regulation, expertise develops from both external support and self-directed practice sessions (Zimmerman, 2006). Both of these factors are essential for exceptional talent development (Bloom, 1985). In social – cultural theories of workplace training, learning is becoming a process located in the framework of participation rather than inside the learner (Hager, 2013). According to Mezirow (1995), learners must become critical of their own assumptions to transform their frame of reference. Critical reflection on their own experiences leads to a perspective transformation through communicative learning, emphasizing the importance of dialogue with others. However, even if collective learning is starting to receive significant attention, it is not replacing notions of individual learning (Hager, 2013).

As shown in Figure 1, deliberate practice is essential in different skill acquisition stages; in most fields, it takes 10 years to become an expert (Ericsson *et al.*, 1993). Later research has shown that the 10-year rule is not absolute: in some fields (e.g. chess, sport), total mastery of the skill takes about six years, and in others (e.g. music, science), to reach the top level, it takes 20-30 years of deliberate practice (Ericsson, 2006). Ericsson's relative approach to the study of experts' characteristics assumes that the fundamental capacities and domain-general reasoning abilities of experts and non-experts are almost identical. The major difference between experts and novices is that the former are more knowledgeable, through deliberate practice, than the latter. (Chi, 2006.) The model applied in this study is based on a different approach: the goal of an absolute approach is to understand how truly exceptional people perform in their domain of expertise (Chi, 2006).

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Vocational expertise and excellence

Gifted individuals with an exceptionally high level of natural abilities (intellectual, creative, socioaffective, sensori-motorical), intrinsic characteristics (self-regulation and personality) and auspicious extrinsic conditions (physical, cultural and sociological milieu, important individuals, activities, accidents) may reach the level of vocational excellence through deliberate practice (Nokelainen, 2014). Individuals who do not meet all of these conditions may still become competent professionals (vocational expertise) through deliberate practice. Competence refers to individual's potential capacity to deal with job-related situations and tasks according to certain formal or informal criteria set by someone else (Ellström, 1997). Following this, qualification is seen as a competence that is required by the work and implicitly or explicitly determined by individual qualities (Ellström, 2001). Mulder (2011) has defined trichotomy of approaches of the concept of competence: competence and behavioristic functionalism; competence as integrated occupationalism; and competence as situated professionalism. The third approach refers to professional associations (e.g. pilot associations) and local actors' (e.g. airline executives) influence "on the desired competence fields and the extent to which the professionals need to be proficient in these fields" (Mulder, 2015). In this study, a panel of experienced operative superiors assigned participants into "expertise" and "excellence" groups on the basis of each individual's on-the-job performance.

Methods

Design

The target population of the study consisted of air traffic controllers (ATCO, $n=300$) who work in 27 airports in Finland. To understand the qualifications and skills required of ATCOs on the job, we began the study in 2011 by interviewing three persons (manager, air traffic controller and trainer, human resource specialist) who had more than 10-years' work experience in the field. Duration of these interviews varied from 60 to 90 minutes. We then proceed to develop a semi-structured interview instrument on the basis of these key personnel interviews and

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existing research. The interviews of 28 ATCOs were conducted in 2011 in four Finnish airports and included interviewees from provinces ($n=7$, 25.0 per cent) and cities ($n=21$, 75.0 per cent). The work tasks differ between the one- or two-person air traffic control units in the provinces and the units comprising several employees and posts found in the larger cities. These airports were selected to represent different types of airports (and ATCO job profiles) in Finland.

The selection of interviewees within the target units was random, as the participation in interview sessions was based on their pre-determined work shifts. The research data also included the interviewees' aptitude test scores and training records. Relating to the *RQ2*, the division between ATCOs performing at the level of expertise ($n=9$, 32.1 per cent) and excellence ($n=17$, 60.7 per cent) was made by a panel of experienced operative superiors. The classification was made on the basis of ATCOs on-the-job performance. As all operative air traffic controllers have high level of knowledge and expertise (Costa, 1995), the panel used the following criteria to judge the merits of the participants: safe working (low number of critical incident reports); effective air traffic control (aim at the maximum capacity); overall perception of air traffic services; understanding the guidelines and regulations; and self-initiative and commitment. This job performance-related information (missing $n=2$, 7.1 per cent) was concealed from the researchers until the content analysis of the interview data was completed.

Participants

The participants of the study included 28 ATCOs, of which eight were females (28.6 per cent) and 20 were males (71.4 per cent). Their age average was 37.9 years ($SD=38.0$). Participants were interviewed with a semi-structured interview instrument. Duration of interviews was from 50 to 90 minutes. Most of the interviewees ($n=25$, 89.3 per cent) had been at least six years in air traffic controlling. Half of the interviewees ($n=14$, 50.0 per cent) had another professional qualification and all of the interviewees ($n=28$, 100.0 per cent) had earlier work experience from another professional field. A little more than half of the group had been familiar with aviation before undergoing ATCO training, having experience of private piloting ($n=6$, 21.4 per cent) or military aircraft ($n=9$, 32.1 per cent). After graduating from ATCO training, most of the interviewees ($n=22$, 78.6 per

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cent) were placed in provincial airports. The minority ($n=6$, 21.4 per cent) was placed in a larger city, Helsinki-Vantaa Airport (usually based on exceptional training performance).

Instrument

The semi-structured interview was based on the significance of self-regulation and cognitive and social features in vocational talent development (Greenspan *et al.*, 2004; Nokelainen, 2008; Zimmerman, 1998). It contained two sections: (1) characteristics (self-regulation and natural abilities; see Table I for details); and (2) vocational talent development (initial interest, perseverance and mastery; see Table II for details).

Analyses

The research questions were examined using theoretical concept analysis. The qualitative interview data analysis took the form of quantitative and qualitative content analysis (*RQ1* and *RQ2*) of the textual empirical data using a sophisticated analysis tool, NVivo. The content analysis of the data is highly systematic (Schreier, 2014). As the framework of the analysis in this study is based on the existing theory, directed (or deductive) content analysis approach was used (Hsieh and Shannon, 2005). The empirical data were examined and categorized according to the theoretical concepts related to the theoretical models used in the study (Tuomi and Sarajärvi, 2002). Unit of analysis, a meaningful piece of text in the interview transcript (e.g. “The most important thing is to stay motivated. To be good or even better than before.”) was assigned a code relating to a theoretical concept (e.g. “intrinsic goal orientation”). Frequency counts (n) of codes for each theoretical concept are presented in Tables I and II. Qualitative content analysis was applied to examine latent and more context-dependent meanings (Schreier, 2014). The meaningful pieces of the interviews were analyzed in the context of their use and thematic criterion was utilized for segmentation (see quotations). The qualitative content analyses provided more descriptive examination of the data (Krippendorff, 2004; Schreier, 2014.)

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Table I Characteristics and environmental factors determining air traffic controllers' initial interest in this field of work, their perseverance in acquiring a vocational skill, and their mastery of the skill

<i>Initial interest in the work field</i>	
Aviation and ATCO's profession	(n = 19, 26.0%)
Family	(n = 14, 19.2%)
Suitable background	(n = 11, 15.1%)
Career change	(n = 10, 13.7%)
Professional benefits	(n = 7, 9.6%)
Access to working life	(n = 6, 8.2%)
Friends	(n = 5, 6.8%)
Curriculum	(n = 1, 1.4%)
Total	(N = 73, 100.0%)
<i>Perseverance in acquiring a vocational skill</i>	
Volition and motivation	(n = 30, 26.8%)
Curriculum and teaching	(n = 16, 14.3%)
Training performance	(n = 12, 10.7%)
Social environment	(n = 12, 10.7%)
Ambition	(n = 12, 10.7%)
Competition	(n = 9, 8.0%)
Confidence in skills	(n = 8, 7.1%)
Access to working life	(n = 5, 4.5%)
External expectations	(n = 5, 4.5%)
Earlier experiences	(n = 3, 2.7%)
Total	(N = 112, 100.0%)
<i>Perseverance in acquiring mastery of the skill</i>	
Leadership and personnel policy	(n = 37, 19.8%)
Working tasks and aviation	(n = 23, 12.3%)
Working environment	(n = 23, 12.3%)
Professional responsibility	(n = 21, 11.2%)
Workplace training and professional development	(n = 19, 10.2%)
Ambition	(n = 14, 7.5%)
Possibility to influence	(n = 13, 7.0%)
Professional benefits	(n = 11, 5.9%)
Career progression	(n = 9, 4.8%)
Social environment	(n = 9, 4.8%)
Skilled co-workers	(n = 8, 4.3%)
Total	(N = 187, 100.0%)

n = Frequency counts of the codes

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In addition to theoretical concept analysis, Bayesian methods (Bernardo and Smith, 2000) were applied in this study as they work robustly with small samples and allow the use of nominal indicators (textual or numerical data) and prediction with the model derived from the empirical evidence (Nokelainen, 2008; Nokelainen and Silander, 2014). A specific technique, Bayesian Classification Modeling (BCM, see Nokelainen, 2008), was used to select the most probable predictors of vocational excellence ($RQ2$ and $RQ3$), and to increase the research validity of qualitative methods in a confirmatory way.

Table II Vocational characteristics of the air traffic controllers representing vocational expertise and those representing vocational excellence

Characteristics	Employees representing vocational expertise ($n=9$, 32.1%)	Employees representing vocational excellence ($n=17$, 60.7%)	All interviewees ($N=28$, 100%)
<i>Self-regulatory abilities</i>			
Intrinsic goal-orientation	($n = 14$, 13.2%)	($n = 29$, 15.4%)	($n = 48$, 15.1%)
Extrinsic goal-orientation	($n = 15$, 14.2%)	($n = 24$, 12.8%)	($n = 44$, 13.8%)
Volition	($n = 16$, 15.1%)	($n = 28$, 14.9%)	($n = 46$, 14.5%)
Control beliefs	($n = 6$, 5.7%)	($n = 16$, 8.5%)	($n = 24$, 7.5%)
Efficacy beliefs	($n = 4$, 3.8%)	($n = 4$, 2.1%)	($n = 8$, 2.5%)
<i>Natural abilities</i>			
Linguistic	($n = 5$, 4.7%)	($n = 2$, 1.1%)	($n = 7$, 2.2%)
Cognitive	($n = 22$, 20.8%)	($n = 41$, 21.8%)	($n = 67$, 21.1%)
Spatial	($n = 3$, 2.8%)	($n = 11$, 5.9%)	($n = 15$, 4.7%)
Intrapersonal	($n = 11$, 10.4%)	($n = 15$, 8.0%)	($n = 29$, 9.1%)
Musical	($n = 0$, 0.0%)	($n = 3$, 1.6%)	($n = 3$, 0.9%)
Bodily-kinesthetic	($n = 1$, 0.9%)	($n = 1$, 0.5%)	($n = 2$, 0.6%)
Interpersonal	($n = 9$, 8.5%)	($n = 14$, 7.4%)	($n = 25$, 7.9%)
Total	($N = 106$, 100.0%)	($N = 188$, 100.0%)	($N = 318$, 100.0%)

n = Frequency counts of the codes

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The input data matrix for BCM contained the following variables: 12 characteristics (such as “intrinsic goal orientation”, “volition” and “control beliefs”; see Table II), “job performance”, “entrance examination success” and “study success”. The numerical values for the 12 characteristics variables were based on the code frequencies from preceding theoretical concept analysis. For instance, if John had mentioned “intrinsic goal orientation”-related information three times during the interview, his value (code frequency) for that variable would be 3. “Job performance” variable had two textual values assigned by an external panel (“expertise” and “excellence”). “Entrance examination success” variable had also two values based on final ranking in the tests (“good”=others and “excellent”=top 40 per cent). “Study success” variable represents overall study success during ATCO training (5=excellent, 1=poor). BCM was used to search with a data mining approach for a model that contains the most probable predictors (*RQ2*: 12 characteristics variables; *RQ3*: “entrance examination success” and “study success” variables) for the class variable (*RQ2* and *RQ3*: “job performance”). The classification accuracy of the model is provided and compared to the baseline classification accuracy (i.e. classifying the cases without the model). All computations were performed with the B-Course computer program (Myllymäki *et al.*, 2002).

Results

RQ1) What characteristics and environmental factors determine air traffic controllers’ initial interest in this field of work, their perseverance in acquiring a vocational skill, and their mastery of the skill?

The interviewees’ strongest motivation (Figure 2 and Table I) to apply for ATCO training was their interest in aviation and the profession of ATCO ($n=19$, 26.0 per cent). Most of the interviewees had some earlier connections to aviation in their family background ($n=14$, 19.2 per cent) or peer group ($n=5$, 6.8 per cent). About a third of the interviewees also mentioned having a suitable background ($n=11$, 15.1 per cent) for ATCO work, such as experience of military training or air force or

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private piloting, and one-fourth of the interviewees were interested in ATCOs' professional benefits ($n=7$, 9.6 per cent) such as salary, working hours, professional status and work stability. The potential for crossover into a new career ($n=10$, 13.7 per cent), the general employment situation, such as the recession and unemployment situation ($n=6$, 8.2 per cent), as well as the concise curriculum ($n=1$, 1.4 per cent), were also brought up as motivational factors for applying for ATCO training.

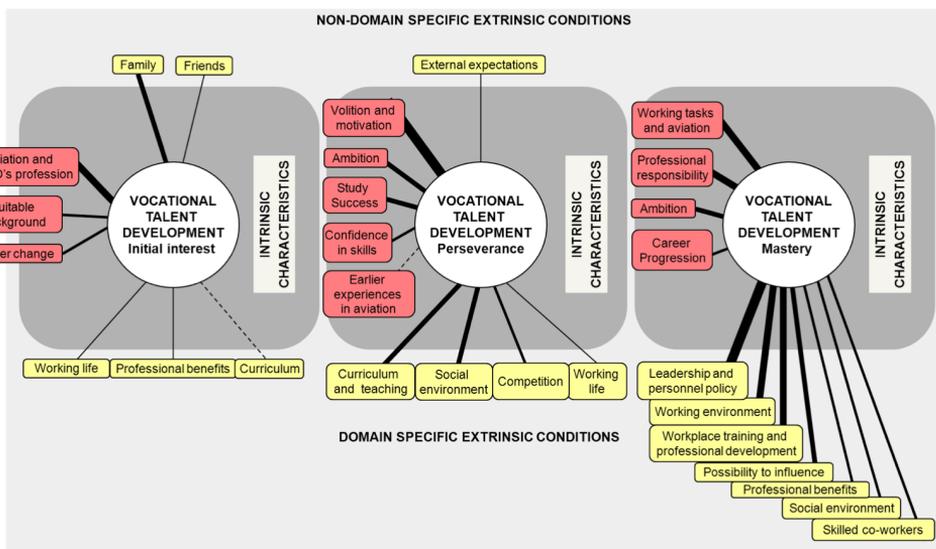


Figure 2. Characteristics and environmental factors determining air traffic controllers' initial interest in this field of work, their perseverance in acquiring a vocational skill, and their mastery of the skill. Note: The line width represents the significance of each characteristic; the wider the line, the more significant the interviewees considered the characteristic in question

According to the interviewees, ATCO training requires volition and motivation ($n=30$, 26.8 per cent) to maintain perseverance in studying (Table I). The challenges are mostly faced during the theoretical part of the studies. A lot of detailed information has to be learned in a short time without a real contact into practice. Hence, earlier experiences of aviation simplify the learning process. On the other hand, the intensive and time-limited study schedule is also seen as

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practical and well organized and therefore simple to follow. The role of the teachers, with their expertise, enthusiasm and learning acumen is acknowledged in motivating and supporting students (curriculum and teaching, $n=16$, 14.3 per cent). The supportive social atmosphere ($n=12$, 10.7 per cent), training performance ($n=12$, 10.7 per cent), ambition ($n=12$, 10.7 per cent), positively orientated competition ($n=9$, 8.0 per cent), confidence in one's own skills ($n=8$, 7.1 per cent), access to working life ($n=5$, 4.5 per cent) and external expectations ($n=5$, 4.5 per cent), as well as previous experience and desire for a career change ($n=3$, 2.7 per cent), also affected perseverance during the training period.

