Towards sustainable innovations

Towards sustainable innovations

Unravelling teachers' innovative work behaviour

Peggy Lambriex- Schmitz

Towards sustainable innovations

Unravelling teachers' innovative work behaviour

Peggy Lambriex- Schmitz

ISBN: 978-94-93315-37-2

Cover design: Céline Gidding& Guus Gijben

Layout and printing: Guus Gijben | Proefschrift-aio.nl

Towards sustainable innovations

Unravelling teachers' innovative work behaviour

DISSERTATION

To obtain the degree of Doctor at Maastricht University,
on the authority of the Rector Magnificus, Prof. dr. Pamela Habibović
in accordance with the decision of the Board of Deans,
to be defended in public on Thursday March 30, 2023, at 13.00 hours.

by

Peggy Marly Michaela Lambriex- Schmitz

Supervisors

Prof. Dr. Mien Segers
Prof. Dr. Simon Beausaert

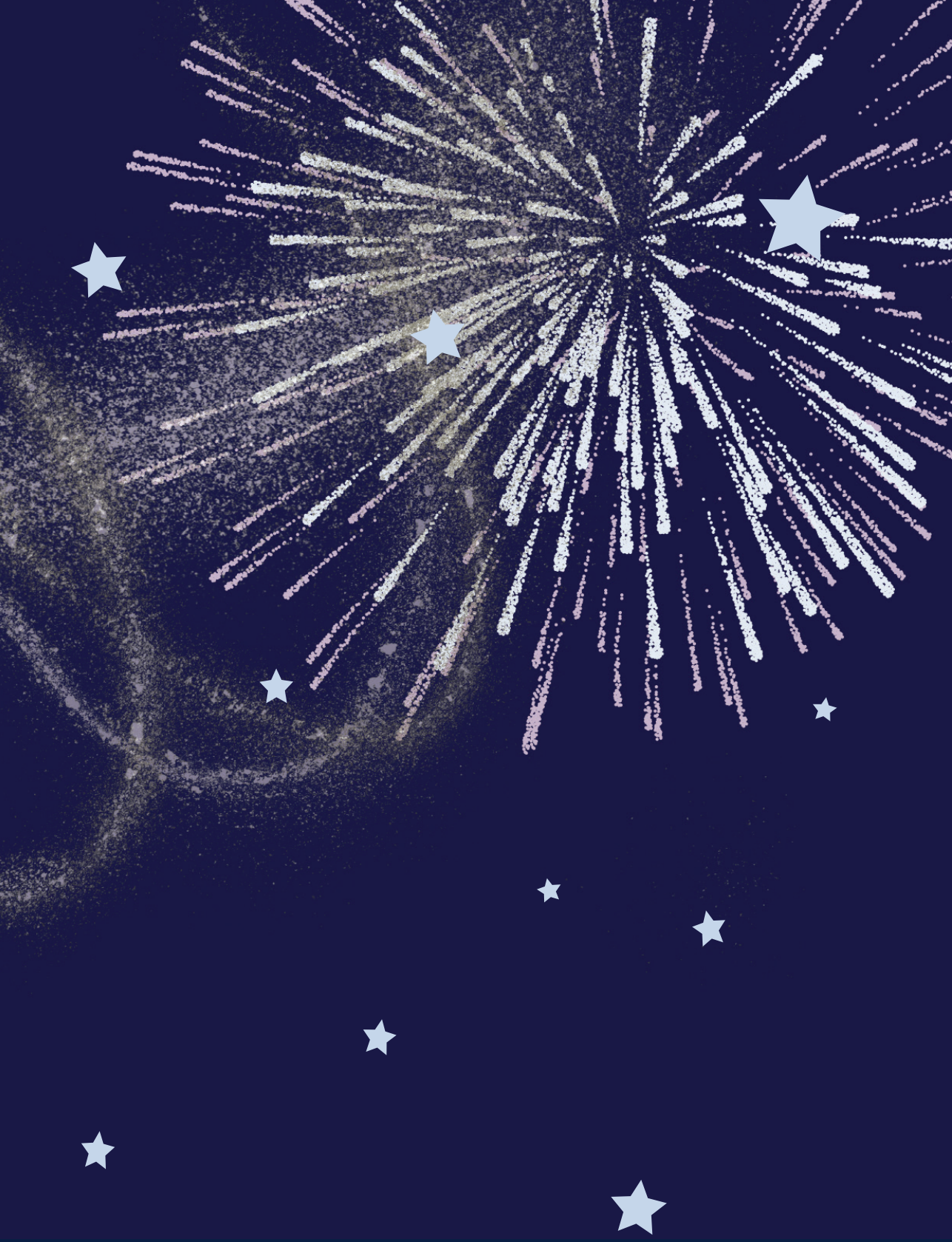
Co-supervisor

Dr. Marcel R. Van der Klink, Zuyd Hogeschool

Assessment committee

Prof. Dr. Wim H. Gijselaers (chair)
Prof. Dr. Diana Dolmans
Prof. Dr. Regina Mulder, Universität Regensburg, Germany
Prof. Dr. Marjan Vermeulen, Open University, The Netherlands

TABLE OF CONTENTS



Chapter 1

General introduction

Towards sustainable innovation in education

Het is al middag als ik, als beginnend docent, een willekeurige kast open op zoek naar paperclips. Mijn oog valt op een uitgewerkt lesprogramma en ik blader er doorheen. Dit lesprogramma ziet er zeer gedegen, aantrekkelijk en gevarieerd uit maar is naar mijn weten geen onderdeel van het curriculum. Enige navraag leert mij dat dit ooit ontwikkeld is vanuit innovatiegelden maar het lesprogramma uiteindelijk nooit is uitgevoerd noch deel is geworden van het totale curriculum. 'Zonde van het geld en de moeite' denk ik nog en ga over tot de orde van de dag.

Jaren later blijf ik nog steeds geconfronteerd met mooie producten of uitgewerkte ideeën die nooit verder geraken dan een plank in een kast of in een sub map op een server. Daarnaast zie ik ook innovatieprojecten die de implementatiefase wel halen maar die gaandeweg ook weer verdwijnen. Ondertussen werken docenten zich een slag in de rondte en ervaren zij te weinig ruimte om met rust onderwijs te kunnen uitvoeren of ontwikkelen terwijl nieuwe projecten in een steeds sneller tempo worden ingezet.

Bovenstaande observatie heeft mij geïnspireerd om onderzoek te doen naar het duurzaam implementeren van onderwijsinnovaties en hoe individuele docenten en een docententeam gestimuleerd en gefaciliteerd kunnen worden in het actief innoveren van onderwijs op een duurzame wijze. De kern van dit proefschrift is het begrip duurzaamheid en de zoektocht naar de professional van de toekomst die in staat is innovaties duurzaam te implementeren.

English

It is noon when I, as a newly-qualified teacher, open a random cabinet in search of paper clips. My eye catches an elaborated lesson plan and I flip through it. The plan looks thorough, appealing, and varied, but, to my knowledge, it is not part of the current curriculum. After some inquiry I learn that this lesson plan was once developed with innovation funds, but was never actually used or implemented. 'What a waste of money and effort', I think before proceeding to the order of the day.

The years go by and still I'm confronted with excellent products or well-developed ideas that never got any further than a shelf in a closet or a subfolder on a server. I also see innovation projects that actually are implemented only to

later disappear again after some time. Teachers work hard, and feel they have insufficient time and space to implement or develop educational innovations. At the same time, new projects are being launched at an increased pace.

The above observation inspired me to conduct research on the sustainable implementation of educational innovations, as well as on how individual teachers and teacher teams can be encouraged and facilitated to innovate education in a sustainable manner. At the heart of this thesis lies the concept of sustainability and the search for the professional of the future who can implement innovations sustainably.

This dissertation begins with the observation that many innovations in higher or vocational education are not implemented sustainably, thus leading to the loss of substantial resources, time, effort, and finances. Each year significant investments are made into innovation projects in education, where new products or procedures are developed. Educational innovations today include, for example, integrating 21st-century skills or soft skills, such as communication, collaboration and flexibility into the curriculum to support students in the development of an entrepreneurial mind-set (Sias et al., 2017). Moreover, new technologies are continually being implemented to support student learning (Bourgonjon et al., 2013; Eteokleous, 2008).

These innovation projects are usually run in a fairly predictable way. Investments are made to develop a programme and a budget is provided for its implementation. Development teams, consisting of teachers, are composed to work on the design and development of new products, such as educational modules or procedures, which are then launched. This is followed by a relatively short implementation period. Once this phase is concluded, the programme is expected to be fully implemented and the focus on the project disappears, despite the teachers who implemented it have not yet internalised the innovation. Subsequently, new follow-up actions that build on the 'implemented' innovation are enacted, while the teachers remain in the process of transforming their behaviours in line with the original innovation and are left feeling as if they are unable to keep up. Due to there being no time or space to sustainably acquire these new behaviours and attitudes, or to incorporate them into teaching routines, these follow-up actions result in enormous workloads and superficial implementations of innovations (Waslander, 2007; Trigwell et al., 1994).

The innovation cycle

The above-described approach to generating new developments in education is largely in line with the first three steps of the innovation cycle, namely recognition, initiation and implementation (West & Farr, 1989).

Recognition refers to acknowledgement of opportunities with which to improve education, initiation involves the proposal of new ideas, and the implementation step is where the ideas are further elaborated and implemented.

Unfortunately, in practice, many educational innovations are not embedded sustainably, but rather relegated to an office drawer or shelf. Teachers quickly fall back into previous teaching routines and the innovation is forgotten (Askell-Williams & Koh, 2020). The last step of the innovation cycle, stabilisation, where the emphasis is on making the innovation sustainable, has tended to receive little attention in many of these educational innovation projects.

Within education, it is often the teachers themselves who participate in these projects and have to ensure that innovations are embedded more sustainably within the school. It has been recommended that, in order to increase the success of sustainable innovations, the innovations themselves become integral parts of teachers' routine tasks, as well as that teachers need to be convinced of the efficacy and added value of innovations (Verloop et al., 2001).

Sustainability

In the context of educational innovation, sustainability is a term with many different connotations. Loh et al. (2013, p.32) define sustainability as 'the ability of a project to maintain its operations, services and benefits during its projected lifetime'. Within the context of educational change, sustainability has been defined as 'the process of change, the way in which the school works on innovations and whether this way of working becomes part of the daily routines of teachers' (Geijsel & Van Eck, 2011, p.70). This implies that teachers are mainly routine professionals (Verloop et al., 2001), and that sustainability means learning and applying new routines. This is in line with the definition given by Wierda-De Boer et al. (2020), who stated that an innovation is sustainable if 'routines have changed permanently. The innovation is consolidated and serves as a basis for further development'. In addition, Askell-Williams and Koh (2020) stated that 'the implementation of an effective initiative over a context-dependent timeframe leading to irreversible desirable system change' (p. 622). Educational organisations, such as schools and universities, are complex adaptive systems that interact at various levels. Indeed, they involve many different stakeholders (e.g., students, parents, teachers, managers), departments (e.g.,

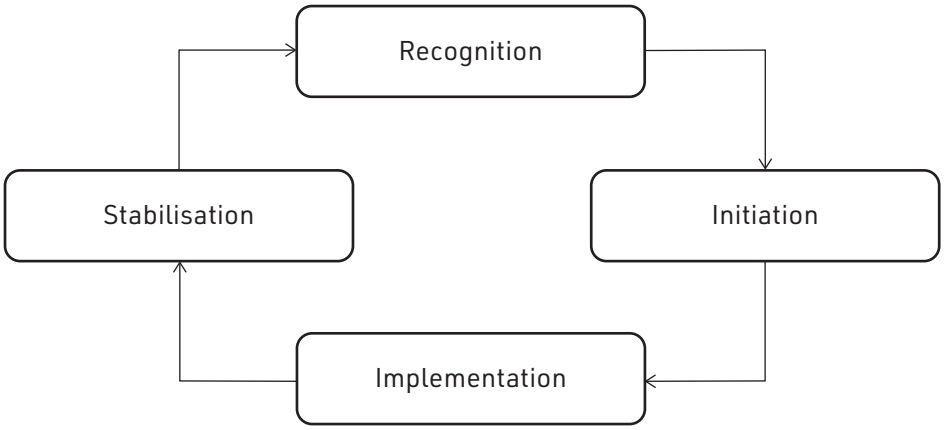


Figure 1.1 The innovation cycle (West & Farr, 1989)

HR, finance, student administration) and committees (e.g., exam and programme committees). During innovation processes, these interactions tend to be reciprocal. This means that sustainable innovation is not a linear cause-effect stepwise system, but rather one which requires an emerging system change with reciprocal interactions between the different components of educational organisations. Finally, Serduykov (2017) argued that educational innovations are only sustainable when they result in improvements to student learning outcomes. He stated that 'yet, though there is a good deal of ongoing educational research and innovation, we have not actually seen discernible improvements in either school students' or college graduates' achievements to this day' (p. 6). As one of the key elements for innovations that lead to improved student leaning they refer to systemic support throughout the innovation process of all those involved.

Based on the above definitions and descriptions, we define sustainability as a phase in which teachers have adopted the new behaviour and enacted a permanent change to their routines. We characterise sustainable innovation as follows:

- An internalised change in the behaviour of teachers;
- A change where the organisation changes along with the teacher;
- A change that spreads across a social system and leads to systemic change;
- A change that endures over time;
- A change that leads to improved student learning outcomes.

The role of teachers in innovation

Teachers stimulate and facilitate student learning in order to support them in preparing for a constantly changing world. Current social and economic developments require different skills from future professionals, meaning that there is a need for teachers to be equipped to develop and adapt curricula accordingly. Teachers play a key role in supporting students to prepare for the labour market, and it is therefore important that they can respond quickly and appropriately to these changing circumstances by delivering innovative education. In other words, the innovative behaviour of teachers is crucial for keeping education aligned with societal needs. Traditionally innovative work behaviour (IWB) has been defined as: 'The intentional creation, introduction and application of new ideas within a work role, group or organization in order to benefit role performance, the group or the organization' (Janssen, 2000, p.288). In order for teachers to exhibit innovative behaviour, they must be actively involved in all phases of the innovation process, thereby allowing them to shape the innovation themselves. The starting point here is the beliefs and attitudes of teachers, as well as dialogue towards something new (Verloop et al., 2001). A shared sense of urgency also allows for emergent opportunities to be grasped, to developed, implemented, expanded to include others, and be sustainably embedded within the organisation. To include sustainability in the definition of IWB, we propose the folowing definition:

Innovative work behaviour is a multi-stage iterative process in which employee behaviour targets the exploration of opportunities, idea generation, promotion, and realisation, as well as the sustainable implementation of these ideas, processes, products or procedures within a role, group or organisation, whereby the ideas are (relatively) new and intended to benefit the relevant unit of adoption.

This ties in with the observation that innovation can only occur if there is sufficient support for the change, and if there is enough time and space to work together to ensure the change becomes a sustainable part of the routine.

Further to organisational and institutional factors, the success of educational innovations often depends on the teachers who, as a team, must implement them within the school (Hasanefendic et al., 2017). Especially in education, the team in which one works is crucial. 'After all, you teach alone, but educate students together'. Sustainable educational innovations require continuous behavioural changes of both the teaching team and the support staff. 'Institutions will not change until their members change' (Sherry, 2002, p. 214). In other words, teacher teams need to engage in team innovative work behaviour (TIWB), which can be defined as 'the sum of all physical and cognitive tasks that teams carry out in their work context to

attain the necessary requirements for the development of an innovation' (Widmann et al., 2016, p.432). Although TIWB has received considerable attention in research, many questions remain unanswered. In the following section, we elaborate on both individual and team IWB, and these unanswered questions.

Challenges in research on educational innovations

In this dissertation, we adress the following three main challenges in research on innovations in education: [1] conceptualisation and measurement of IWB, [2] identification of the antecedents of IWB, and [3] unravelling team innovative work behaviour. Building on these challenges, we formulate the aims and contributions of the studies reported in this dissertation.