In working life, encouragement, fair leadership and workable personnel policy ($n=37$, 19.8 per cent) played a significant role in supporting the ATCOs' commitment to work (Table I). Effective human resource management was considered to be one of the critical aspects of leadership; sufficient human resources (workload, quality assurance, etc.) were seen as an important factor in ensuring well-being at work. Leaders are expected to be aware of ATCOs' everyday work to comprehensively benefit from their expertise. The most important factors strengthening perseverance in mastering a skill in ATCOs' working life are interesting, challenging and varied work tasks along with a continuing interest in aviation ($n=23$, 12.3 per cent), as well as an efficient work environment ($n=23$, 12.3 per cent) (Table I). The optimal working environment consists of reliable equipment and technology, adequate working space, good ergonomics and a sufficient infrastructure at the airport. The interviewees also underlined their professional responsibility and commitment to meeting safety and client service expectations ($n=21$, 11.2 per cent) and their personal ambition and will to succeed ($n=14$, 7.5 per cent). A motivating work includes workplace training and educational opportunities ($n=19$, 10.2 per cent) that encourage employees to independently develop their competencies. The opportunity to influence one's own working tasks and organizational development ($n=13$, 7.0 per cent), professional benefits such as salary and working hours ($n=11$, 5.9 per cent), career progression ($n=9$, 4.8 per cent), social environment ($n=9$, 4.8 per cent) and skilled co-workers ($n=8$, 4.3 per cent) were also considered meaningful environmental factors for well-being, commitment, and motivation at work.

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RQ2) What are the differences in characteristics between the air traffic controllers representing vocational expertise and those representing vocational excellence?

The research results indicate that *goal-orientation* has an important role for ATCOs' with vocational expertise (Figure 3 and Table II). Intrinsic goal-orientation ($n=48$, 15.1 per cent) was linked to individual ambition, as well as strong interest in air traffic control and aviation. Extrinsic goal-orientation ($n=44$, 13.8 per cent) consisted of various factors such as professional benefits (working hours, salary), professional status, professional responsibility and positively orientated competition between ATCOs (emphasized during the training period). Classification accuracy of the BCM was 89.3 per cent, which was clearly better than the baseline value of 60.7 per cent (i.e. predicting without the model). Bayesian analysis supported the qualitative analyses, emphasizing the importance of intrinsic goal-orientation. It also illustrated that the employees representing vocational excellence had a stronger intrinsic goal-orientation than the employees representing vocational expertise:

[...] natural ambition of wanting to be good. Air traffic controllers perhaps generally have strong professional pride.

Interesting and rewarding work; that is the basis of wanting to stay in this job until retirement.

Volition ($n=46$, 14.5 per cent) is also considered to be one of ATCOs' most important vocational characteristics. Concentrating on the work requires not only volition and sustainability but also the ability to regulate vitality from peak periods to quiet traffic periods. Determination and perseverance are considered to be the basis of problem-solving and decision-making as one needs to be able to trust one's own skills in any circumstances.

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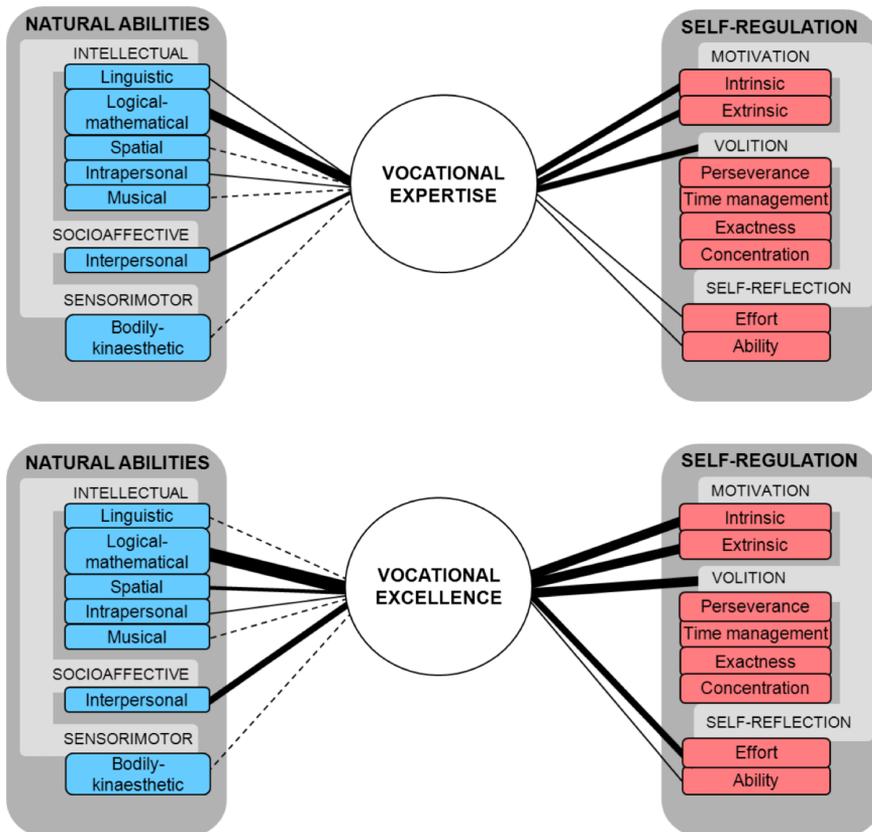


Figure 3. Vocational characteristics of the air traffic controllers representing vocational expertise and those representing vocational excellence (The line width represents the significance of each characteristic; the wider the line, the more significant the interviewees considered the characteristic in question.)

In addition, ATCOs’ work requires exactness, carefulness and time management skills to meet the official requirements of air traffic control. In the interviews, volitional differences between the ATCOs were related to exactness, carefulness and time management skills. In Bayesian analysis, volition appeared slightly higher among the employees representing vocational excellence (Figure 3 and Table II):

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The precisely defined work practice, consistent revising and structured training system ensure that individual habits vanish. There are only small differences [between ATCOs]. I am different to other ATCOs in the sense that I read all the regulations and instructions carefully and precisely, and try to think [...] the majority waves them aside. It reflects on work, even if it is not a safety-critical issue.

[...] but I still consider myself more precise than the majority [...] a bad air traffic controller has delays, good air traffic controllers do not cause delays, and this is something that pilots appreciate because of the strict time limits.

Self-reflection: success in working life was more often seen as a result of one's efforts (control beliefs, $n=24$, 7.5 per cent) than as a result of one's abilities (efficacy beliefs, $n=8$, 2.5 per cent). Active self-reflecting and practicing, leading to routines, were considered to increase the potential for success in working life. However, unsuccessful performance was more often seen as a result of difficult circumstances (bad weather, non-functioning equipment, etc.) than something that was under one's own control. Some abilities were considered by a few of the interviewees as inborn and therefore impossible to be learned, i.e. it is impossible to achieve a high level of skill by practicing:

With your own input and motivation you are able to keep going. One can influence one's own success.

Being able to perform like that is probably partly a result of having genetic, physical, and mental abilities.

Based on the results of Bayesian analysis, attribution interpretations turned out to be one of the main differences between the employees representing vocational expertise and those representing excellence. The ATCOs representing vocational expertise emphasized the significance of effort for success during the training period and the importance of abilities for success in working life. The ATCOs representing vocational excellence did not see effort as having a big role in training success. Furthermore, they did not stress the importance of effort or ability during working life.

In reference to Gardner's (1983, 1993) multiple intelligence (MI) theory, the seven dimensions of natural abilities were being identified in the context of

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ATCOs' work. *Logical-mathematical* skills ($n=67$, 21.1 per cent) were seen as the most fundamental of all the characteristics in ATCOs' work, including the following cognitive skills: perceptive skills (situation awareness, predicting of coming situations), simultaneous skills (ability to concentrate on many things at the same time), fluent problem-solving and reasoning capabilities and learning skills (ability to assimilate new information fluently), as well as the capacity to apply theories to everyday life. The significance of *intrapersonal skills* ($n=29$, 9.1 per cent), i.e. one's understanding of one's own skills, capacities and feelings, was also considerable. Vocational development was described as a process whereby new information is assimilated into old routines and knowledge; vocational learning implies reflecting on earlier performance. Interviews showed some differences between the ATCOs' abilities to reflect on their own performance even if it was not a distinctive factor between vocational expertise and vocational excellence according to the Bayesian analyses:

When you have dealt with the same kind of situation several times, the last one will always go best. Better performances are always a result of learning something from the previous time.

One must be mentally healthy; something unexpected will happen in everyone's career and you must be able to handle it by yourself; with the help of the others as well, but above all by yourself.

There are two kinds of air traffic controller, also in here [workplace]. Some are always learning and they know that some things could have been done better. The others, however, do not get involved and continue working the same way. I am amazed by that and I'll try to fix the performance.

Some employees need more ready-made solutions; other employees are able to assess different alternatives, even in a short time.

Stress tolerance and regulation, calmness and good nerves in particular were considered to be vital in ATCOs' work. The interviewees underlined the importance of resistance to pressure in decision-making; the ability to make quick decisions and take responsibility for those decisions. An important part of ATCOs' work is to be able to mentally process the stress after unsuccessful performances.

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The importance of *interpersonal skills* ($n=25$, 7.9 per cent), social skills, communication skills, understanding of others and collaborative orientation was also acknowledged as an important part of successful air traffic control even if ATCOs' work consists largely of independent work and only partly of group work. However, extrovert characteristics were not included in important vocational characteristics. Instead, ideal teamwork was even described in one of the interviews such as "top quality and non-verbal". Another specific vocational characteristic of ATCOs' work was *spatial ability* ($n=15$, 4.7 per cent), the ability to deal with spatial, three-dimensional, information.

Less often mentioned vocational characteristics based on MI theory were linguistic skills, bodily-kinesthetic skills and musical skills. The work language and terminology in air traffic controlling is mostly English, which requires *linguistic skills* ($n=7$, 2.2 per cent) and the ability to communicate in international work environments. Linguistic skills include good memory: awareness of detailed regulations and other professional information. Only two references were related to *bodily-kinesthetic* skills ($n=2$, 0.6 per cent). One was that verbal communication, including the voice and speech rhythm, has to remain calm and clear when communicating with pilots or other ATCOs. The other reference to bodily-kinesthetic skills was connected to motor skills that are part of the advanced routines. *Musical skills* ($n=3$, 0.9 per cent) were referred to in the context of hobbies.

RQ3) How does air traffic controllers' performance during training or in the entrance examination predict vocational excellence in working life?

BCM was performed to answer the research question. Job performance (with values of "expertise" and "excellence") was the class variable in the analysis, and the predictor variables were the ATCOs' entrance examination ranking and overall study success during ATCO training. Classification accuracy was 100.0 per cent, which was clearly better than the baseline value of 55.6 per cent. The results indicated that success in the entrance examination or during the training period did

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not predict vocational excellence in working life, as neither of these predictor variables was selected to the model.

Discussion

The findings of this study are in parallel with those of earlier research (Korpelainen *et al.*, 2009; Nokelainen *et al.*, 2009; Nokelainen, 2010, 2014), showing that cognitive skills (logical-mathematical skills, problem-solving, perceptive skills, learning skills, simultaneous skills), self-reflection (control beliefs, stress tolerance), volition (perseverance and determination, exactness and carefulness, ability to concentrate, time management skills) and goal-orientation (extrinsic and intrinsic motivational factors) are recognized the most important characteristics of vocational expertise. Interpersonal skills (social skills), intrapersonal skills (ability to understand and analyze one's own performance) and spatial skills (conceptual understanding of three-dimensional information) were also among the acknowledged characteristics of ATCOs. The main differences between the ATCOs representing vocational expertise and those representing vocational excellence were related to self-regulation. Motivation and volition proved to be stronger among the employees representing vocational excellence. Findings of the current study are in accordance with previous research. Yeo and Neal (2008) studied factors related to changes in subjective cognitive effort during simulated ATC tasks. They showed that participants with high level of Conscientiousness (indicated by perseverance, see Figure 3) were self-disciplined and committed to their goals. Another study (Yeo *et al.*, 2009) showed positive relationship between mastery- approach (i.e. intrinsic motivation to master a specific skill, see Figure 3) and performance in an ATC task.

Control beliefs, on the other hand, were considered a less significant factor in training performance among the employees representing vocational excellence. In working life, both control and efficacy beliefs were considered even less important factors. The result validates the connection between the intentional conceptual change (Limón Luque, 2003) and vocation-specific skills (Ruohotie, 2003). This finding is also in line with recent research on psychometric, cognitive and developmental psychology. According to Demetriou *et al.* (2011), the processes of

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the human mind during problem-solving are organized into four systems: (1) specialized structural system (SSS); (2) representational capacity system; (3) inference system; and (4) consciousness system. The first system involves mental processes connected to environmental domains. In this study, this refers to the domains of the MI theory (natural abilities). The second system represents representational and information processing needs (episodic integration, executive control) between the first (SSS) and fourth systems (consciousness). The third system is responsible for connecting and integrating information and operations (conceptual change, meta-representation) in relation to the current goal between the first and fourth systems. The fourth system monitors, controls and regulates processes activated at a given moment. This system is presented by intrinsic characteristics in our model (Figure 1). Learner needs to be competent in regulating his/her own performance but also have sufficient vocation-specific skills to apply the skills in practice. Competent self-regulators have all the necessary skills to provide the conditions for change as they both are able to regulate their vitality, stress, anxiety, boredom and other feelings, and have sufficient vocation-specific skills – in ATCOs' work, this means particularly strong cognitive skills.