Challenge 1: Conceptualisation and measurement of IWB

In order to further develop the field of IWB research, one must first properly define the concepts of IWB and TIWB, and measure them in a reliable and validated way.

Regarding conceptualisation, various definitions have previously been formulated for IWB, and numerous instruments have been developed to measure it in line with the phases of the innovation cycle (West & Farr, 1989) or the innovation process as described by Kanter (1988). Concerning the latter, she divided the innovation process into four different phases: Idea generation, coalition building, idea realisation and transfer/ diffusion. Idea generation involves both recognising and anticipating opportunities through generating ideas that align with emerging opportunities. In the coalition building phase, the idea must receive sufficient support to be allowed to be developed. This phase aims at finding sufficiently impactful allies in order for the idea to be suitably facilitated. The idea realisation phase involves forming a team so as to flesh out the new idea in concrete terms and ensure that it can also be applied by others. Finally, in the transfer/ diffusion phase, the idea is firmly embedded in the existing systems. This last phase is also referred to as stabilisation phase (West & Farr, 1989) or institutionalisation/ continuation phase (Fullan, 2007).

Comparing these phases with the widely used definitions of IWB, it is surprising that they do no explicitly include sustainability. For example, in 2000, Janssen proposed the term 'innovative work behaviour' for the 'intentional creation, introduction and application of new ideas within a work role, group or organization in order to benefit role performance, the group or the organization' (p. 288). His definition was widely adapted (e.g., De Jong & Den Hartog, 2010; Tuominen & Toivonen, 2011; for an overview of studies in the educational context, see Thurlings et al., 2015). This lack of explicitely recognising sustainability as an integral dimension of IWB, is also reflected in the current IWB measurement instruments.

Regarding the measurement of IWB, although the concept consists of several phases (idea generation, idea promotion and idea realisation) and is thus multi-dimensional, IWB has mainly been measured with short questionnaires that cover the entire uni-dimensional concept (e.g., Scott & Bruce, 1994; Spreitzer, 1995; Janssen, 2000; Radaelli et al., 2014). Moreover, the questionnaires that do measure IWB as a multi-dimensional construct tend not to include a sustainability dimension. IWB has been measured on a two-dimensional level, consisting of creativity and implementation (Krause 2004; Dorenbosch et al., 2005), a four-dimensional level, including idea exploration, generation, championing and implementation (De Jong & Den Hartog, 2010), and a five-dimensional level, with an added reflection dimension (Messmann & Mulder, 2012). This means that insight into the last phase of Kanter's innovation model 'transfer/ diffusion' (1988) or the last phase of West and Farrs' (1989) innovation cycle (i.e., stabilisation) have been largely underexplored. And yet it is precisely this phase that provides insight into the sustainability of innovations and, as such, their long-term success. For a detailed description of the history of the development of the concept of IWB and the instruments which measure it, please see the theoretical framework of this thesis outlines in Chapter 2. In order to deal with this challenge, in Study 1, we developed and validated a survey to measure IWB, taking a multi-dimensional perspective and including the sustainability dimension.

Challenge 2: Identification of the antecedents of IWB

Further to conceptualisation and measurement, numerous studies (both quantitative and qualitative) have examined the factors that influence IWB. Factors that have been shown to significantly affect IWB include individual factors, or more specificly such demographic factors as income (Carmeli et al., 2006), years of education, and having other job functions (Runhaar, 2008), or individual personal factors, such as curiosity and openness (Messmann & Mulder, 2011; Horng et al., 2005), attitudes and beliefs (Mueller et al., 2008; Yang & Huang, 2008), motivation (Loogma et al., 2012; Messmann & Mulder, 2011), self-efficacy (Runhaar, 2008; Stylianidou et al., 2005), and skill variety (Noefer et al., 2009). Moreover, organisational factors have been shown to have a positive effect. Examples of influential organisational factors include interactions, talking or communicating with colleagues (Horng et al., 2005; Tomic & Brouwers, 1999; Messmann & Mulder, 2011), support from co-workers (Binnewies & Gromer, 2012) or support from management (Loogma et al., 2012), and learning facilities (Bourgonjon et al., 2013; Mueller et al., 2008).

However, when analysing previous studies on the antecedents of IWB, it became clear that the concept has predominantly been explored through questionnaires, which measure IWB uni-dimensionally and with a limited number of items. This means that

only the effects of the antecedents on the overall concept of IWB have been measured and that, so far, a distinction between IWB phases (including its sustainability dimension) has yet to be made. As a result, it has not been possible to identify factors that influence the different dimensions of IWB – particulary that of sustainability.

We approached this challenge by studying the antecedents of the different dimensions of IWB from two different perspectives, namely adaptive expertise (Study 2, Chapter 3), and learning and development (Study 3, Chapter 4). An important argument for adoptig the first perspective is the vast amount of research indicating that being active in innovation requires an employee to show 'flexibility, ability to innovate, continious learning, seeking out challenges, and creativity', or to act as an adaptive expert (Carbonell et al., 2014, p.15). From this perspective we focus on three factors that have been shown to have a strong predicting power in explaining individual differences in adaptive behaviour: [1] task variety, [2] management support and [3] exposure to innovation.

First, previous research has shown that task variety - that is, employees who conduct a wide range of tasks (Morgeson & Humphrey, 2006) - have more possibilities to combine different knowledge and skills. If a teacher is involved in a variety of tasks, knowledge has to be applied to various situations and many experiences are accumulated, thus challenging them to become an adaptive learner (Karaevli & Hall, 2006). An adaptive learner is capable of converting what has been gained from previous experiences into knowledge and skills for new tasks (Smith et al., 1997). Carrying out many different tasks is a motivating factor for sustainable IWB, such as the generation and implementation of new ideas (Noefer et al., 2009).

Second, in addition to task variety, research has repeatedly demonstrated that support from managers positively affects teachers' IWB (Binnewies & Gromer, 2012; De Arment et al., 2013; Hammond et al., 2011). However, it is worth distinguishing between two different types of management support: [1] encouragement for showing innovative behaviour and [2] providing the necessary conditions for working on innovations. Employees who feel supported in their innovative behaviour, and where innovative behaviour is expected, seem to be more able to generate and implement ideas (Janssen, 2005; Krause 2004; Loogma, 2012). Providing time and money to participate in innovation processes is found to be an important antecedent of IWB (De Jong & Den Hartog, 2007).

Third, a stimulating climate entails the exposure to new ideas, the involvement in innovations, and the stimulation of an employees' belief that they are capable of playing an active role in the innovation process. The literature has repeatedly

shown the importance of exposure to innovation (e.g., Daft, 1978; Dewar & Dutton, 1986; Ducharme et al., 2007). In the context of education, Bourgonjon et al. (2013) showed how teachers become more enthusiastic about an innovation when they see colleagues apply the new ideas successfully.

In Study 2, we adopted the adaptive expertise perspective to address the role of task variety, management support, and exposure to innovations for the different dimensions of IWB (including the sustainability dimension).

In Study 3, we chose the learning and development perspective to study antecedents of IWB. Within education, it has been generally recognised that schools in which teachers are encouraged to engage in lifelong learning foster engagement in IWB. A supportive learning climate stimulates teachers to reflect on their practices, co-develop new ideas, and promote and realise them in a sustainable way. The environment in which this learning can occur has been conceptualised in many different ways. Given our focus on innovation sustainability and the role of the learning climate in such a context, we focused specifically on three dimensions of the learning climate: [1] a supportive learning environment, [2] management support, and [3] exposure to innovations. All three of these can be considered as contextual-related factors.

A supportive learning environment builds on psychological safety, the appreciation of differences, openness to new ideas, and time for reflection (Garvin et al., 2008; Singer et al., 2012). Learning from errors should be central to a learning environment (Nikolova et al., 2014). A supportive learning environment promotes the feeling of being able to learn. The number of successful innovations in education increases if teachers experience a stimulating climate that encourages innovation (Fullan, 2007).

Management support, including [1] encouragement for showing innovative behaviour and [2] the provision of the necessary conditions for working on innovations, and exposure to innovations, which entails [1] the exposure to new ideas, [2] the involvement in innovations, and [3] stimulation of the beliefs of an employee being capable to fulfil an active role in the innovation process, were included based on our Study 2.

Beside the contextual-related antecedents, we included the personal-related factors (including background characteristics) of gender, age, tenure, number of working hours, and type of education - for which we controlled during the analyses.

Challenge 3: Unravelling team innovative work behaviour

In recent years, research on innovation has shifted its focus from the individual to the teacher team (Widmann et al., 2016). The responsibility for the success or failure of an innovation is thus no longer linked to an individual, but an entire team becomes responsible for creating, promoting, developing and sustainably implementing an innovation. This is in line with Kanter's classification, in which the innovative process is already perceived as being team oriented. The transfer/ diffusion phase not only concerns the physical systems, but above all requires behavioural change from the users. Despite this starting point, the development of the concept is often viewed from an individual perspective, while the conceptualisation of the phases implies that it is closer to a collective team process. For a comprehensive overview of all the studies on team IWB, please see Chapter 5 of this thesis. The theoretical framework describes a large number of definitions and covers the history of research on TIWB. Altough TIWB received considerable academic attention, the sustainability dimension has been left somewhat under-researched (much like in individual IWB research). Moreover, Widmann et al.'s (2016) review showed that most studies on TIWB used survey-based, cross-sectional methodologies, thus ignoring the fact that IWB phases are iterative and fluid and, that more insights are needed into the dynamics of these social processess (Dyer & Nobeoka, 2000; Singh, 2005). Furthermore, the majority of the survey-based studies in Widmann et al.'s (2016) review collected data from individual team members, ignoring that TIWB is a social interactive process.

In order to deal with these challenges, we sought to use Study 4 to explore in depth how TIWB, as a social-interactive process, manifests itself in the various phases of an innovation project, as well as to what extent TIWB is an iterative, fluid process.

Research model and research questions

This dissertation intends to contribute to the theoretical and empirical knowledge of the concept and measurement of IWB, including the sustainability dimension and its antecedents or, more specifically, learning climate (management support, supportive learning environment and exposure to innovation) and task variety. The different studies were conducted in various contexts and levels of education (secondary vocational [MBO], higher vocational [HBO], university), using a mixture of measuring instruments namely questionnaires (Studies 1,2, and 3) and behavioural observations (Study 4).

The central research questions are:

1. How can IWB be conceptualised and measured? (Study 1)
2. How does the learning climate influence teachers' IWB? (Studies 2 and 3)
3. How does task variety influence teachers' IWB? (Study 2)
4. Which TIWBs emerge within the different phases of an innovation project? (Study 4)
5. Does TIWB proceed in an iterative, fluid or linear manner? (Study 4)

Dissertation outline

This dissertation investigates how to conceptualise and measure IWB in the context of education, and explores the influencing factors on teachers' IWB. Furthermore, the thesis studies IWB at both the individual and team levels. We used four studies to [1] increase our understanding and measurement of IWB in the context of education (Study 1), [2] investigate how different antecedents support IWB in the context of vocational (higher) education with a focus on sustainability (Studies 2 and 3), and [3] unravel TIWB during an educational innovation project in the context of higher education (Study 4). Studies 1, 2 and 3 investigated IWB on the individual level, while Study 4 focused on the team level.

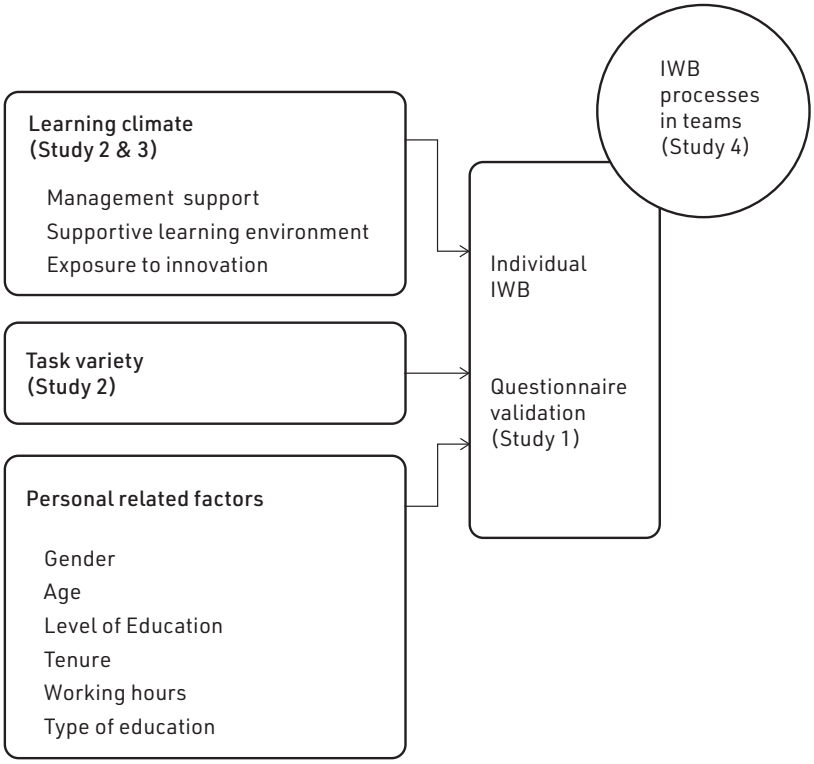


Figure 1.2 Research model

Study 1: Development and validation of a multi-dimensional instrument to measure teachers' IWB.

The first study (see Chapter 2) investigates how to conceptualise and measure IWB as a multi-dimensional concept. Based on a comprehensive literature review, we re-conceptualised IWB by adding sustainability as a core dimension to the previously identified four dimensions. Accordingly, we developed a scale measuring the sustainability dimension, and adapted the Mulder and Messmann's (2012) IWB instrument for teachers. We tested the construct validity of this newly developed multi-dimensional IWB instrument in a Dutch context, using Rasch techniques and confirmatory factor analysis (CFA).The psychometric characteristics of our instrument were examined in a sample of teachers in The Netherlands working in four different vocational (abbreviated in Dutch to MBO and HBO respectively) education institutes (n = 440).

Study 2: Stimulating teachers' IWB. The role of task variety, management support and exposure to innovation.

Professionals in the education sector are expected to engage in IWB that not only entails the generation, but also the realisation and sustainable implementation, of new ideas. In a sample of 458 teachers in Dutch secondary (MBO) and higher (HBO) vocational education, we investigated the relation between environmental factors (namely task variety, management support and exposure to innovation) and IWB across the different phases of the innovation process (including sustainability), see Chapter 3. For this purpose we used a 44-item IWB instrument which measured the following five dimensions: Opportunity exploration, idea generation, idea promotion, idea realisation and idea sustainability (Lambriex-Schmitz et al., 2020). Hierarchical multiple regression analyses were used to analyse the data.

Study 3: Towards sustainable innovations in education. The role of the learning climate on teachers' IWB.

Given the dynamic environment, teachers are expected to show IWB, that is, generating, implementing and sustaining new ideas. However, IWB might be dependent on features of the work environment. In Study 3 (see Chapter 4), we explored the relation between the learning climate (defined as a supportive learning environment, management support and exposure to innovation) and IWB. This study was conducted among teachers from two Dutch vocational (MBO) colleges (n= 206). We used a 44-item instrument to measure five dimensions of IWB: Opportunity exploration, idea generation, idea promotion, idea realisation and idea sustainability (Lambriex- Schmitz et al., 2020). Hierarchical multiple regression analysis and path analysis were used to analyse the data.

Study 4: Unravelling IWB processes in teams.

Sustainable innovations demand teams with the ability to demonstrate TIWB. Thus far, TIWB has been assumed to be an iterative process as based on research among individual team members with survey-based, cross-sectional methodologies. In Study 4 (see Chapter 5) we sought to delve deeper into how TIWB occurs in the various phases, as well as into the dynamic interplay between the phases and sequencing using a longitudinal qualitative approach. A case study was conducted involving a teacher team working at a Dutch university that had to design, develop and implement an educational module. We audiotaped and transcribed 19 team meetings throughout an eight month period. For the analysis a codebook was used based on the definitions of the five main dimensions of IWB and the items of the validated IWB questionnaire (Lambriex-Schmitz et al., 2020). The coding process was conducted in three rounds: Detecting meaningful segments, applying the coding scheme through appointing main and sub-codes, and a final round of double-blind coding (Cohen et al., 2000).