Intrapersonal skills, the skills of analyzing work, were also recognized as one of the essential strengths in air traffic control. Teperi and Leppänen (2011) examined ATCOs' work processes from the perspective of organizational crisis, in a case organization, that was followed by an intervention and project evaluation. The research results indicated that the new approach to the supervision of work, which is based on self-reflection, is workable in practice and increases employees' motivation to change their way of acting and developing work in the unit. However, Teperi and Leppänen (2010) note that even if organizations have the means to maintain employees' basic professional skill level, there is a lack of an integrated model for organizational learning at all levels of air traffic management that weakens the methods and aims related to vocational development such as self-reflection, feedback and sharing information. In this study, the differences between the employees representing vocational expertise and those representing excellence demonstrated the same occurrence of varying methods of analyzing work processes that challenges vocational development. Environmental factors, such as

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workplace training, giving and receiving feedback, and opportunities to influence, proved to have an impact on increasing employees' motivation in vocational development.

Conclusions and implications

Work expectations are increasing in air traffic controlling, as controllers are required to perform their work safely, effectively, flexibly and in an environmentally friendly and customer-orientated manner, while coping with steadily increasing air traffic (ICAO, 2011, 2013). At the same time, technology is increasingly supporting or completely replacing traditional human functions and the work is becoming more pre-defined and monotonous. Kirwan (2001) stresses the importance of reconciliation of the controller and technology; automation in the growing air traffic management industry requires new competencies and raises questions of motivation. The human dimensions of job satisfaction and role meaningfulness are sometimes underplayed even if such factors as motivation and reaction to stress can be determining factors in system performance and safety. This study examined vocational expertise and vocational excellence in relation to air traffic controllers (ATCOs) in the context of their working life. It also focused on features related to ATCOs' developmental pathways from initial interest in the work field to perseverance in acquiring a vocational skill during the training period and mastery of the skill in working life. The results of this study confirm the significant role of human factors, especially self-regulatory abilities, motivation, and volition, in air traffic controlling alongside automation technology.

The development of ATCOs' vocational expertise or excellence was seen as a process occurring in the working context, where new information is assimilated into old routines and knowledge by analyzing own performance. The results showed some differences between the ATCOs' levels of intrapersonal skills (understanding of one's own skills, capacities and feelings). The most important domain-specific and non-domain-specific factors that strengthen perseverance in acquiring mastery of a skill in working life are interesting, challenging and varied work tasks, an interest in aviation, and strong professional pride and commitment.

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The importance of other professional factors such as leadership (human resource management, feedback, opportunity to influence), working environment (physical and social environment), educational possibilities, professional benefits (salary and working hours), and career progression was also emphasized.

The research results indicate that success in the entrance examination or during the training period do not predict vocational excellence in working life. This is in parallel with Billett's (2001) notion that highly detailed and prescriptive vocational education curricula should be more relaxed and practice-oriented to promote skills needed in working-life. He further suggests that vocational education pathways "should assist individuals in developing greater breadth of understanding about their occupation and associated fields" (Billett, 2011, p. 243). However, the entrance examination system and ATCO training appear to provide a sufficient basis for ATCOs' vocational development. First, nearly all students graduate from ATCO training, as the multiphase entrance examination eliminates all but high-performing students. Random selection of the interviewees included 17 out of 28 employees representing vocational excellence. Although ATCO training is not tertiary, but secondary-level education, more than one-third of the interviewees had a right to study in a university or polytechnic institution of higher education. Second, the interviewees considered that the training offered the necessary learning content for progression into working life that also follows vocational development in the work context. However, to support the development of vocational excellence in ATCO training or modify entrance examinations design, greater account may need to be taken of the significance of self-regulation skills along with vocation-specific skills; students are assumed to be aware of the potential usefulness of self-regulation processes but in fact need motivation to self-regulate (Zimmerman, 2001).

The critical question arising from the research is how organizations can recognize and benefit from ATCOs' vocational excellence in comparison with vocational expertise; whether vocational excellence brings any additional value to ATC. The basic system performance may not require vocational excellence as all ATCOs are expected to maintain the same high professional level in their work, but as discussed earlier, motivation can be seen as one of the determining factors in

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safety. Compared to non-safety-critical vocations, which offer more variation in using vocational excellence potential (Nokelainen, 2014; Nokelainen *et al.*, 2009), ATCOs' pre-defined work may require new positions, responsibilities or career pathways in the future from organizations to benefit from vocational excellence and to keep employees representing vocational excellence motivated in their chosen career.

Limitations

We acknowledge that there are limitations in the present study. First, the four airports were not selected randomly. Although they represent different types of airports (and ATCO job profiles) in Finland quite well, future studies should include comparative aspect to airports in other countries. Second, the number of participants ($N=28$) in the study was quite small, limiting generalization of the results to the target population ($N=300$). Future research on this domain should be extended to include also quantitative measurements, allowing more generalizable results. Third, although the analysis for the *RQ3* was based on a technique that is not sensitive to missing values (BCM), missing data in ATCOs' aptitude test scores, training records, and employee assessments added uncertainty to the results.

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Notes

1. Number of air transport passengers has steadily increased 2004-2012 from 1.9 to 2.9 billion (The World Bank statistics, <http://data.worldbank.org>).
2. For instance, in Finland, applicants are tested in multiphasic examinations in such areas as general giftedness, personality, spatial skills, stress tolerance, ability to concentrate, and language skills. The intake of new students is only approximately 2-3 per cent of applicants (Finavia, 2013).

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Finnish WorldSkills Achievers' Vocational Talent Development and School-to-Work Pathways

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Abstract: This paper examines the perceptions of vocational expertise and school-to-work pathways among WorldSkills Competition (WSC) achievers and their co-workers and employers within the Finnish context. At the biennial international WSC, young people (aged 18-to-23 years) from over 60 countries demonstrate their skills in more than 40 trades. Individualized training for this competition is provided through the cooperation of vocational institutions (e.g., expert coaches, team leaders and competition panellists) and industry (e.g., mentors, sponsors, materials, equipment). Semi-structured thematic interviews ($N=51$) were conducted in 2013 and 2014 with former Finnish WSC medal or diploma winners ($n=18$) who had since begun their working lives (1-to-15 years of work experience). Their employers ($n=16$) and colleagues ($n=17$) were also interviewed. Results showed that in addition to vocation-specific knowledge and skills, problem-solving skills, creativity, social skills and self-regulatory skills were acknowledged as the most significant elements of vocational expertise. The findings also indicated that formal vocational education combined with deliberate practice and training based on expert mentoring improved the long-term career progress and vocational expertise of the WSC achievers.

Keywords: VET, Vocational Education and Training, Skilled Worker, Education-Work Relationship, Talent Development, Career Exploration

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1 Introduction

Recent research on VET underline the importance of integrating formal education and workplace learning. This reflects the need for students and teachers to learn how to mediate between the different forms of expertise and the demands of different contexts and how to navigate the boundaries between them (Griffiths & Guile, 2003; Guile & Griffiths, 2001; Tuomi-Gröhn, Engeström, & Young, 2003). In the biennial international WorldSkills Competition (WSC), young people (aged 18-23 years) from over 60 countries demonstrate their vocational competence in more than 40 trades (WSI, 2010). The competitors are selected to participate in the WSC based on their success in their vocational studies and in official national competitions. Before the four-day event is held, all competitors participate in an additional training programme. The individualized competition training is carried out in cooperation between vocational institutions (expert coaches, team leaders and panellists) and industry (e.g., mentors, sponsors, materials, equipment). As the WSC offers alternative perspectives on crossing the boundaries between formal education and the workplace, and it finds itself on the political agenda as a strategy to heighten the status of vocational education and training (VET) (European Council, 2010), it is highly relevant to more closely investigate the impact of skills competitions on participants' learning opportunities, outcomes and motivation.

This paper builds on a large interview study ($n=51$) with vocational skills competition participants and their co-workers and employers in order to gather their perceptions of vocational expertise and school-to-work pathways. The specific focus is on the former WSC medal and diploma winners' perspectives on the development of vocational excellence. The data includes interviews with Finnish WSC achievers ($n=18$) who have since entered working life (1-15 years of work experience), and their co-workers ($n=17$) and employers ($n=16$) from the same workplace. The fertility of the grounds for this research is based on two facts: Firstly, the former WSC achievers have been evaluated as excellent performers by an external international panel, and secondly, they have participated in a training program in which they received guidance from vocational expert mentors. The main goal of this study is to provide information about the advantages and disadvantages of the WSC training in relation to traditionally implemented VET in the context of Finland. This research focuses on an investigation of the WSC achievers' and their non-competing co-workers' perspectives on the main characteristics they consider important to performing well professionally, their vocational pathways after vocational education, and the most important external conditions that have supported their vocational development. The research questions asked by this study are the following:

(RQ1) How is vocational expertise perceived by the former WorldSkills Competition achievers in relation to their co-workers and employers?

(RQ2) What kinds of school-to-work pathways describe the former WorldSkills Competition achievers in relation to their co-workers?

(RQ3) What kind of influence has the WorldSkills Competition and training experience had on achievers' vocational development and pathways in relation to vocational education?

2 Theoretical Framework

WorldSkills Competition

In the biennial international WSC, young people (aged 18-23 years) from over 60 countries demonstrate their vocational competence in more than 40 trades (e.g., health care, hairdressing and robotics). The WSC is the largest skills competition in the world, in which young professionals compete for the world championship (WSI, 2010). Each competitor receives a score (from 0-600 points) from a panel of international experts based on his or her performance during the four-day competition. Finland provides an interesting context in which to examine the influence of WSC because skills competitions have been included in the country's strategic planning for international cooperation in VET by the Finnish National Board of Education (2014). The participants are the selected students of vocational upper secondary school. Instead of providing financial or material rewards, participation in international competitions allows vocational institutions to compare the quality and elements of their training to those of other countries and improve the skills and international competences of their students (e.g., through international networking) and teachers (e.g., by designing the tasks for the competitions, assessing the performance of contestants together with experts from other countries, and gaining an international perspective into training and teaching at the highest level) (Finnish National Board of Education, 2014).

The competition training system is coordinated by the non-profit organization SkillsFinland and supported by the Finnish Ministry of Education and Culture and the Finnish National Board of Education. The training is implemented in cooperation with vocational institutions (expert coaches, team leaders and WorldSkills Champion Panellists) and industry (e.g., mentors, sponsors, materials and equipment). The training period is mostly individualized and carried out in vocational institutions and workplaces. Moreover, it also includes collaborative practising (e.g., national team camps) (SkillsFinland, 2017). The content of the training is based on the earlier skills competition tasks that follow the VET requirements of vocational qualifications and specialist qualifications and acknowledge the perceptions of experts from different countries. The training is included with the components related to vocation-specific skills and knowledge as well as psychological and physical preparation to overcome competition-related issues (Saarinen, 2010). The training starts approximately one year before the competition. The competitors are selected to participate in the WSC based on their success in the national (Taitaja) skills competition or through training providers' contacts with vocational institutions or companies (SkillsFinland, 2017). According to the WSC achievers interviewed in this study, the impetus to join the competition often comes from the VET teachers and their impressions of their students' success, motivation and willingness to participate in the WSC.

Developmental Model of Vocational and Professional Excellence

The developmental model of vocational and professional excellence (DMVE) (Nokelainen, 2016; Pylväs, Nokelainen, & Roisko, 2015) is developed on the basis of the earlier empirical research on modeling of vocational expertise and excellence (Nokelainen, Stasz & James, 2013; Nokelainen, 2010; Nokelainen & Ruohotie, 2009; Nokelainen, Korpelainen, & Ruohotie, 2009; Korpelainen, Nokelainen, & Ruohotie, 2009; Ruohotie, Nokelainen, & Korpelainen, 2008; Tirri & Nokelainen, 2011; Nokelainen, Tirri, Campbell, & Walberg, 2007; Nokelainen & Ruohotie, 2002). The DMVE model is applied in this study to investigate the vocational skills competition participants', their co-workers' and their employers' perceptions of the natural abilities, intrinsic characteristics (self-regulation) and extrinsic conditions that influence the development of vocational expertise. The model presented in the Figure 1 is comprised of the following components: *natural abilities* (multiple intelligence theory [MI], Gardner, 1983), *intrinsic characteristics* (the socio-constructivist approach to self-regulation, Zimmerman, 2000), *deliberate practice* (Ericsson, 2006) and *extrinsic conditions* (domain and non-domain factors related to talent development, Bloom, 1985; Lave & Wenger, 1991; Tuomi-Gröhn et al., 2003).

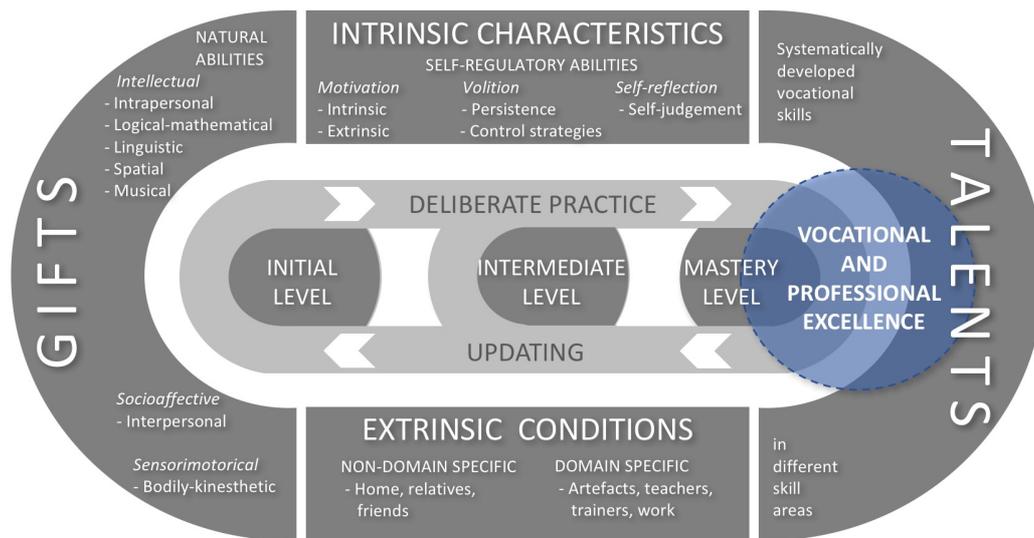


Figure 1: Developmental model of professional and vocational excellence (Nokelainen, 2016; Pylväs et al., 2015)

The model illustrates the process of how inborn gifts develop into talents. Previous research in the domain of vocational skills competitions shows that gifted individuals with exceptional natural abilities (intellectual, creative, socio-affective and sensorimotor), intrinsic characteristics (self-regulation) and auspicious extrinsic conditions (physical, cultural and sociological milieus; exposure to important individuals; activities; accidents)

may reach a level of vocational excellence through deliberate practice. Individuals who fail to meet all of these conditions may still become competent professionals (vocational expertise) through deliberate practice. (Nokelainen, 2010; Nokelainen, Smith, Rahimi, Stasz, & James, 2012; Pylväs et al., 2015).