Chapter 6 provides an integration and discussion of the key findings of the four conducted studies. Moreover, it discusses the limitations, avenues for further research and practical implications related to enhancing sustainable innovations in education. This thesis offers practical contributions that can help teachers and schools to sustainably implement educational innovations.

Please note that this dissertation contains a collection of closely-related articles that have been published in journals (Chapters 2 and 3) or are submitted (Chapters 4 and 5). Each chapter was written to be read independently, which may lead to inevitable repetition and overlap between them.

References

Askell-Williams, H., & Koh, G. A. (2020). Enhancing the sustainability of school improvement initiatives. School Effectiveness and School Improvement, 31(4), 660–678.

Binnewies, C. & Gromer, M. (2012). Creativity and innovation at work: The role of work characteristics and personal initiative. Psicothema, 24(1), 100–105.

Bourgonjon, J., De Grove, F., De Smet, C., Van Looy, J., Soetaert, R., & Valcke. (2013). Acceptance of game-based learning by secondary school teachers. Computers & Education, 67, 21–35.

Carbonell, K. B., Stalmeijer, R., Könings, K., Segers, M. R., & van Merrienboer, J. J. G. (2014). How experts deal with novel situations: A review of adaptive expertise. Educational Research Review, 12, 15.

Carmeli, A., Meitar, R., & Weisberg, J. (2006). Self-leadership skills and innovative behavior. International Journal of Manpower, 27.

Cohen, L., Manion, L. & Morrison, K. (2000). Research methods in education (5th ed.). Routledge Falmer.

Daft, R. L. (1978). A dual-core model of organizational innovation. Academy of Management Journal, 21(2), 193–210.

De Arment, S. T., Reed, E. & Wetzel, A. P. (2013). Promoting adaptive expertise: A conceptual framework for special educator preparation. Teacher Education and Special Education, 36(3), 217–230.

De Jong, J. P. & Den Hartog, D. N. (2007), How leaders influence employees' innovative behavior. European Journal of Innovation Management, 10(1), 41.

De Jong, J., & Den Hartog, D. (2010). Measuring innovative work behaviour. Creativity and Innovation Management, 19(1).

Dewar, R. D., & Dutton, J. E. (1986). The adoption of radical and incremental innovations: An empirical analysis. Management Science, 32(11).

Dorenbosch, L., Engen, M. L. V., & Verhagen, M. (2005). On-the-job innovation: The impact of job design and human resource management through production ownership. Creativity and Innovation Management, 14(2).

Ducharme, L. J., Knudsen, H. K. & Roman, P. M. (2007), Emotional exhaustion and turnover intention in human service occupations: The protective role of coworker support. Sociological Spectrum, 28(1), 81–104.

Dyer, J. H., & Nobeoka, K. (2000). Creating and managing a high-performance knowledge-sharing network: The Toyota case. Strategic Management Journal, 21(3), 345–367.

Eteokleous, N. (2008). Evaluating computer technology integration in a centralized school system. Computers & Education, 51(2), 669–686.

Fullan, M. (2007). The new meaning of educational change (4th ed.). Teachers College Press.

Garvin, D. A., Edmondson, A. C., & Gino, F. (2008). Is yours a learning organization? Harvard Business Review, 86(3), 109.

Geijsel, F., & Van Eck, E. (2011). Duurzaam vernieuwen. Leren van Expeditie durven, delen, doen. VO-raad.

Hammond, M. M., Neff, N. L., Farr, J. L., Schwall, A. R., & Zhao, X. (2011). Predictors of individual-level innovation at work: A meta-analysis. Psychology of Aesthetics, Creativity, and the Arts, 5, 90–105.

Hasanefendic, S., Birkholz, J. M., Horta, H., & van der Sijde, P. (2017). Individuals in action: Bringing about innovation in higher education. European Journal of Higher Education, 7(2), 101–119.

Horng, J. S., Hong, J. C., ChanLin, L. J., Chang, S. H., & Chu, H. C. (2005). Creative teachers and creative teaching strategies. International Journal of Consumer Studies, 29(4), 352–358.

Janssen, O. (2000). Job demands, perceptions of effort-reward fairness and innovative work behaviour. Journal of Occupational and Organizational Psychology, 73, 287–302.

Janssen, O. (2005). The joint impact of perceived influence and supervisor supportiveness on employee innovative behaviour. Journal of Occupational and Organizational Psychology, 78(4), 573–579.

Kanter, R. (1988). When a thousand flowers bloom: Structural, collective, and social conditions for innovation in organizations. Research in Organizational Behaviour, 10.

Karaevli, A. & Hall, D. T. T. (2006). How career variety promotes the adaptability of managers: A theoretical model. Journal of Vocational Behavior, 69(3), 359–73.

Krause, D. E. (2004). Influence-based leadership as a determinant of the inclination to innovate and of innovation-related behaviors: An empirical investigation. The Leadership Quarterly, 15(1), 79–102.

Lambriex-Schmitz, P., Van der Klink, M. R., Beausaert, S., Bijker, M., & Segers, M. (2020). Towards successful innovations in education: Development and validation of a multi-dimensional innovative work behaviour instrument. Vocations and Learning, 1–28.

Loh, L. C., Friedman, S. R., & Burdick, W. P. (2013). Factors promoting sustainability of education innovations: A comparison of faculty perceptions and existing frameworks. Education of Health, 26(1), 32–38.

Loogma, K., Kruusvall, J. & Ümarik, M. (2012). E-learning as innovation: Exploring innovativeness of the VET teachers' community in Estonia. Computers & Education, 58(2), 808–817.

Messmann, G., & Mulder, R. H. (2011). Innovative work behaviour in vocational colleges: Understanding how and why innovations are developed. Vocations and Learning, 4(1), 63–84.

Messmann, G., & Mulder, R. H. (2012). Development of a measurement instrument for innovative work behaviour as a dynamic and context-bound construct. Human Resource Development International, 15(1), 43–59.

Morgeson, F. P. & Humphrey, S. E. (2006). The work design questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design and the nature of work. Journal of Applied Psychology, 91(6), 1321.

Mueller, J., Wood, E., Willoughby, T., Ross, C. & Specht, J. (2008). Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. Computers & Education, 51(4), 1523–1537.

Nikolova, I., Van Ruysseveldt, J., De Witte, H., & Van Dam, K. (2014). Learning climate scale: Construction, reliability and initial validity evidence. Journal of Vocational Behavior, 85(3), 258–265.

Noefer, K., Stegmaier, R., Molter, B. & Sonntag, K. (2009). A great many things to do and not a minute to spare: Can feedback from supervisors moderate the relationship between skill variety, time pressure, and employees' innovative behavior? Creativity Research Journal, 21(4), 384–93.

Radaelli, G., Lettieri, E., Mura, M., & Spiller, N. (2014). Knowledge sharing and innovative work behaviour in healthcare: A micro-level investigation of direct and indirect effects. Creativity and Innovation Management, 23(4), 400–414.

Runhaar, P. R. (2008). Promoting teachers' professional development [Unpublished doctoral dissertation]. University of Twente.

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. Academy of Management Journal, 37(3).

Serdyukov, P. (2017). Innovation in education: What works, what doesn't, and what to do about it? Journal of Research in Innovative Teaching & Learning.

Sherry, L. (2002). Sustainability of innovations. Journal of Interactive Learning Research, 13(3), 211.

Singer, S. J., Moore, S. C., Meterko, M., & Williams, S. (2012). Development of a short-form learning organization survey: The LOS-27. Medical Care Research and Review, 69(4), 432–459.

Singh, J. (2005). Collaborative networks as determinants of knowledge diffusion patterns. Management Science, 51(5), 756–770.

Sias, C. M., Nadelson, L. S., Juth, S. M., & Seifert, A. L. (2017). The best laid plans: Educational innovation in elementary teacher generated integrated STEM lesson plans. The Journal of Educational Research, 110(3), 227–238.