Natural Abilities

The structure of the main DMVE components (Nokelainen, 2016; Pylväs et al., 2015) is based on Gagné's (2004, 2010) differentiated model of giftedness and talent (DMGT). Chance is understood to play a predominant role in the DMGT as it includes both genetic and parental endowments affecting natural abilities and intrapersonal characteristics (Gagné, 2004, 2010). To investigate the role of natural abilities (gifts) in the development of vocational expertise and excellence, DMVE applies the original seven-dimension version of Gardner's (1983, 1993, 1999) multiple intelligence (MI) theory that consists of 1) linguistic; 2) logical-mathematical; 3) musical; 4) spatial; 5) bodily-kinaesthetic; 6) interpersonal; and 7) intrapersonal intelligence. According to Martin (2001), in the workplace learning context, *linguistic intelligence* refers to an ability to read and produce professional documents and to communicate actively and adaptively with colleagues and clients. *Logical-mathematical intelligence* is related to technical awareness and an understanding of hardware and software and objective and logical assessments of problems related to people or products. *Musical intelligence* is related to attendance to auditory cues, such as the tone, volume and sequence of people, machines or environments. *Spatial intelligence* involves the use of visual elements not only in work tasks and product or service development, but also in other concrete applications related to workplace productivity or marketing. *Bodily-kinaesthetic intelligence* relates to the motor skills needed to carry out various work tasks, such as an ability to use tools or other equipment efficiently. *Interpersonal intelligence* is vital in everyday interactions with colleagues and clients, for example, to lead and work within teams and to give constructive feedback. *Intrapersonal intelligence* refers to a person's self-awareness of one's own feelings, goals, ethics and abilities in changing situations at work.

Intrinsic Characteristics

Self-regulated learning has been studied in depth mainly in the context of social cognitive theory (Bandura, 1986). The term "self-regulation" refers to the process by which self-generated thoughts, feelings and actions are planned and systematically adapted to further one's learning and motivation (Schunk & Ertmer, 2000; Zimmerman, 2000). Self-regulatory skills allow learners to modify their performance based on personal characteristics and environmental conditions (Zimmerman, 2000). Further, self-regulated learning is not limited to academic contexts, but can occur wherever learning - whether formal or informal - takes place (Kaplan, 2008). Research has shown that successful learners can monitor and regulate the following triadic elements: volition, motivation and self-reflection (e.g., Kitsantas & Zimmerman, 2002; Zimmerman, 1989, 1998; Zimmerman & Kitsantas, 2005). *Motivational* processes help the learner to formulate decisions and to promote decision-making, whereas volitional processes guide one's subsequent enactment of the decision (Corno, 1989). *Volition* includes persistence, the will to learn,

endeavour/effort, mindfulness in learning, regulation, and evaluation processes. It also involves various control strategies (e.g., the allocation and control of resources, emotional attentiveness and motivational control strategies) and methods of processing knowledge (Zimmermann, 2006). The processes of *self-reflection* enable individuals to evaluate their experiences and thought processes (Bandura, 1986). According to Weiner (1974), individuals constantly seek to understand why an event has occurred. The learner may interpret the failure of a strategy as the result of too little effort (control beliefs) and then decide to increase his or her subsequent effort. The learner may also attribute his or her failure to a lack of ability (efficacy beliefs) when the response will most likely require increasing one's effort. Attribution interpretations (control and efficacy beliefs) can lead to both positive and negative self-reactions because they are under one's own control (Zimmerman, 1998; Zimmerman & Kitsantas, 1997). Positive reactions reinforce intrinsic goal orientation and positive interpretations of oneself as an employee, such as beliefs in one's own competencies and opportunities (Merenti-Välimäki, Nokelainen, & Tirri, 2005; Nokelainen et al., 2007).

Deliberate Practice

Intrapersonal characteristics precede the practice component in the DMGT (Gagné, 2004, 2010) because practice is based on the presence of gifts (natural abilities) and intrapersonal characteristics (e.g., self-regulation). Deliberate practice is essential in talent development; in most fields, it takes ten years to become an expert (Ericsson, Krampe, & Tesch-Römer, 1993). Recent research, however, has shown that the ten-year rule is not absolute; in some fields (e.g., chess, sports) total mastery of the necessary skills takes about six years, whereas in other fields (e.g., music, science), reaching the top can take 20-30 years of deliberate practice (Ericsson, 2006). Ericsson's relative approach to the study of experts' characteristics assumes that the fundamental capacities and domains - the general reasoning abilities of experts and non-experts alike - are almost identical. The major difference between experts and novices is that through deliberate practice, the former are more knowledgeable than the latter (Chi, 2006). However, to truly understand the influence of the environment on the maximum level of performance, deliberate practice must be characterized and distinguished from other types of everyday activities in which learning may be an indirect result. Ericsson et al. (1993) define deliberate practice as a "highly structured activity, the explicit goal of which is to improve performance" and link deliberate practice to such factors as engagement, motivation and monitored performance.

Extrinsic Conditions

Environmental conditions also follow intrapersonal characteristics in the DMGT (Gagné, 2004, 2010) as the differences in "normal" environments fail to explain differences between average and outstanding achievement (Greenspan, Solomon, & Gardner, 2004). However, environmental conditions have been proven to play an important role in talent development. From a social-cognitive view of self-regulation, expertise develops from both external support and self-directed practice sessions (Bloom, 1985; Zimmerman, 2006). Earlier talent research (Bloom, 1985; Greenspan, Solomon, & Gardner, 2004) has

identified three stages of talent development through which talented children progress: initial participation (first attraction to the activity and initiation of formal instruction), perseverance (acquisition of basic and intermediate skills), and mastery (building upon acquired skills to develop expertise and to compete on higher levels). According to Bloom (1985), parents make the talent field accessible and desirable to their children. The home environment provides the structure necessary for early learning (time, valuation, support, resources, and instruction) and instils the child's work ethic. The work ethic applies initially to most activities in the home and school, and later relates most directly to learning and participation in the chosen talent field. The social reactions of parents and other individuals in the immediate environment establish a child's original motivation and engagement in the domain, and when added to the accumulated experience and the help of teachers and coaches, a developing individual learns to internalize methods for assessing improvement, monitoring the effects of practice and setting goals (Bloom, 1985).

In the context of workplaces, the contribution of individual assistance and support by more experienced co-workers also seems to provide a significant basis for learning (Billett, 2001; Virtanen, Tynjälä, & Eteläpelto, 2014). Without the existence of a theoretical basis for understanding and guidance from experts, student learning at work may remain unsystematic and incidental (Collin & Tynjälä, 2003; Virtanen & Tynjälä, 2008). In socio-cultural theories of workplace training, learning is becoming a process situated within the framework of participation rather than within the learner, even if it does not replace notions of individual learning (Hager, 2013). Eraut (2000) argues that aspects of an individual's knowledge accumulated through lifelong learning will always exist and become unique to them. Still, an individual is likely to encounter knowledge that is shared among the group with which he or she works. Lave and Wenger (1991) have proposed that learning happens in everyday interactions and through participation in communities of practice. Learning occurs as part of a process in which learners gradually move from peripheral participation to full participation in the community of practice. However, the master-novice relationship and the professional monopoly on expertise (based on such factors as age or status) may be important elements but are also problematic. Multiple contexts demand and afford different but complementary - yet sometimes conflicting - cognitive tools, rules, and patterns of social interaction (Fuller & Unwin, 2004). The criteria of expert knowledge and skill is defined differently in various contexts; by operating in, and moving between, multiple parallel activity contexts, experts face challenges when negotiating and combining elements from different contexts to achieve hybrid solutions. According to Tuomi-Gröhn et al. (2003), the school should prepare its teachers and students to work as boundary crossers between the worlds of school and work and engage students in real-life processes during their studies as students can see things from a fresh angle, have time to reflect and take the initiative before they are caught up in the routines and dynamics of the workplace.

3 Methods

Participants

The data includes interviews with Finnish WSC medal or diploma winners ($n=18$) who have since entered working life (1-15 years of work experience), and their co-workers ($n=17$) and employers ($n=16$) from the same workplace. The WSC achievers interviewed participated in the WSC between 1997-2011 and earned either a gold, silver or bronze medal, or a diploma (for being awarded more than 500 points). Going through the WSC high-standard evaluation process, the WSC achievers are being considered to perform on the high level of expertise in this study. To account for the differences between vocational fields, the interviewees were chosen to represent three different trades designated by the researchers: 1) customer service; 2) manual labour; and 3) technical work (Table 1).

Table 1: Overview of the sample

Participants ($N=51$)	WorldSkills achievers ($n=18$)	Co-workers ($n=17$)	Employers ($n=16$)
Age, M_{age} (SD_{age})	29.4 (5.012)	32.0 (7.433)	46.1 (7.191)
Female $n(\%)$	7 (13.7)	8 (15.7)	7 (13.7)
Male $n(\%)$	11 (21.6)	9 (17.6)	9 (17.6)
Work experience, years (SD)	8.7 (4.081)	12.2 (6.978)	24.0 (8.556)

Instrument

A total of 51 semi-structured thematic interviews (70-90 minutes) were conducted in 2013-2014 in 18 workplaces. Interviews served as the research method offering some leeway to pursue the angles deemed important by the interviewee, while also enabling the interviewer to focus the conversation on issues considered important to the research (Brinkmann, 2014). The interview instrument was developed on the basis of our previous research on vocational expertise and focused on examining the significance of natural abilities, intrinsic characteristics (self-regulation) and extrinsic conditions in the development of vocational expertise (e.g., Pylväs et al., 2015). Questions such as “*How would you characterize an employee who succeeds well in your vocation?*” or “*How do you think that vocational education has prepared you for working life?*” were included in the interviews.

Analysis

We used qualitative content analysis to analyse the research data. Qualitative content analysis can be defined as a research method used for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns (Hsieh & Shannon, 2005). The aim of the analyses was to create conceptually and empirically grounded categories related to the analytical context and rooted in empirical material to reflect the topic of the study (e.g., Dey, 1993). We obtained the text data from transcribed semi-structured interviews, which we managed

(by organizing data sources and managing coding) using NVivo software. The unit of analysis selected for coding was a meaningful piece of text in the interview transcript, such as a word, sentence or short narrative (Krippendorff, 2012; Schreier, 2014). The coding frame consisted of the main categories and subcategories built by following the directed (or deductive) analysis approach based on the existing theory (Hsieh & Shannon, 2005; Schreier, 2014). However, since a key objective was to provide a thorough description of the material, we combined concept-driven categories with data-driven categories (Schreier, 2014). Thematic criteria served to divide the text material into data-driven units that would fit the coding frame (Schreier, 2014). When an important characteristic separates people into groups, one or more groups can also be selected as units of analysis (Patton, 1987). In this study, the sampling units consisted of both coding units (main categories and subcategories) and three demographic groups of interviewees (WSC achievers, co-workers and employees).

4 Results

How is vocational expertise perceived by the former WorldSkills Competition achievers in relation to their co-workers and employers?

The WSC achievers and their co-workers and employers shared a similar view of the most important skills related to vocational expertise: logical-mathematical skills, interpersonal skills and self-regulatory skills. The role of intelligences (natural abilities) will first be discussed, followed by a discussion on the role of self-regulatory skills.

Natural abilities. According to the interviewees, vocation-specific skills may not be the most critical of all the vocational skills, but they are required to perform well in vocational fields. Depending on the vocational field, one must have the necessary vocation-specific skills emphasising e.g., *sensorimotor skills* (bodily-kinaesthetic abilities supporting manual skills) and/or *logical-mathematical skills* (domain-specific knowledge). All of the interviewed groups highlighted the importance of logical-mathematical skills, but there were also the differences in terms of the cognitive skills that were considered the most important. The WSC achievers and employers underlined the importance of problem-solving skills more than the co-workers did and they believe that sufficient cognitive skills are the foundation for actualizing vocational excellence. These two groups discussed the importance of a broad understanding of the work processes that enable an employee to handle multiple tasks and to overcome various and unexpected problems independently and quickly. Moreover, the employers highlighted the importance of commercial expertise as many vocational trades involve working in private companies.

Creativity was one of the vocational skills highlighted in many of the interviews, particularly by the WSC achievers. Creativity was included with the artistic and visual skills needed in vocations such as florist and hairdresser. On the other hand, creativity was related to the creative thinking that may inspire a person to create something new, such as a new idea or method of working. Thus, creativity was also closely connected to problem-solving skills and innovativeness. To perform at the level of vocational excel-

lence, a person was considered to need the ability to create, innovate or solve problems independently. *“Excellence then requires more logical thinking, to be able to apply everything one has ever seen, heard or done. Such skills and adequate work experience help one to become a top expert”* (WSC achiever).

All of the interviewed groups also emphasized the significance of *interpersonal skills* as an element of vocational expertise. Several aspects of interpersonal skills were brought up in the interviews: the knowledge of human nature, extroverted personality, energetic and positive attitude, open-mindedness and encouragement, flexibility and humility, customer service orientation, teaching skills and mentoring skills. In some cases, interpersonal skills were even seen to compensate for the lack of some other vocational strengths such as manual skills. Only a few of the WSC achievers and their co-workers mentioned *spatial skills* (three-dimensional skills), *linguistic skills* (language skills, writing, documentation and guidance) and *intrapersonal skills* (recognizing one’s own strengths and weaknesses) in the context of vocational expertise.

Self-regulation. The interviewees of the three target groups specified multiple characteristics related to self-regulation that they considered important or vital to their vocational expertise and vocational development. Most importantly, the interviewees emphasized the significance of the following self-regulatory skills: volition (concentration, calmness, carefulness and organizational skills) and internal *motivation* (ambition to learn and develop professionally, initiative). Volition was described by an interviewee: *“And perseverance and patience is needed in everything, because if there are any problems or other hassles, it takes time to make sense of it. Perseverance is needed, at least”* (Co-worker).

The co-workers, in particular, highlighted the importance of internal motivation in the vocational field and work tasks. There were also a few interviewees in each group of interviewees who discussed external motivational factors that may have an influence on one’s professional development, such as ambition, expectations of career progression and ongoing changes in the work environment. Overall, motivation was recognized as an important prerequisite for vocational expertise. *Self-reflection* was acknowledged by all of the target groups even if it was less emphasized than volition and motivation. Tolerating stress in high-pressure work situations and reflecting on one’s own performance were both perceived as important in working life.

What kinds of school-to-work pathways describe the former WorldSkills Competition achievers in relation to their co-workers?