Smith, E. M., Ford, J. K. & Kozlowski, S. W. J. (1997). Building adaptive expertise: Implications for training design strategies. In M. A. Quinones and A. E. Ehrenstein (Eds.), Training for a Rapidly Changing Workplace: Applications of Psychological Research, 89–118. American Psychological Association.

Spreitzer, G. M. (1995). Psychological empowerment in the workplace: Dimensions, measurement, and validation. Academy of Management Journal, 38(5), 1442–1465.

Stylianidou, F., Boohan, R., & Ogborn, J. (2005). Science teachers' transformations of the use of computer modeling in the classroom: Using research to inform training. Science Education, 89(1).

Thurlings, M., Evers, A.T., & Vermeulen, M. (2015). Toward a model of explaining teachers' Innovative behavior: A literature review. Review of Educational Research, 85(3), 430–471.

Tomic, W., & Brouwers, A. (1999). Teacher burnout, perceived self-efficacy in classroom management, and student disruptive behaviour in secondary education. Curriculum and Teaching, 14(2).

Trigwell, K.R., Prosser, M., & Taylor, P.H. (1994). Qualitative differences in approaches to teaching first year university science. Higher Education, 27, 75–84.

Tuominen, T., & Toivonen, M. (2011). Studying innovation and change activities in KIBS through the lens of innovative behaviour. International Journal of Innovation Management, 15(2), 393–422.

Verloop, N., Van Driel, J., & Meijer, P. (2001). Teacher knowledge and the knowledge base of teaching. International Journal of Educational Research, 35(5), 441–461.

Waslander, S. (2007). Leren over innoveren: Overzichtsstudie van wetenschappelijk onderzoek naar duurzaam vernieuwen in het voortgezet onderwijs. VO-project Innovatie.

West, M. A., & Farr, J. L. (1989). Innovation at work: Psychological perspectives. Social Behaviour, 4, 15–30.

Widmann, A., Messmann, G., & Mulder, R. H. (2016). The impact of team learning behaviors on team innovative work behavior: A systematic review. Human Resource Development Review, 15(4).

Wierda-De Boer, H., De Lange, M., & De Vijlder, F. (2020). Verbindend vernieuwen. Hoe interne en externe samenwerking bijdraagt aan het verduurzamen van onderwijsinnovaties in het mbo. HAN University of Applied Sciences.

Yang, S. C. & Huang, Y. F. (2008). A study of high school English teachers' behavior, concerns and beliefs in integrating information technology into English instruction. Computers in Human Behavior, 24(3), 1085–103.

Chapter 2

Towards sustainable innovations in education: Development and validation of a multi-dimensional innovative work behaviour instrument

Abstract

Our study aims to develop and validate a multi-dimensional innovative work behaviour instrument to measure teachers IWB. Current IWB conceptualisations and operationalisations need further attention. Existing measurements miss empirical evidence of the construct validity and moreover do not include a sustainability dimension. Based on a thorough and comprehensive conceptualisation of IWB, we first adapted and extended the items of previously used instruments and developed items for a sustainability dimension. Second, we tested the construct validity of this newly developed multi-dimensional IWB instrument in a Dutch context, using Rasch techniques and Confirmatory Factor Analysis (CFA). The psychometric characteristics were examined in a sample of teachers working in vocational education (n = 440). The results revealed five dimensions of IWB, namely opportunity exploration, idea generation, idea promotion, idea realisation (differentiated in two sub-dimensions: Criterion-based implementation and learning-based communication) and idea sustainability (differentiated in two sub-dimensions: External dissemination and internal embedding). The dimensions were reliably measured (α .84- .94) using 44 items. This new instrument, which builds on recent conceptualisations of IWB as well as on the pivotal innovation models of West and Farr (1989) and Fullan (2007), offers for an international group of researchers a conceptually sound and valid tool to validate explanatory models of innovative teacher behaviour. For practitioners in the domain of educational innovation, it offers the opportunity to diagnose, in a sound way, the extent of the necessary conditions of teachers IWB for an educational innovation to succeed.

THIS CHAPTER IS BASED ON:

Lambriex-Schmitz, P., Van der Klink, M. R., Beausaert, S., Bijker, M., & Segers, M. (2020). Towards successful innovations in education: Development and validation of a multi-dimensional innovative work behaviour instrument. Vocations and Learning, 13(2), 313-340

Introduction

Higher and vocational education experience the sheer necessity to innovate. Rapidly changing labour markets require the acquisition of skills and knowledge that are often absent in education programmes (World Economic Forum, 2016). Moreover, there is an ongoing debate on safeguarding the quality of education with regard to improving instructional methods, assessments, and their impact on teachers' competences (organisation for economic cooperation and development, 2009; 2018 [OECD]). Today's innovations in education concern, for example, integrating 21st century skills or soft skills such as communication, collaboration and flexibility in curricula, to support students' entrepreneurial capacities (Schleicher, 2012; Sias et al., 2017). Also, new technologies in the classroom that foster new ways of teaching and learning are implemented (Bourgonjon et al., 2013; Eteokleous, 2008).

However, the need for innovations in education strongly depends on how teachers put these innovations into practice. Many innovations in education do not result into the the desired changes. Next to institutional factors, teachers' behaviour to cope with innovations is of upmost importance for understanding the succes or failure of innovations (Hasanefendic et al., 2017). Teachers play a crucial role in innovations (George & Sabapathy, 2011; Koeslag- Kreunen et al., 2018). As Sherry (2002) states: 'Individuals must be the focus if change is to be facilitated. Institutions will not change until their members change' (p.214). Innovations require that teachers develop new behaviour, but often, even after a considerable period of time, teachers abandon the newly aquired behaviour and fall back to comfortable old routines (Verloop et al., 2001). To safeguard the succes of innovations it is crucial to encourage and enhance teachers' innovative behaviour (Thurlings et al., 2015).

Innovative work behaviour (IWB) is an emerging concept, originally defined by Janssen (2000) as individual behaviour that leads to the initiation, presentation and realisation of new ideas, products or procedures within the working place, team or organisation. Since then this definition has been used, and further elaborated by many researchers. Also in the education context, IWB has gained attention. For example, Messmann (2012) defines IWB as a multi-stage iterative process, consisting of four different phases: 1] Opportunity exploration which entails paying attention to trends, opportunities for innovation and problem recognition; 2] idea generation, i.e. generating novel and useful ideas for products, services or processes; 3] idea promotion, which includes seeking sponsorship for the ideas among colleagues and supervisors and apply for funding and facilitation and finally; 4] idea realisation, which involves the creation and implementation of a prototype or model in the workgroup or organisation. The phases are partly dependent, but

do not necessarily follow a fixed order, resulting in a complex, dynamic, non-linear model of IWB (Messmann & Mulder, 2012). For instance, when promoting new ideas, teachers might identify new opportunities for innovation.

Though the IWB-concept has been further developed, some gaps need our attention. Firstly, if IWB is compared with current theoretical insights on innovations, a conceptual gap can be identified. Innovation theories emphasize the need to stabilise the innovation (West & Farr, 1989). This stabilisation phase is sometimes also labeled as 'transfer' or 'diffusion' (Kanter, 1988), or 'continuation' or 'institutionalisation' (Fullan, 2007). Stabilisation is crucial when it comes to enhancing the sustainability of innovations. Stabilisation is an extension of the implementation phase, in which the innovation is anchored into the organisational system. The integration of innovation in the organisation increases its long-term succes and continuity (Fullan, 2007; West & Farr, 1989). However, thus far sustainability has not been included in IWB-conceptualisations and operationalisations.

Secondly the few identified studies that have developed and empirically tested IWB-measurement instruments have been faced with challenging situations (see Table 1). The initial IWB measures consist of only a few items, representing one IWB-dimension. These measures do not reflect the complex and multi-dimensional nature of IWB. Other studies have explored multiple measures for distinct IWB-dimensions, but often fail to test the validity of these separate dimensions (Krause, 2004; Dorenbosch et al., 2005) or report limited evidence on the construct validity of the subdimensions due to four under-represented dimensions (e.g., De Jong and Den Hartog, 2010). As Messick (1995) points out: Construct under-representation threatens validity. The multiple IWB measures, developed by Messmann and Mulder (2012) for the education context suffer from similar deficiencies. Their work supports the existence of multiple IWB-dimensions. However they cannot yet empirically substantiate an idea realisation dimension.