To analyse the participants’ vocational pathways, the results follow the three identified stages of talent development (Bloom, 1985; Greenspan, Solomon, & Gardner, 2004) discussing initial participation (first attraction to the vocational field), perseverance (acquisition of basic and intermediate skills in VET), and mastery (building upon acquired skills to develop expertise and to compete on higher levels at work).

Initial interest. The background to the interviewees’ initial interest in their vocational fields was largely consistent among both the WSC achievers and their co-workers. The most common statements were related to an interviewee’s personal interest in their chosen

vocational field and their family background: “*Maybe it was because I saw my mother working and enjoying it, and I saw how much she got out of it*” (Co-worker).

Family and friends were the greatest influences on the choices of profession, thus supporting Bloom’s (1985) concept that parents make the talent field accessible and desirable to their children and the home environment provides the structure necessary for early learning. Our data shows that the decisions were guided by such factors as family members’ professional backgrounds, the immediate family environment (e.g., available equipment, authentic work experiences) and the family members’ confidence in the education system and their children’s aptitudes for certain skills areas. A few of the interviewees from both target groups had also found their career path through work experience (e.g., workplace training in secondary school or non-military service) or a vocational school tour. In addition, some of the interviewees had chosen their career based on their study success or education offerings.

I came from a family of farmers, so manual skills have always been there. My uncle developed patents for some agricultural stuff, so it surely comes from there somewhere. In fact, I can see the same thing now in my own two sons; somehow they are more technically oriented (WSC achiever).

Study period. The WSC achievers’ and their co-workers’ experiences of their study period diverged at some level. Most of the WSC achievers considered themselves more successful than average students. They actively studied not only in a formal setting, but also in their spare time. They also greatly emphasized their internal motivation towards the vocational field and their enthusiasm for vocational education throughout their studies. Some of the WSC achievers described themselves as conscientious and hard-working students and the others underlined how their advanced studying skills helped them to succeed in their studies. Furthermore, some of the interviewed co-workers considered themselves to be more successful in their studies than average students. Among those interviewees, study success was also seen as being based on their conscientious and hard-working characteristics, study habits and strong motivation.

Yes, I was different from others. If I think back on our class, then yes, I certainly was the only one who studied from morning until evening. . . Maybe I differed in the sense that I had a strong will to learn. I think that is why I was chosen to participate in this event even though we would have had, as far as I recall, three other candidates to go (WSC achiever).

While only a few of the WSC achievers considered themselves to be average students during their studies, most of the co-workers assessed themselves as having performed at an average level. Their average or lower level of study success was seen as the result of such factors as young age, lack of motivation, lack of earlier work experience or random choices made in their career and training.

Working life. The WSC achievers acknowledged their strong professional networks, easy school-to-work transitions, high levels of expertise and career success more often than

their co-workers. Half of WSC achievers mentioned that finding a job after graduation was easier because of the contacts they had gained during the skills competitions. The WSC achievers also described their career development in working life as better than average more often than their co-workers. This was supported by more than half of the employers who acknowledged the exceptionally high level of expertise of the interviewed WSC achiever working in their organization: *“I could let [the WSC achiever] run the business quite confidently, he is that rock-solid a professional; he knows what to do”* (Employer).

The higher level of vocational expertise was included with vocation-specific natural abilities (e.g., technical knowledge, sensori-motor skills) and self-regulatory skills (e.g., motivation, self-confidence, volition, self-reflection and learning skills). A little more than one-third of the employers also considered the WSC achievers working in their organizations to be above average in terms of career development.

For sure, the biggest factor is the contacts. But the fact is that the contacts were earned through my success in vocational competitions. Let’s put it this way: if I were to become unemployed for some reason, I would find a new job through these contact networks, and very quickly (WSC achiever).

Some (less than one-third) of the co-workers also described their career development in working life as better than average and believed that the work experience or practical training they gained during their studies had influenced their school-to-work transition. Those co-workers who also felt that they had superior expertise to average employees acknowledged their strong self-regulatory skills.

The WSC achievers’ and co-workers’ thoughts concerning their work-related future ambitions revealed no particular differences. Both groups discussed the significance of lifelong learning, the ambition to learn and motivation to develop professionally. Career development was related to assuming responsibility for work tasks and further education. The common future interests of the co-workers were related to creating a private enterprise, engaging in further education, working in international environments and projects or be promoted in the organization. The WSC achievers emphasized slightly more often their career development, professional development and teaching/coaching (e.g., vocational skills competitions) ambitions. Moreover, a few of the WSC achievers mentioned the possibility of a career change, two of them for medical reasons.

What kind of influence has the WorldSkills Competition and training experience had on achievers’ vocational development and pathways in relation to vocational education?

The study had a specific focus on former WSC achievers’ perspectives on the advantages and disadvantages of skills competitions. The empirical finding implied that the WSC achievers acknowledged several benefits of the WSC and training. In particular, they reported gaining a boost in their career due to gaining access to a high level of expertise and extensive professional networks. The WSC supported the WSC achievers’ school-to-work transitions and strengthened their reputations and vocational confidence: *“New*

situations will not make you nervous, because you have experienced so much that you know how to handle them” (WSC achiever).

Skills competition experience and training was also considered to develop or strengthen self-regulatory skills such as volition (e.g., perseverance and exactness), motivation in the vocational field and self-reflection (e.g., stress-tolerance and self-confidence), as well as logical-mathematical skills (e.g., technical knowledge and skills, problem-solving skills and special expertise) and interpersonal skills (e.g., collaborative learning and customer service).

Some of the employers also highlighted the advantages of the skills competitions and training, as they had found the WSC achievers to have strong self-regulatory skills (e.g., motivation, volition and determination), logical-mathematical skills (e.g., technical knowledge and skills) and interpersonal skills (e.g., customer service and social skills). However, a few of the WSC achievers perceived no discernible advantage from participating in the skills competition. Some of those interviewees stated that the competition tasks were inconsistent with real working life, while others noted that their success went unacknowledged outside of the competition environment or the training failed to meet expectations.

The group most satisfied with formal VET was the WSC achievers who considered their studies to have been an important basis for their vocational expertise and considered them advantageous later in their career: *“I feel that [...] I have gained good skills there [vocational education]. And the thing that I have certainly understood over the years is specifically lifelong learning”* (WSC achiever).

Participation in the skills competition and training had even sparked some of the WSC achievers' interest in teaching in vocational institutions or coaching in skills competitions.

Overall, the significance of workplace learning was underlined by all groups of interviewees. Both the WSC achievers and their co-workers believed that an authentic work environment enables a student or novice employee to explore actual work tasks, to learn by doing and to become familiar with the hectic schedules of working life. One of the WSC achievers acknowledged that the WSC and training provides one with the opportunity to devote more time to learning, which one seldom has in the workplace. Those employers who described workplaces as “the main learning environment” felt that formal VET only provides a student with certain basic skills to use in the beginning of their career, based on the assumption that the rest of their knowledge and skills will be acquired on-the-job.

... there should be more work, more hours of work. We did not have that much client work. It would be important to have holistic work tasks, to have a specific time frame in which to manage the whole task, more orientation towards authentic work (WSC achiever).

Some of the WSC achievers, co-workers and employers also expressed their discontent with formal vocational education. The criticism was concerning the outdated knowledge (lack of recent work experience and further education) of teachers, obsolete technology and devices as well as weak or theoretically oriented curriculum. However, some of

the statements were targeted at certain institutions rather than VET in general. Finally, most of the criticisms of formal vocational education hailed from the employer-interviewees. The employers were especially worried about the lack of commercial expertise (business skills) that was considered important or crucial in any vocational field.

5 Conclusions

This study examined the perceptions of former WSC medal and diploma winners, their co-workers and employers regarding vocational expertise and experiences of school-to-work pathways. The specific focus of our investigation was to better understand the WSC achievers' perspectives on the influence of vocational skills competitions on their subsequent professional growth processes and career development. The findings showed that the WSC achievers and their co-workers and employers shared a common view of vocational expertise included with both natural abilities and self-regulatory skills. Vocation-specific skills, sensorimotor skills (manual skills) and logical-mathematical skills (contextual knowledge) were seen as the foundation for performing well in a vocational field. All groups emphasized the importance of interpersonal skills; possessing good social skills was even seen as a way to compensate for weakness in some other areas. Self-regulatory skills, volition, motivation and self-reflection, were acknowledged as characteristics that are vital to one's vocational expertise and vocational development. WSC achievers differed from their co-workers by placing a strong emphasis on the importance of logical-mathematical skills (understanding overall work processes, creative thinking and quick and independent problem-solving skills). By contrast, their co-workers dominated in discussions related to the significance of internal motivation.

The results showed some differences between the WSC achievers' and their co-workers' experiences in their school-to-work vocational pathways. Similar factors influenced both the WSC achievers' and their co-workers' choice of career, whether it reflected their personal interest in the vocational field or was based on the recommendation of family members or friends. In a few cases, the decision was based on previous work experience, academic success or the available study opportunities. During their studies, the co-workers' vocational pathways diverged in the sense that most of the WSC achievers, but only a few of the co-workers described their academic success as better than average. Success in their studies was related to strong self-regulatory characteristics, such as internal motivation towards the vocational field and volition (a conscientious and hard-working attitude), coupled with engaging in deliberate practice (individual active studying and advanced studying skills). The significance of workplace learning was underlined more often than formal VET by all the groups of interviewees. Most of the WSC achievers acknowledged the importance of both formal education and WSC to their development of vocational excellence. However, the advantages provided by the WSC and training were also particularly related to crossing the boundaries between student life and working life, thereby providing the student with an opportunity to create extensive professional networks and strengthen their vocational confidence in order to make the school-to-work transition easier and more efficient.

6 Limitations

This study describes the self-reported statements of the three different groups of interviewees with the aim of revealing some interesting findings regarding general factors related to vocational development. To draw further comparative conclusions between the target groups, however, the differences in the participants' backgrounds (e.g., vocational field, vocational school and current employer) create some limitations. Further research focusing on only one specific vocational field might yield more extensive information about vocation-specific career stages and turning points. Furthermore, one of the main factors that determine the success of content analysis and the trustworthiness of the study is a coding process (e.g., Hsieh & Shannon, 2005; Krippendorff, 2013; Schreier, 2014). Authentic citations have provided examples of meaningful pieces of the text behind the inferences and categorizations and empirical material, as qualitative researchers tend to acknowledge the possibility of multiple interpretations of textual units (Krippendorff, 2013; Patton, 1990). An empirically validated analytical framework served as the basis for the categories. As one of the most critical phases of the content analysis is the requirement of mutual exhaustiveness and exclusiveness (e.g., Schreier, 2013), all relevant aspects of the transcript were intended to cover a category, and any unit of analysis was to be coded only once under one main category to ensure coding consistency.

7 Discussion

In this paper, we have discussed the role of natural abilities and intrinsic characteristics (self-regulatory skills) in the development of vocational expertise and excellence. The vocational skills itemized by the interviewees of this study support previous research underlining the significance of both natural abilities (intellectual, creative, socio-affective and sensorimotor) and self-regulatory skills (Nokelainen, 2010; Nokelainen et al., 2012; Pylväs, Nokelainen, & Roisko, 2015) in vocational achievement. According to Gardner and Moran (2006), multiple intelligences can be related to occupational roles; however, in work contexts, the power of an multiple intelligences (MI) theory can be even greater through an examination of the ways the intelligences interact in individuals or within teams. A variety of potential combinations create different patterns to allow for a wider array of competences and performances to arise as one intelligence can mediate and constrain, compensate or catalyze another. According to the Gardner's and Moran's (2006) approach on interacting intelligences, in this study the WSC achievers underlined the importance of logical-mathematical skills intertwined with creativity. On the other hand, interpersonal skills were considered to compensate for the lack of some other vocational skills. Thus, the findings support the idea that what matters is not only how intelligent a person is, but how varying levels of different intelligences interact within a particular situation or job (Gardner & Moran, 2006). Further research is needed to better understand the crucial combinations of skills and intelligences needed in changing working life and to go beyond the traditional subject teaching in VET. The same complexity applies to developing vocational expertise in social contexts with multiple people, whether the focus

of learning is on cognitive, motivational or emotional processes. Collaborative working requires regulative learning skills to co-construct shared task representations, shared goals and shared strategies (Järvelä & Hadwin, 2013). In working life, the amount of information processing required is usually more than one person can even handle, thereby invalidating the notion of a single, all-purpose intelligence of a single individual (Gardner & Moran, 2006). In addition to intertwined intelligences, the understanding of shared expertise should also be involved in the pedagogical planning of study assignments to provide opportunities for VET students to develop a sufficient foundation for lifelong learning.

The findings support Bloom's (1985) view on the home environment providing the structure necessary for early learning (e.g., work ethics, motivation and engagement in the domain). Further, in order to control their learning processes independently during their studies and later in their working lives, students were considered to need opportunities to develop strong self-regulatory skills. Following Ericsson's et al. (1993) approach, the empirical results of this study emphasised the importance of deliberate practice to talent (or vocational) development and its connection to such factors as engagement and motivation. Some components of the WSC and training are certainly creating advantageous patterns that ought to be developed further and exploited in VET in general. The time that motivated experts gave to the WSC achievers to practise their vocational skills in authentic environments was perceived as having a positive influence on their motivation in the vocational field, development of vocational excellence, school-to-work transition, and self-confidence. The study of Wilde and James Rely (2015) also found a parallel result; the success of UK participants in the WSC is due to the intense effort, commitment and teaching and learning of the training managers and competitors. This study suggests focusing greater attention on VET students' development of learning skills and self-regulatory skills during vocational education. There is need to provide students with the possibility of strengthening those skills within the sphere of vocational education through the help of teachers but to recognize potential advantages of collaboration with experts from working life.

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Finnish Apprenticeship Training Stakeholders' Perceptions of Vocational Expertise and Experiences of Workplace Learning and Guidance

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Abstract This study examines Finnish apprenticeship training stakeholders' perceptions of vocational expertise and experiences of workplace learning and guidance. The semi-structured interview data was collected in 2015 in two vocational fields: the social and health care services sector (five workplaces) and the technology sector (five workplaces). The sample ($N = 40$) consisted of apprentices ($n = 10$), their co-workers ($n = 10$), workplace trainers ($n = 10$) and employers ($n = 10$). The study applies the classifications of natural abilities and self-regulation to identify the most important individual characteristics related to vocational expertise. The socio-cultural approach to workplace learning and guidance illustrate that vocational expertise also develops from external support through participation and guidance in everyday interactions in the contexts of education and work. The data was analysed using qualitative content analysis. The findings indicate that individuals with fluent cognitive skills (e.g., problem solving skills) combined to advanced social skills, self-awareness and self-regulation are perceived as vocational experts. The apprenticeship training was considered to draw upon an extensive learning environment to facilitate an apprentice's vocational development by offering access to authentic work tasks and collective support by experienced workers. Yet, the lack of time, resources and pedagogical

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approaches were found to hinder individual guidance and reciprocal workplace learning between apprentices and experienced workers. The workplaces were shown to provide fruitful learning possibilities for those apprentices with strong self-regulatory skills.

Keywords Apprenticeship training · Vocational expertise · Workplace learning · Guidance · Self-regulation

Introduction

Interest in workplace learning has grown in recent decades due to the changing character of work and recognition of the workplace as a learning environment (e.g., Fuller and Unwin 2004; Illeris 2003). Compared to formal learning, however, the features of workplace learning have been less intensively studied (Virtanen et al. 2009). Tynjälä's (2013) integrative pedagogics approach emphasises that incorporating work-based learning in education requires the development of pedagogical models that consider the situated nature of learning but also generic knowledge on the development of expertise. Also according to Guile and Griffiths (2001; Griffiths and Guile 2003), learners need to develop the capacity to participate in workplace activities and cultures but they also need to learn how to draw upon their formal learning and use it to interrogate workplace practices: to mediate between different forms of expertise and the demands of different contexts. This study continues the current research on workplace learning by focusing on the development of vocational expertise in the context of apprenticeship training. The study serves to deepen our understanding of the working life perspective on those generic vocational knowledge and skills that are acknowledged as the most important part of one's vocational expertise and the potentials for developing those skills in the contexts of education and work. The paper discusses both individual aspects of vocational expertise and the role of environmental conditions in the development of expertise.

The study examines apprenticeship training stakeholders' perceptions of vocational expertise and experiences of workplace learning and guidance in the context of Finnish vocational education and training (VET). The sample ($N = 40$) includes interviewees from the social and health care services sector (five workplaces) and the technology sector (five workplaces): apprentices ($n = 10$), their co-workers ($n = 10$), workplace trainers ($n = 10$) and employers ($n = 10$). Firstly, the aim is to identify the participants' perceptions of the most important individual characteristics related to vocational expertise. To study vocational expertise, we apply the classification of natural abilities (multiple intelligence [MI] theory, Gardner 1983, 1993, 1999) and the approach to self-regulation (e.g., Zimmerman 1989, 1998, 2000). Moreover, the aim of the study is to describe the working life stakeholders' experiences workplace learning and guidance and to recognize environmental factors supporting and hindering apprentices' development of expertise. A socio-cultural approach to workplace learning is applied in the study by focusing on the framework of participation (Lave and Wenger 1991), connectivity (Griffiths and Guile 2003; Guile and Griffiths 2001) and guidance (Billett 2001, 2002, 2014; Filliettaz 2011).

The European Commission (2013) aims to strengthen work-based learning in VET to meet the goals of improving individual employability and increasing economic competitiveness. Reflecting global trends, the current reform of vocational upper secondary education in Finland, which will enter into force in 2018, aims at greater

flexibility in the provision of workplace training and completion of qualifications in a more hands-on manner (Prime Minister's Office 2016). However, as long as apprenticeship training follows the vocational education and training (VET) curricula defined by national qualification requirements, education providers' locally approved curricula and students' personal study plans (Cedefop ReferNet Finland 2011), education providers still remain the so-called competent bodies when it comes to curriculum-based vocational qualifications (Stenström and Virolainen 2014). On the other hand, trainers' and workplace instructors' activities are largely dependent on themselves, their employers and what training is on offer (Cedefop ReferNet Finland 2011) and learners are expected to contribute to production at the worksite while also being educated (Fjellström and Kristmansson 2016). To cross the boundaries of educational structures and enhance the dialogue between formal education and working life, there is need to acquire more information of working life perspectives on vocational development. The practical contribution of the present study is that to widen our understanding of the perceptions and experiences shared in common by several working life stakeholders associated with Finnish work-based apprenticeship training.

In this study, we investigate the following questions in the Finnish context of apprenticeship training: 1) How is vocational expertise perceived in apprenticeship training? 2) How is workplace learning experienced in apprenticeship training? 3) What factors support and hinder guidance in apprenticeship training?

Theoretical Framework

Vocational Expertise

Recent theories of vocational expertise acknowledge the importance of integrating theoretical, practical and self-regulatory knowledge in the development of professional expertise and vocational competence (e.g., Bereiter 2002; Eraut 2004; Tynjälä 2013). In this study, vocational expertise is identified based on the original seven-dimension version of Gardner's (1983, 1993, 1999) MI theory. According to the theory, expertise consists of 1) linguistic; 2) logical-mathematical; 3) musical; 4) spatial; 5) bodily-kinaesthetic; 6) interpersonal; and 7) intrapersonal forms of intelligence. According to Martin (2001), in the workplace learning context, *linguistic intelligence* refers to an ability to read and produce professional documents and to communicate actively and adaptively with colleagues and clients. *Logical-mathematical intelligence* is related to technical awareness and an understanding of hardware and software and objective and logical assessments of problems related to people or products. *Musical intelligence* is related to attendance to auditory cues, such as the tone, volume and sequence of people, machines or environments. *Spatial intelligence* involves the use of visual elements not only in work tasks and product or service development, but also in other concrete applications related to workplace productivity or marketing. *Bodily-kinaesthetic intelligence* relates to the motor skills needed to carry out various work tasks, such as an ability to use tools or other equipment efficiently. *Interpersonal intelligence* is vital in everyday interactions with colleagues and clients, for example, to lead and work within teams and to give constructive feedback. *Intrapersonal intelligence* refers to a person's self-awareness of one's own feelings, goals, ethics and abilities in changing situations at work.

A self-regulated learning perspective has shifted the focus of educational analysis to students' personally initiated strategies designed to improve learning outcomes and environments (Zimmerman, and Schunk, D. H. (Eds.). 2001). The term 'self-regulation' refers to the process in which self-generated thoughts, feelings and actions are planned and systematically adapted to further one's learning and motivation (Schunk and Ertmer 2000; Zimmerman 2000). Further, self-regulated learning is not limited to academic contexts, but can occur wherever learning—whether formal or informal—takes place (Kaplan 2008). Self-regulatory skills allow learners to modify their performance based on personal characteristics and environmental conditions (Zimmerman 2000). Research has shown that successful learners can monitor and regulate the following triadic elements: volition, motivation and self-reflection (e.g., Kitsantas and Zimmerman 2002; Zimmerman 1989, 1998; Zimmerman and Kitsantas 2005). *Motivational* processes help the learner to formulate decisions and to promote decision-making, whereas volitional processes guide one's subsequent implementation of the decision (Corno 1989). Intrinsic motivation refers to the innate propensity to engage one's interests and exercise one's capacities, and further, to seek and conquer optimal challenges whereas extrinsic motivation hails from the aid of extrinsic rewards or environmental controls (Deci and Ryan 1985). *Volition* includes persistence, the will to learn, endeavour/effort, mindfulness in learning, intrinsic regulation, and evaluation processes (Zimmerman 2006). The processes of *self-reflection* enable individuals to evaluate their experiences and thought processes (Bandura 1986). An increase in the sense of control strengthens one's tolerance of stress and commitment to the task and helps the learner to identify the best learning strategies in a given situation (Zimmerman 1998; Zimmerman and Kitsantas 1997). Earlier research has shown that apprentices are largely responsible for their own learning and must often initiate activities to develop their skills independently (Gurtner et al. 2011; Reegård 2015; Savoie-Zajc and Dolbec 2003; Smith 2000; Tanggaard 2005). Such situations often push learners to develop their self-regulatory skills (Reegård 2015; Virtanen and Tynjälä 2008; Virtanen et al. 2014) and strengthen their social skills (Evanciew and Rojewski 1999; Savoie-Zajc and Dolbec 2003). However, the work community may also view excessive requests for guidance, or being a slow learner, as tiresome behaviour, which may also lead to the discontinuation of the apprentice's training in the workplace (Gurtner et al. 2011; Nielsen 2008).

Workplace Learning

In socio-cultural theories of workplace training, learning is becoming a process located in the framework of participation rather than within the learner, even if it does not replace notions of individual learning (Hager 2013). Lave and Wenger (1991) have proposed that learning happens in everyday interactions and through participation in communities of practice. Learning is happening as part of a process in which learners move from peripheral participants to full members of the communities of practice. The increase in responsibility should take place gradually with apprentices being given more responsibility and more demanding tasks commensurate with their skills development (Evanciew and Rojewski 1999; Filliettaz 2011; Gurtner et al. 2011; Nielsen 2008; Smith 2000). Preparation and continuous learning arises through active and interdependent engagement by apprentices in their work (Billett 2016), whereas the affordances for learning are dependent on access to guidance during workplace

activities (Fjellström and Kristmansson 2016). The contribution of individual assistance and support by more experienced co-workers seem to provide a significant basis for learning at work (Billett 2001; Virtanen et al. 2014). Without a theoretical basis and guidance from experts, student learning at work may remain unsystematic and incidental (Collin and Tynjälä 2003; Virtanen and Tynjälä 2008). Pedagogical skills influence the ways in which experienced workers are able to share their knowledge and provide opportunities for apprentices to participate in productive tasks at work (Filliettaz 2011). Billett (2000, 274) elaborates on guided learning as “an activity in which more experienced workers use techniques and strategies to guide and monitor the development of the knowledge of the less skilled workers and to encourage them to engage in knowledge construction processes”.

Learners are usually assigned a designated workplace trainer, along with other colleagues, experts and workplace managers who interact with them while they engage in their work tasks. However, workplace guidance is often seen from a collective perspective, as the nominated trainers are not the only ones providing learners with guidance. (Chan 2014; Collin and Valleala 2005; Corney and du Plessis 2010; Evanciew and Rojewski 1999; Gurtner et al. 2011; Onnismaa 2008; Reegård 2015; Smith 2000; Tanggaard 2005.) According to Filliettaz (2011), having analysed the collective and distributed nature of guidance in the context of apprenticeship training, the range of guidance providers goes far beyond official trainers and supervisors to comprise a wide scope of workmates who may share their work environment with apprentices on a regular basis or occasionally. Sharing knowledge and skills among colleagues, regardless of age and status, is essential to the development of expertise (Fuller and Unwin 2004; Onnismaa 2008). Reciprocal relationships between all members of work communities help to build mutual trust and respect (Fuller and Unwin 2004; Nielsen 2008; Onnismaa 2008). A sense of equality and community at work are important factors in learning a profession (Collin and Valleala 2005; Fuller and Unwin 2004). Collective guidance may afford rich opportunities for learning but it may also lead to confusion when discrepancies emerge between experts or when important dimensions of the tasks remain implicit (Filliettaz 2011). Moreover, the concept of connectivity (Griffiths and Guile 2003; Guile and Griffiths 2001) illustrates the relationship between theoretical and everyday knowledge and different demands arising in the contexts of education and work. Learners need to participate in workplace activities and cultures but they also need to learn how to draw upon their formal learning and use it to interrogate workplace practices. In addition to bringing accumulated *vertical* knowledge and skill to bear on new situations, learners need to develop the capacity to mediate between different forms of expertise and the demands of different contexts (also between workplaces), which involves the process of *horizontal* development.

Figure 1 illustrates the main stakeholders involved in the Finnish apprenticeship training and their operational environment regarding the discussed approaches of workplace learning. The components of the figure are not exclusionary; rather, they interact and overlap with each other. The two inner circles (grey area) describe an apprentice's vocational expertise and they are based on the recent theories of vocational expertise integrating theoretical, practical and self-regulatory knowledge (e.g., Bereiter 2002; Eraut 2004; Tynjälä 2013). *Theoretical and practical knowledge* (natural abilities, e.g., Gardner 1983, 1993, 1999) can be developed by *self-regulative knowledge* (motivation, volition and self-reflection, e.g., Kitsantas and Zimmerman 2002;

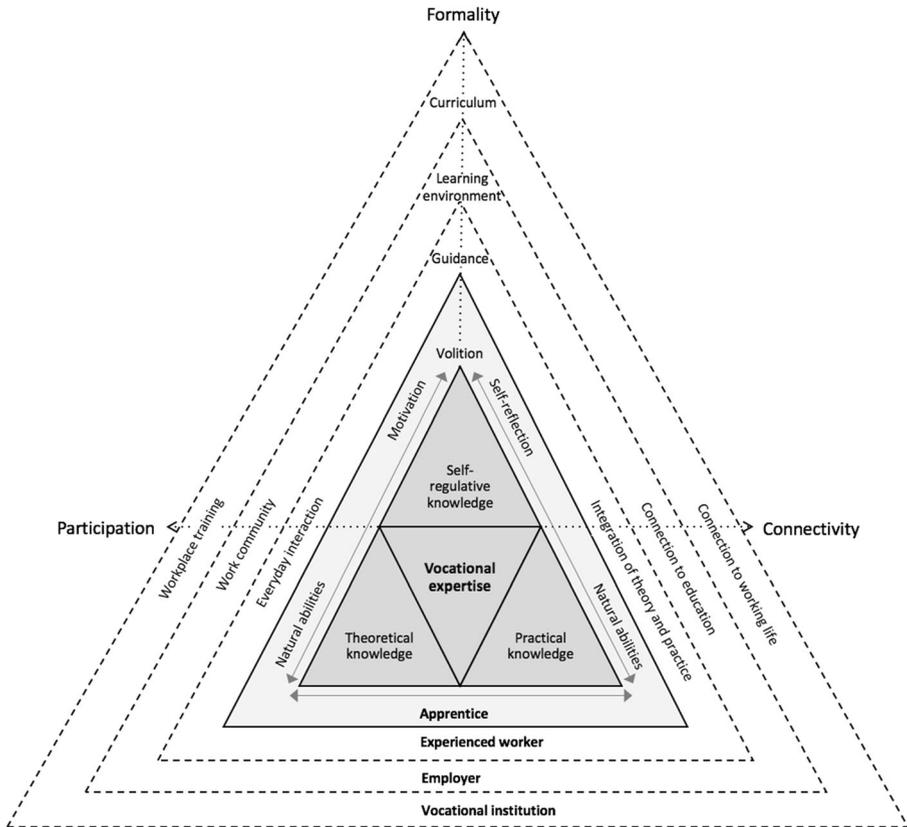


Fig. 1 Development of vocational expertise in apprenticeship training

Zimmerman 1989, 1998; Zimmerman and Kitsantas 2005). The three outermost circles are based on the socio-cultural approach to workplace learning (e.g., Lave and Wenger 1991; Griffiths and Guile 2003; Guile and Griffiths 2001) and guidance (e.g., Billett 2001, 2002, 2014; Fillietaz 2011) and they illustrate that vocational expertise also develops from external support through participation and guidance in everyday interactions in the contexts of education and work.