In sum, IWB conceptualisations and operationalisations need further attention. Existing measurements miss empirical evidence of the construct validity and moreover do not include a sustainability dimension. Our study aims to develop and validate a multi-dimensional IWB instrument to measure teachers IWB. Based on a thorough and comprehensive conceptualisation of IWB, we first adapted and extended the previous used instruments and developed items for a sustainability dimension. Second, we tested the construct validity of this newly developed multi-dimensional IWB instrument.

Theoretical framework

Kanter (1988) developed the foundation for IWB, as it is known today. She suggested that the innovation process in organisations could best be understood by dividing it into tasks that individuals engage in, correlating with the innovation process. The following four tasks were identified: Idea generation, coalition building, idea realisation and transfer/ diffusion. Since Kanter, many authors have addressed the role of the individual in innovation, often referred to as innovative behaviour (e.g., Scott & Bruce, 1994; Woodman et al., 1993). Janssen (2000) proposed the term innovative work behaviour for the 'intentional creation, introduction and application of new ideas within a work role, group or organization in order to benefit role performance, the group or the organization' (p.288). Janssen's proposal was adopted on a wide scale (e.g., De Jong & Den Hartog , 2010; Tuominen & Toivonen, 2011; for an overview of studies in the educational context, see Thurling et al., 2015). If we compare this elaboration with the phases of innovation proposed by Kanter, we see that the transfer/ diffusion phase is not included in Janssen's concept.

Previous dimensions of IWB

Many scholars have discussed the multi-dimensionality of individual innovation and, later on, IWB. In 1990, Farr and Ford proposed a two-stage model that includes a creative and an implementation part. In the same vein, Krause (2004) and Dorenbosch et al., (2005) argued for a two-stage model comprising creativity-oriented and implementation- oriented work behaviour. In addition to two-stage models, multi-stage models have been proposed. For the three-stage model, the dimension idea promotion was added to the idea generation, and idea realisation dimensions (e.g., Janssen, 2000, Scott & Bruce, 1994, 1998). In the four-stage model scholars have included the opportunity exploration (OE) phase, which preceeds idea generation. In the OE phase problems and needs in one's work context are recognised, and change opportunities are created (e.g., Janssen et al., 1997; Kleysen & Street, 2001). In a first five-stage model, Kleysen and Street (2001) added the formative investigation stage, referring to the Krause (2004) testing phase. This stage entails formulating new ideas and solutions, testing them, and evaluating the outcomes (Kleysen & Street, 2001). Messmann and Mulder (2012) added a fifth stage to the opportunity exploration, idea generation, promotion, and realisation stages: The reflection stage. This stage 'encompassess assessing the progress of innovation development, evaluating activities and outcomes based on criteria for success, examining one's personal advancement during innovation development, and improving action strategies for future situations.' (p. 46).

Idea sustainability as an additional dimension of IWB

The multi-stage models of IWB outlined above are, notably, comparable with innovation models described in the innovation literature. Both the innovation models of West and Farr (1989) and Fullan (2007) in the educational context propose corresponding phases. If we compare the two models, it can be observed that the first two phases of West and Farr's model (recognition and initiation) are both included in the initiation phase of Fullan's model. This initiation phase consists of change initiation, where performance gaps are recognised and new solutions or ideas are generated. Both models identify an implementation phase, during which the group executes the innovation the first time, and where effects of the implementation are observable in the work place. West and Farr completed the innovation cycle with a stabilisation phase, or, as Fullan named it, a continuation phase. In this phase, the change has to become embedded in the organisational system. Hence, the continuation phase is an extension of the implementation phase, anchoring the innovation in the organisation. Both models present a more encompassing definition of innovation, which is important, given that in educational settings there is a tendency to ignore the conditions (such as time) for the continuation or stabilisation phase. In this context, both West and Farr, and Fullan stress the importance of a stabilisation or continuation phase to sustain an innovative idea.

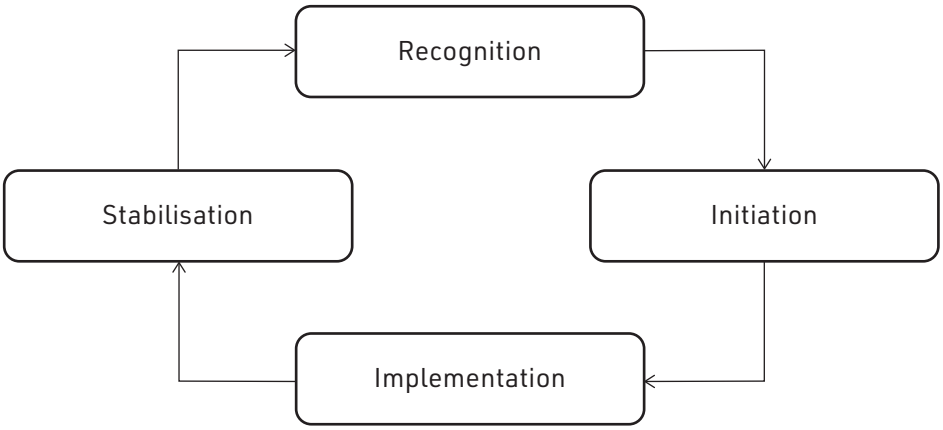


Figure 2.1 The innovation cycle (West & Farr, 1989)

The prevailing conceptualisations of IWB include dimensions that refer to the first three phases of the innovation cycle (see Figure 2.1). Remarkably, neither the stabilisation nor the continuation phase is reflected in any of the IWB conceptualisations. Despite Kanter's (1988) emphasis on the diffusion phase, this phase has not been included in more recent conceptualisations of IWB, such as the

work of Messmann and Mulder (2011) who argue that the diffusion is unrelated to innovation, with different contextual characteristics, other persons and distinct resources. However, as Van de Ven (1986) puts it: 'An invention or creative idea does not become an innovation until it is implemented or institutionalized' (p.604). So, Van de Ven (1986) and Johnson et al. (2004) argue that it is necessary to focus both on the implementation of innovations in the short and the long term. It follows that those responsible for the implementation of an innovation must continue to work on its sustainability, where the further continuation of the newly implemented idea must be a primary goal. This sustainability phase includes disseminating innovative ideas into the deeper structure of the organisation through institutionalisation (Gannaway et al., 2013; Reay et al., 2013). Particular steps have to be taken to strengthen the infrastructure that are necessary to sustain an innovative idea (Johnson et al., 2004). The literature specifies the folowing features of sustainability: Improving and optimising the innovation, such as updating and continuous regeneration to avoid implementation dips (Coffey & Horner, 2012; Fullan, 2002, Loh et al., 2013); embedding the innovation in-depth in the system of the organisation, by capacity building for securing adequate resources (Loh et al, 2013; Fullan, 2007); disseminating the innovation on a larger scale, like planning for project growth and broader application of an innovative idea (Loh et al., 2013) and finally visualisation of the benefits of the innovation for stakeholders by stimulating community participation and communicating a longer-term vision and outcomes (Loh et al., 2013). In sum, we propose the following definition of IWB:

Innovative work behaviour is a multi-stage iterative process in which employee behaviour targets the exploration of opportunities, idea generation, idea promotion, idea realisation and the sustainable implementation of these ideas, processes, products or procedures within a role, a group or an organisation, whereby the ideas are (relatively) new and intended to benefit the relevant unit of adoption.