In the context of apprenticeship training, the external stakeholders can be at least included with *an experienced worker*, *employer* and *vocational institution*. *Participation* represents an apprentice's operational environment: the vocational institution enables and organizes workplace training, an employer influence on the chosen work community, and an experienced worker has an impact on an apprentice's level of everyday interaction in the work community. *Formality* represents the systematic and pedagogic approach to workplace learning: the vocational institution is responsible for introducing to the workplace the curriculum to follow during the training process, an employer has an influence on learning environment (e.g., work tasks, resources) and an experienced worker is in the role of providing guidance in everyday work. *Connectivity* refers to the knowledge and dialogue between education and work: the vocational institution has an influence on creating and supporting connections to working life, vice versa, the employers influence

on their connections to the vocational institution. An experienced worker has an impact on the process of integration of theory and practice in everyday work.

Methods

Participants

The research data is based on the Finnish apprenticeship training stakeholders' self-reported experiences and perceptions of vocational expertise, workplace learning and guidance. In Finland, apprenticeship training is based on a fixed-term employment contract and approximately 70 to 80% of training takes place in the workplace. Fixed-term employment contract ensures a salary based on collective agreements. Workplace learning is complemented by theoretical studies organised by vocational institution. The education provider (educational institution or apprenticeship office) signs a contractual agreement with the employer on the educational programme, ensures that the qualification requirements are attainable, and that the workplace has sufficient personnel with vocational skills, education and work experience to nominate a responsible trainer or instructor for each student (Act [787/2014] amending the Act on Vocational Education [630/1998]).

The interview sample ($N = 40$) consisted of 10 (5 female, 5 male) apprentice interviewees, 10 (4 female, 6 male) co-worker interviewees, 10 (4 female, 6 male) workplace trainer interviewees, and 10 (4 female, 6 male) employer interviewees (see Table 1). The data was collected at 10 workplaces in 2015. The researchers made the selection of the workplaces and apprentices by using a student register that contains information on Finnish apprentices and apprenticeship training organisers. To take into account the variation between vocational fields, work environments (e.g., job description) and

Table 1 Overview of the sample

Finnish apprenticeship training stakeholders (N = 40)

	Apprentice	Co-worker	Workplace trainer	Employer
<i>Social and health care services sector: workplaces (n = 5), participants (n = 20)</i>				
Age $M (SD)$	33.0 (7.7)	39.6 (12.1)	46.4 (10.1)	54.6 (6.5)
Male $n (%)$	1 (20.0)	1 (20.0)	2 (40.0)	1 (20.0)
Female $n (%)$	4 (80.0)	4 (80.0)	3 (60.0)	4 (80.0)
Work experience in current job $M (SD)$	1.9 (2.4)	5.5 (3.6)	8.2 (7.4)	12.2 (8.2)
Work experience total $M (SD)$	7.9 (2.5)	11.9 (5.7)	20.4 (6.4)	33.0 (7.0)
Workplace trainer experience $M (SD)$			7.1 (7.4)	
<i>Technology sector: workplaces (n = 5), participants (n = 20)</i>				
Age $M (SD)$	24.8 (3.3)	43.0 (10.6)	40.6 (11.5)	56.0 (6.5)
Male $n (%)$	4 (80.0)	5 (100.0)	4 (80.0)	5 (100.0)
Female $n (%)$	1 (20.0)	0 (0.0)	1 (20.0)	0 (0.0)
Work experience in current job $M (SD)$	2.5 (1.8)	13.4 (10.9)	14.2 (9.0)	14.4 (11.0)
Work experience total $M (SD)$	5.9 (2.9)	25.8 (8.4)	21.4 (14.0)	36.6 (10.3)
Workplace trainer experience $M (SD)$			3.4 (2.2)	

employees (e.g., socio-demographic information), the data was chosen to include interviewees from the social and health care services sector and the technology sector (construction, metalwork and machinery). In particular, the sampling criteria was applied to maximize variety in gender of participants. The average age of the participants, social and health care services sector $M = 33.0$ ($SD 7.7$) and technology sector $M = 24.8$ ($SD 3.3$), makes the sample representative with respect of Finnish context. In 2014, 80% of apprentices were over 25 years old (Ministry of Education and Culture & Finnish National Board of Education, 2014). The interviewed co-workers were chosen by the employer interviewees: the selection criteria was that the chosen employee has been working with the apprentice involved in this study. Based on the European Union's (2015) definition of small and medium-sized enterprises (SMEs) and staff headcount, the target organizations represented small enterprises (which employ fewer than 50 persons) and medium-sized enterprises (which employ fewer than 250 persons) that corresponds to the sizes of the Finnish enterprises involved in apprenticeship training. As for the two chosen fields of vocations, the saturation point was reached after conducting the interviews ($N = 40$). The sampling was followed by the data analyses.

Instrument

Semi-structured interviews served as the research method. The format offers the possibility of following up on any angles deemed important by the interviewee, while also enabling the interviewer to focus the conversation on issues that are considered important to the research (Brinkmann 2014). The conversations themes (e.g., vocational expertise, guidance, work community) were included with such questions, as “*How would you characterize an employee who succeeds well in your vocation? What kind of knowledge or skills is required?*” or “*How have you been taught new things at workplace?*”. The interviews lasted from 20 to 60 min. The co-workers were asked a few questions less than the other interviewees (e.g., experiences and responsibilities regarding the training and qualification) as they were not in a responsible position with relation to apprenticeship training. Thus, the shortest interviews lasting from 20 to 30 min were conducted with the co-workers. The semi-structured interviews were transcribed into text data and managed (e.g., organizing data sources, managing coding) by using NVivo software.

Analysis

The epistemological perspective of reality and meanings is based on the notion that individuals hold knowledge and meanings in their minds but they are derived from social interactions and constantly negotiated. (Gergen 1996.) All of our understandings and knowledge are socially constructed and we create our own reality through social interactions, relationships, and experiences (Berger and Luckmann 1966; Gergen 1996). The data was analysed by applying qualitative content analysis, which can be defined as a research method used for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns (Hsieh and Shannon 2005). The aim of the analyses was to create conceptually and empirically grounded categories related to the analytical context and rooted in empirical material to reflect the topic of the study (e.g., Dey 1993).

The unit of analysis selected for coding was a meaningful piece of text in the interview transcript, such as a word, sentence or short narrative (Krippendorff 2012; Schreier 2014). Thematic (data-driven) criteria (themes emerging from the data) served to divide the text material into units (see Schreier 2014). For instance, the units of analyses concerning guidance were categorized based on whether they were related to *practical methods* vs. *broad perspective of guidance*, *the role of workplace trainer* vs. *the work community*, *training programme and qualification ensuring* vs. *work supervision and quality standard ensuring*. The categories related to vocational expertise, however, were built by following the directed (theory-driven) analysis approach based on the existing theory (Hsieh and Shannon 2005; Schreier 2014) of the MI theory by Gardner (1983, 1993, 1999) and the approach to self-regulation (e.g., Kitsantas and Zimmerman 2002; Zimmerman 1989, 1998; Zimmerman and Kitsantas 2005). Unit of analysis in the interview transcript (e.g., "The most important thing is, of course, that you want to develop. That's how you achieve the outcome, and how you develop the best and most effectively.") was assigned a code relating to a theoretical concept (e.g., *internal motivation*). The coding units consisted of both main categories and subcategories. One of the most critical phases of the content analysis is the requirement of mutual exhaustiveness and exclusiveness (e.g., Schreier 2014). Hence, all relevant aspects of the transcript were intended to cover a category but coded only once under one main category to ensure coding consistency.

The variation occurring between the two vocational fields, workplaces (e.g., job description) and employees (e.g., socio-demographic information) were acknowledged in the data-selection criteria. However, instead of conducting a comparative analysis between the chosen field of vocations, the aim of the study was rather to ensure the representativeness of the data in order to identify non-occupational factors related to the topic of the research. Moreover, the four demographic group of stakeholders (apprentices, co-workers, workplace trainers and employers) were included the research data to develop a comprehensive understanding of perceptions related to vocational expertise, workplace learning and guidance in the context of apprenticeship training. However, drawing in-depth conclusions of differences between the four groups of interviewees was not the focus of this paper.

Results

How is Vocational Expertise Perceived in Apprenticeship Training?

The overview of the four apprenticeship training stakeholders' understanding of vocational expertise shows that certain vocational characteristics were considered more applicable than the others. The findings indicated that, in particular, cognitive skills (interrelated with both theoretical and practical skills) and self-regulatory skills were perceived as important elements of vocational expertise. In addition, the significance of interpersonal and intrapersonal skills were acknowledged by the interviewees.

The importance of *logical-mathematical skills* was acknowledged within vocation-specific knowledge and situated in vocational contexts (e.g., empirical and theoretical knowledge and skills, legislation and security information). Moreover, logical-mathematical skills were also discussed within more generic knowledge and skills, e.g., mathematical skills (especially in the technology sector), problem solving skills,

technological skills and information processing. In addition to cognitive skills, several aspects related to *interpersonal skills* emerged from the data, such as social and communication skills, teamwork skills and openness (ability to meet new people) as well as care and empathy (respect for people, listening and presence). Interpersonal skills were emphasized by the interviewees from the field of social and health care services but also acknowledged in the technology sector. *Intrapersonal skills* were acknowledged in the field of social and health care services. Employees were considered to deal with multiple situations and get feedback from customers and colleagues which requires questioning and self-awareness abilities.

“...*You probably need to have the power of reasoning and then problem solving skills.*” (apprentice, technology sector)

“*First of all, you need to have good communication skills. And I don't mean that everybody needs to be talkative and extroverts but you need to be able to communicate with all people, also with your co-workers and clients.*” (workplace trainer, social and health care services sector)

There were also a few specific mentions of some other intelligences needed at work, such as *linguistic skills* (language skills) and *musical skills* (musicianship). *Sensorimotor skills* were discussed by some of the interviewees working in the technology sector as work was considered to require sufficient muscular strength, physical condition and manual dexterity. Instead, work ergonomics was seen as harmful to health by some of the interviewees.

Self-regulatory skills were considered as a vital part of one's vocational expertise. *Internal motivation* and *volition* were acknowledged as the most important self-regulatory vocational skills all stakeholders and both vocational fields. Internal motivation was related to the interest in the field of vocation, willingness to learn and interest in the development of expertise, as well as initiative and positive attitude. The level of self-regulation, motivation in particular, was also shown to shape apprentices' extrinsic conditions (e.g., resources, guidance, learning tasks) during the training. According to the employers, the main reasons for recruiting the apprentices interviewed related to being pleased with their motivation, attitude and work performance. Moreover, according to the interviewees guidance and learning in the workplace was considered to be conditional on an apprentice's motivation and initiative. To get the required support to develop their vocational expertise, apprentices were expected to not only be motivated, self-directed and responsible employees, but also brave enough to ask for help and guidance.

“*Active and initiative. Those come to my mind. Of course, the most important thing is that you want to develop. That's how you achieve results, and how you develop the best and the most effectively.*” (apprentice, technology sector)

“*It is a lot to do with yourself. Sometimes we have those apprentices who are forced to do things. They don't really manage in here.*” (co-worker, technology sector)

Volition was not discussed as often, however, the apprentices in the both vocational fields did acknowledge the importance of volition. Volitional expertise was included in exactness and carefulness, calmness, concentration and organizational skills. Also *self-reflection* was acknowledged but not as underlined as motivation. Self-reflection is congruent with intrapersonal skills and related to the interviewees' descriptions of one's understanding and reflecting on one's own skills, capacities and feelings.

"...probably organizational skills so that you can determine what to do first and schedule your work, what to do and in which order. At least there is lot of that when working with the disabled." (apprentice, social and health care services sector)

The emphasis on the specified vocational expertise were rather on generic than occupation-specific knowledge and skills. The development of logical-mathematical skills, interpersonal skills, intrapersonal skills as well as self-regulative skills were shown to be valid in the both vocational fields. The differences between the two vocational fields were marginal and rather to be seen in the variation within the natural abilities. For instance, social interactions with clients or customers emphasizing the need for interpersonal skills were contextualised differently between the social and health care services sector and technology. Instead, logical-mathematical skills were included with different kind of information processing (e.g., technology, legislation) depending on vocational context. The congruent self-regulative skills on the other hand were highly appreciated in the both vocational fields. Overall, to some extent verbalizing and specifying vocational expertise occurred to be challenging for the interviewees.

How is Workplace Learning Experienced in Apprenticeship Training?

Workplaces were widely acknowledged as learning environments by the apprenticeship training stakeholders. Apprenticeship training as a model of education had also an influence on the apprentices' career choices. Work-based learning was considered to afford them the possibility of 'learning by doing' to connect theory and practice, whereas apprenticeship training was seen as a practical way of training while working. In particular, the interviewees from the social and health care services sector discussed their family-based reasons for choosing apprenticeship training, and its financial benefits. Furthermore, some of the apprentices discussed their preferences for the study methods of apprenticeship training. The co-workers, workplace trainers and employers who were asked for their views on apprenticeship training largely agreed with the apprentices with regard to the benefits of workplace learning. Learning by doing combined with vocational studies was considered the best way of learning a profession. Becoming involved with the work processes in authentic and diverse environments was another of the perceived benefits of workplace learning.

"Well construction trade is exactly the kind of [vocation] that you only learn by doing; [when participating] in apprenticeship training, you work with an older craftsman and you learn theoretical studies in support of vocational institution so the best possible way to be educated in the field of construction work is apprenticeship training." (employer, technology sector)

“...I think that in this field of work it is mostly about how you work with people. And that’s something that none of the schools can teach.” (workplace trainer, social and health care sector)

The interviewees’ experiences of learning through work were situated within authentic everyday activities and social interactions with experienced employees. The findings indicated, however, that employers, workplace trainers and co-workers often regarded apprentices as competent and productive employees even during their training. Particularly in the field of social and health care, apprentices were described as equal workers and members of the work community, enjoying direct access to productive work requiring co-operation with multiple actors.

“She is definitely a member of the work team, she is a full member.” (employer, social and health care sector)

The employers especially gave an optimistic impression of the apprentice’s position in the organization as a full member of the community who represented a (growing) employee rather than a student. Apprentices mostly also considered themselves to be equal employees and full participants within the work community. Only two apprentices in the technology sector saw themselves as trainees in relation to the work community and the industry. Being an equal employee in the workplace meant shouldering a lot of responsibility, autonomy and independence. Accordingly, the high expectations of employees also resulted in a lack of support, guidance and instruction given to apprentices. Some of the workplace trainers expressed their concerns regarding trusting apprentices with too much responsibility. In addition, some apprentices in social and health care retrospectively stated that more guidance would have been welcome, especially at the beginning of their apprenticeship training. In the technology sector, however, apprenticeship training was also seen as a model for learning, where masters pass their knowledge and skills on to novices. Thus, apprentices were considered newcomers who were on a lower level in the hierarchy and needed to learn and earn a higher position through their participation in simple, low-risk tasks.

“I don’t really see him as a student, maybe I am representing the generation that apprenticeship training is like a master training and he is here to learn through work so I don’t see him as a student but rather as a developing expert.” (employer, technology sector)

The benefit of workplace learning was rooted in opportunities to engage apprentices within the target organization. In particular, the employers interviewed attributed the possibility of attracting new employees to the organization through apprenticeship training. From the perspective of the apprentices, the benefit of workplace learning was also rooted in the opportunities it offered to engage in authentic and diverse work practices within the target organization.

“When we can train from the very beginning, these people will become more like us, so that their old work experiences in other firms in this vocational field won't be a hindrance.” (employer, technology sector)

Educational aspect of workplace learning was not emphasized by the apprenticeship stakeholders. As for the outcomes of workplace learning, the emphasis was on the individual acquisition of knowledge rather than reciprocal learning through the sharing of knowledge and skills. Moreover, it rather aimed at developing the skill of managing organization-specific practices than generic vocational knowledge and skills.

“I don't know if they really bring any new expertise to the workplace. I think the flow of know-how is more from us to the apprentices, rather than them bringing us something new.” (workplace trainer, technology sector)

Even if vocational studies were considered useful for apprentices, they were not acknowledged as profitable relative to their effects on the organization or the vocational development of other employees. The role of vocational knowledge gained during the theoretical studies was considered minor or even diminished in everyday practice. Only some of the workplace trainers and co-workers felt that their discussions with apprentices had enhanced their self-reflection or brought their vocational expertise up-to-date.

What Factors Support and Hinder Guidance in Apprenticeship Training?

The findings indicated that the colleagues who comprise the apprentice's immediate social environment share the responsibility of apprentice individual assistance. Collective guidance in the work communities was justified because of the different levels and domains of experienced workers but also because of the changing duty rosters. The employers acknowledged their own role as organizers of operational environment, that is recruitment, communication between vocational institution, employment practicalities and general supervision of work during the apprenticeship training period. Vocational institution was considered to provide another operational environment for the apprentices, but the membership was rather seen peripheral. Moreover, some interviewees from the field of social and health care services also acknowledged the influence of peer support on learning.

Guidance within the work communities was based on the standard introduction to work practices, task-related supervision and asking questions by the apprentices. The apprentices were encouraged to participate and to seek guidance when needed, which emphasized the importance of the apprentices' own strategies and abilities to take the control over learning. Experienced workers reported of having used the techniques and strategies to guide and monitor apprentices, but more strongly underlined the importance of providing opportunities for apprentices to observe and listen to other employees. Some distributions of interactive guidance, such as modelling and questioning, could also be recognized in the workplaces.

“I have often said, when I have had an apprentice as a work partner, that you need to observe what I am doing for a couple of days. Don’t do anything, just observe [...] then you will start doing. Then you will know how, and you need to ask me if I don’t remember to tell you what I am doing.” (workplace trainer, social and health care sector)

The apprentices themselves were rather satisfied with the guidance they had received in their workplaces. However, from the perspective of working life stakeholders one of the biggest factors hindering guidance and support in the workplace seemed to be the lack of time and resources. Whether the time used to give guidance was considered sufficient or insufficient, many of the interviewees assessed their work schedule as being too hectic to apply themselves to guiding apprentices sufficiently.

“I would probably say that one-to-one, discussions. There should be more of those, but we have this lack of time. [...] and there should be more of those goals as well, an apprentice bringing up his/her own goals.” (workplace trainer, social and health care sector)

“...unfortunately it might have been that the experienced worker performed the work task quickly so that the work would be done quickly [...] so the apprentice’s role in those situations is to be a helper and cleaner, the one who takes care of the stuff and so on, but doesn’t really do anything.” (employer, technology sector)

In many workplaces, the primary responsibility of an apprentice was appointed to a workplace trainer even if the area of responsibility was not precisely elaborated and widely supported by the workplace trainers themselves. The responsibility included taking a general view of the apprentice’s performance, practicalities related to apprenticeship training and the main responsibility of providing individual guidance and assessment. Overall, the workplace trainers were expected to have the ability to organize learning (provide opportunities for participation in work tasks) and guide an apprentice (give instructions, support and monitor their performance). In some cases, questioning and critical reflection on learning were also part of the expected or ideal guidance. The co-workers, workplace trainers and employers were also asked to describe their views on the expertise requirements for workplace trainers. In addition to sufficient domain-specific knowledge and skills, the importance of possessing certain pedagogical skills was underlined. First of all, guidance was considered to be based on a workplace trainer’s social and communication skills. Secondly, the responses emphasized self-regulatory skills, including volition (patience, calmness and exactness) and motivation (interest in the vocational field and guidance). The interviewees working in the field of social and health care services also underlined the significance of self-reflection (analysing learning processes and vocational expertise).

“...even if you know how to do the job, it’s different to teach it to someone else. There has to be this social side of you and you need to understand that this person is here to learn.” (workplace trainer, technology sector)

“That you are ready to reflect on your own work and professionalism in that context. It inevitably comes up when we have those discussions, that you reflect on your own actions and your own history.” (co-worker, social and health care sector)

The introduced pedagogical approaches to learning, however, were not transferred into everyday practice at workplaces. Workplace trainers from both vocational fields considered their own vocational expertise sufficient to meet the expectations of apprenticeship training. On the other hand, the need for further education and an interest in updating one's own vocational knowledge was also apparent (particularly among the workplace trainers from the social and health care services sector). The employers also acknowledged the need for further education concerning workplace learning and focused their attention on the vocational institutions organizing it.

“I have blatantly told [an apprentice] not to ask me, not one word, don't you come hanging out here upstairs with your questions, cause you need to find someone professional. I have not dealt with those issues so I don't remember them.” (workplace trainer, social and health care sector)

“I am accredited to approve competence-based qualifications. But it is such a long time ago that I think it is not valid anymore [...] I would have hoped for some external support for this. I haven't received it from anyone.” (workplace trainer, social and health care sector)

The implementation of workplace guidance was also related to the relationship between an apprentice and the workplace trainer. The unsuccessful guidance experiences stemmed from the different viewpoints of the parties concerning the appropriate behaviour or working methods, or in few cases, the distribution of work tasks and schedules. Especially in the field of social and health care services sector, the interviewees discussed apprentices' lack of responsibility and adhesion to operational principles in working life (working hours, clothing, etc.) that occasionally challenge the progress of apprenticeship training. There were also several cases brought up in which the apprentice's challenges in their personal life and life management had impacted the guidance relationship and their study success.

“It does not really concern adults but then if they [apprentices] are quite young and the kind of working life competences, basic skills, are lacking, you need to get involved in that, how you dress at work, behave, when to come to work and leave work.” (co-worker, social and health care sector)

The Table 2 summarizes the findings (RQ2 and RQ3) by identifying some of the main factors influencing on workplace learning and guidance. Moreover, the empirical findings indicated that in the Finnish context of apprenticeship training there are currently both supporting and hindering factors forming the basis of an apprentice's development of expertise. Some of the more crucial and non-occupational factors related to workplace learning and guidance emphasized such as the apprentice's own

Table 2 Factors supporting and hindering workplace learning and guidance from the perspective of Finnish apprenticeship training stakeholders

Focus of research	Supporting factors	Hindering factors
Workplace learning	<ul style="list-style-type: none"> - Workplace acknowledged as a learning environment - Participative interaction acknowledged and encouraged - Interest in developing workplace learning in collaboration with vocational institution - Apprentice's status of an employee and possibilities to influence on work 	<ul style="list-style-type: none"> - Participative interaction reliant on apprentice's self-regulation - Limited collaboration between workplace and vocational institution regarding (e.g., pedagogical knowledge) - Apprentice with too much responsibility
Guidance	<ul style="list-style-type: none"> - Guidance available: observation, modelling and defining questions - Collective nature of guidance: shared responsibility of apprentices assistance and support - Interest in pedagogical knowledge: guidance and apprentices' vocational development - Support for apprentices' development of organisation-specific expertise and engagement 	<ul style="list-style-type: none"> - Lack of shared knowledge building, guidance discussions and reflection of learning - Lack of time, resources and expertise in guidance: reliance on apprentice's self-regulation - Unclarities in responsibility areas regarding guidance of apprentice - Conflicts between apprentice and workplace trainer - Limited recognition of apprentices' theoretical studies

responsibility for participating and seeking guidance (emphasizing the importance of an apprentice's self-regulatory skills), guidance being based on observation and task-related support (indicating the limited activities and resources supporting reciprocal learning) and the demand for collaboration between working life and formal education (in relation to the development of workplace pedagogies and integration of theoretical and practical knowledge).

Conclusion

This study has investigated apprenticeship training stakeholders' perceptions of vocational expertise and experiences of workplace learning and guidance. The aim of the study was to identify both individual aspects of vocational expertise and the role of environmental conditions in the development of expertise. The study begins with identifying the participants' perceptions of the most important individual characteristics related to vocational expertise. The findings indicate that individuals with fluent cognitive skills (e.g., problem solving skills) combined with advanced social skills, self-awareness and self-regulation are perceived as vocational experts. The stakeholders involved in the apprenticeship training saw the potential for authentic work environments to offer apprentices the ability to develop vocational knowledge and skills in that will lead to an occupation. However, in order to become engaged in the learning process and to become active members of a work community apprentices were in a need of strong self-regulatory skills even during the training. Although workplaces

were widely acknowledged as learning environments they seemed to rather provide fruitful learning possibilities, in particular, for those apprentices with strong motivation, volition (e.g., exactness and carefulness, calmness, concentration and organizational skills) and ability to self-reflection. In turn, the experiences of the most challenging cases or those who dropped out of apprenticeship training were related to a lack of self-regulation and personal management.

The experiences of the implementation of guidance at the workplaces were considered to focus on observing other employees and on task-related defining questions. Only a few examples of more interactive guidance were discussed in the interviews. Thus, apprentices were expected to be self-directed and assertive in order to seek out help and guidance. The biggest factors hindering individual guidance in the workplace seemed to be not only the lack of time and resources but also pedagogical approaches. Firstly, the collective orientation to guidance was proven to cause some confusion and lead to inconsistency with regard to areas of responsibility between the work community. Secondly, the processes of learning were mostly focused on practical and theoretical knowledge gained in the workplace whereas the theoretical knowledge gained in vocational institution was considered to play either a minor or an invisible role. Workplace learning was believed to afford an incomparable opportunity to learn by doing in authentic and diverse environments, thereby connecting theory to practice. However, even if theoretical studies completed in vocational institution were considered useful for apprentices, they were not acknowledged as profitable in relation to their benefits to the work practices or vocational development of other employees restricting the opportunities for shared knowledge building and reciprocal learning. Overall, the need and desire for closer collaboration with vocational institutions with relation to pedagogical approaches of working life was underlined by the apprenticeship training stakeholders.

Limitations

It is acknowledged that there are limitations that may have affected the findings. Firstly, the study is based on the self-reported statements of the participants. The possibility of their being different interpretations of or verbalizations between the interviewees and the researcher has to be taken into account. The trustworthiness of the analysis was strengthened by presenting the reader with what was communicated in the interviews by using the authentic interview transcriptions and how the analyses was integrated with analytical context. Furthermore, the participants represented various vocational fields, workplaces and demographic backgrounds. By choosing the Finnish context to examine the topic of the study, it also needs to be acknowledged that some of the factors may only be specific for Finnish VET and working life (e.g., the average age of the apprentices and the size of the companies participating in apprenticeship training). The data allows for analyses of drawing cross-sectorial or cross-demographic conclusions at certain level of accuracy. However, sample restricted the possibility to present in-depth comparative findings of the topic. Nevertheless, the data saturation was achieved and the study design was extensive enough to construct the descriptive findings related to the topic of the research. The saturation was based on the idea of social representativeness; instead of observing the number of participants and generalizing the findings to concern also other cases (e.g., workplaces), the aim of the study

was rather to extensively observe the relations between variables of describing general structures of the topic that can be related to other cases (Gobo 2004).

Ethical considerations were taken into account when collecting the research data. First of all, the participants were interviewed individually. In order to ensure the confidentiality of the data, any information that could have been used to identify the participants has been omitted when reporting the results. As many of the employees and employers interviewed were working in the same company, information security and anonymity was designed carefully to prevent the study from having any negative impacts on the participants.

Discussion

This paper has made a contribution towards understanding the working life perspective on vocational expertise and some of the many variables that shape how apprenticeship training is understood and conducted in the Finnish context. When identifying vocational expertise, the emphasis was strongly placed on developed self-regulatory skills following our earlier findings (e.g., Nokelainen et al. 2017; Pylväs et al. 2015). Being often considered as an equal employee in the workplace meant shouldering a lot of responsibility, autonomy and independence for apprentices. Thus, when other vocational skills are expected to develop gradually by gaining work experience, learners are expected to regulate their own learning from the very beginning of the apprenticeship training. This discrepancy is important to take into account, especially when focusing on developing apprenticeship training programmes that are suitable for young students. The study suggests that the development of apprenticeship training should focus more heavily on the stakeholders' understanding of vocational development included with a knowledge of self-regulated learning. The findings indicate that apprentices are in a need of the space, time and guidance to strengthen their self-regulatory skills during the training.

Organizational perspective on guidance indicated the lack of time and resources but also pedagogical knowledge regarding collaborative working and reciprocal learning. The stakeholders of the organizations did not acknowledge the potentials of having an apprentice in the workplace other than a possibility of engaging a new employee. Zinn (2013) has examined the epistemological beliefs of commercial/technical trainees and determined that the most underdeveloped epistemological beliefs were found in the 'source of knowledge dimension' when 20.14% of the trainees assumed that (vocational) knowledge must be 'taken on' from authority figures (trainers, teachers, etc.) and failed to sufficiently acknowledge their own role in the acquisition of vocational knowledge. He also notes that as work is increasingly transforming into knowledge-based work, trainees must be able to see themselves as 'sources of knowledge' in the context of a two-way training partnership and understand that they can also use reflexive reasoning to make a contribution to the formation of insight in vocational knowledge. While the positions of experts and professional role models are currently given to workplace instructors and other employees, also teachers remain advisors, networkers and collaborators (Isopahkala-Bouret 2010). As the focus of learning is usually on organization-specific and task-specific knowledge and skills, it may fail to affect the apprentices' horizontal development to help them mediate between the different forms of expertise and contexts (Griffiths and Guile 2003; Guile and

Griffiths 2001). Consequently, workplaces are in a need of new structures and pedagogical approaches to learning and guidance to better support mutual knowledge sharing and knowledge building that develops the vocational expertise of both apprentices and other employees of the organizations. The findings of this study indicate that teachers and other institutional actors need to significantly strengthen their role and to take on a more visible role in sharing their pedagogical expertise also in the workplace. Moreover, integrating educational learning goals with organizational benefits and learning culture demands further research in the future.

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