Previous Measures of IWB excluding the idea sustainability dimension

Alongside the discussions that have taken place at a conceptual level, efforts have been made to measure IWB, see Table 1. In 1994, Scott and Bruce developed the first instrument to measure IWB ('individual innovation'). Although they define innovative behaviour as encompassing three dimensions (idea generation, coalition building and idea realisation), their six-item instrument is a one-dimensional operationalisation. Starting from a similar conceptualisation (idea generation, idea promotion, idea realisation), Janssen (2000) is the first researcher who tries to develop a multi-dimensional scale (nine items) using both self and other's ratings of IWB. Due to high correlations between the subscales he infers that the set of items represents a single scale with high reliability for the total instrument. However,

Table 2.1 Findings from literature: Authors, number of items and dimensions, quality of measurements, number of respondents and domains

Authors	(Conceptual) Dimensions and items	Number of Likert scale categories	Reliability and validity	Number of respondents	Domain
One-dimensional			No validity tests reported		
Scott & Bruce (1994)	Idea generation, promotion and realisation 6 items	5 point Likert scale	Reliability (= .89).	n= 172	Engineers, scientists and technicians in R&D facility in industrial domain
Bunce & West (1995)	Innovative behaviour 5 items	No information available	Reliability sample 1 = (.75), sample 2 = (. 80)	Sample 1 n= 435 Sample 2 n= 281	Employees from a national health service
Spreitzer (1995)	Innovative behaviour 4 items	No information available	Reliability (= .91)	n= 393	Managers of an industrial company
Basu & Green (1997)	Innovative behaviour 4 items	No information available	Reliability (= .93), supervisor ratings.	n= 225	Employees of a printing manufacturer
Scott & Bruce (1998)	Innovative behaviour 4 items	7 point Likert scale	Sample 1: Reliability (= .86). Significant correlation with objective measure of individual innovation Sample 2: Reliability (= .84)	Sample 1 n= 110 Sample 2 n= 149	Sample 1: engineers and scientists in R&D facility in industrial domain, Sample 2: R&D engineers in electronic equipment
Janssen (2000)	Idea Generation, idea promotion, idea realisation 9 items	7 point Likert scale	Good reliability (= .94). High inter-correlations, so assumed scale to combine additively to create overall scale (= .95 and = .96 for self-ratings and supervisor ratings). Significant correlation between both scales (r = .35)	n = 170 self-ratings n= 110 supervisor ratings	Employees of industrial organisation in food sector.
Kleysen & Street (2001)	Opportunity exploration, generativity, formative investigation, championing and application 14 items	6 point Likert scale	Reliability (= .95). No evidence found for 5-dimensional model	n= 225	Multiple types of employees and organisations
Radaelli et al., (2014)	Innovative behaviour 4 items (based on Janssen, 2000)	7 point Likert scale	Reliability (= .94)	n= 155	Healthcare employees

Authors	(Conceptual) Dimensions and items	Number of Likert scale categories	Reliability and validity	Number of respondents	Domain
Multi-dimensional					
Krause (2004)	2 dimensions generating and testing of ideas & implementation.Total 8 items creativity (5 items) implementation (3 items)	7 point Likert scale Exploratory Factor Analysis (EFA)	No validity tests reported Reliability (= .78 / .81).	n= 399	Middle management of multiple types of organisations
Dorenbosch et al., (2005)	2 dimensions creativity- oriented and implementation-oriented behaviour Total 16 items creativity (10 items) implementation (6 items)	5 point Likert scale (EFA)	No validity tests reported Reliability (= .88 / .90) conceived to combine additively as overall scale for IWB (= .92)	n= 132	Administrative employees of governmental organisation
De Jong & Den Hartog (2010)	4 dimensions (10 items) idea exploration (2 items) idea generation (3 items), idea championing (2 items) idea implementation (3 items)	5 point Likert scale (EFA) and Confirmatory Factor analysis (CFA)	Reported content validity and criterion validity. Empirical evidence, supporting the number of dimensions, is lacking. The author's notion that the 10 items can be used as an overall scale make it unlikely that the 10 items represent four dimensions. It is likely that the four operationalisations are under-representations of the underlying variables, which threaten the construct validity (Boyle, 1991; Messick, 1995) Reliabilities: Idea exploration (=.88), idea generation (=.90) idea championing (=.95) idea implementation (=.93)	n= 703	Employees and managers from small knowledge-intensive firms
Messmann & Mulder (2012)	4 dimensions (20 items) opportunity exploration (4 items) idea generation (6 items) idea promotion (7 items) reflection (3 items)	6 point Likert scale	Empirical evidence for 4 of the 5 dimensions. Idea realisation items loaded on the other factors. Reliabilities: Opportunity exploration (= .76) idea generation (= .83) idea promotion (= .87) reflection (= .76). Criterion validity and initial evidence for content, construct and cross validity	n= 335 and n= 293	Employees of automotive supply organisation and teachers in vocational education

both separate measures are still applied frequently, although there is insufficient information on the validity of the instruments (Thurlings et al., 2015; Yidong & Xinxin, 2013). Another attempt to develop a multi-dimensional scale is reported by Kleysen and Street (2001). They identified the dimensions: Opportunity exploration, generativity, formative investigation, championing and application. Their instrument has been tested in a variety of organisations, but they have not been able to provide evidence for their five-dimensional model. Studies, which have not executed validity tests, have reported a two-dimensional (Krause, 2004; Dorenbosch, et al, 2005) or four-dimensional (De Jong and Den Hartog, 2010) measure; although the latter article provides limited evidence for its construct validity. The most recent measures provided by Messmann and Mulder (2012), who have developed measures for five dimensions namely: Opportunity exploration, idea generation, idea promotion, idea realisation and reflection. However, the authors have not yet succeeded to identify the idea realisation dimension in the validation sample.

Table 2.1 illustrates the most recent attempts to develop measures for multiple IWB-dimensions. However, only a few studies also attempt to validate the measures. Merely two out of the four studies that hypothesise multiple IWB-dimensions provide empirical evidence that (partly) supports the hypothesised dimensions. The remaining two studies do not go beyond reporting initial consistency measures in terms of Cronbach's Alpha. Internal consistency is a prerequisite for validity but does not guarantee validity (Boyle, 1991). Moreover, in contrast to the original theory on IWB, the four studies fail to conceptualise and operationalise a sustainability dimension. Therefore, this study aims to develop and validate a multi-dimensional instrument for measuring IWB consisting of five dimensions, namely opportunity exploration, idea generation, idea promotion, idea realisation and idea sustainability.

Method

Procedure and participants

Data on the innovative work behaviour scale were collected from four different vocational education institutes in the South of The Netherlands. Their board members expressed in meetings with the authors that in their institutes educational innovation is of paramount importance. All four institutes have taken initiatives to put innovation high on their agenda. Each board member has given permission to approach the deans of the different departments in their institutes. A number of deans responded and allowed access to the teamleaders of the various education teams. These teamleaders have been visited and informed by the researcher on the

subject of the study. Teacherteams were informed by teamleaders and were asked to participate in the study on a voluntary basis by filling out an online questionnaire. In total, 440 teachers completed the survey. More than half of the sample was female (58.8%). On average, participants had 15.5 years of work experience in the vocational sector and the average age was 48.34 years. Respondents worked in various domains (i.e. economics, ICT, healthcare, hospitality, education etc.)

Scale construction

Based on the literature review, we hypothesised that innovative work behaviour consisted of five dimensions, namely opportunity exploration, idea generation, idea promotion, idea realisation and idea sustainability. In turn, the scale for measuring IWB had five dimensions, namely opportunity exploration (OE), idea generation (IG), idea promotion (IP), idea realisation (IR) and idea sustainability (IS).

The scale for measuring IWB consisted of 32 traditional IWB items (measuring OE, IG, IP and IR) based on two questionnaires developed by Messmann and Mulder (2012, 2014), completed with 20 literature-based, newly developed items for OE, IG, IP and IR and the sustainability dimension. All items were subjected to reflective discussions between the researchers, keeping in mind the original theoretical framework on IWB, and the broader conceptualisation of educational innovations as discussed above. The pool of 52 items was supposed to represent the right set of items to cover the five dimensions. If needed, items were slightly adapted and reformulated to better attune the target group of vocational teachers. This was the case with two OE items (e.g., exchanging thoughts on recent developments or problems at work with one's colleagues), three IG items (e.g., discussing personal suggestions for improvements with one's colleagues), one IP item (e.g., providing insight on the step-by-step transformation on the new idea into practice) and two IR items (e.g., drawing up possible operational strategies for future and comparable situations). Finally, two new items were added relating to IR, to better discriminate between the dimensions idea promotion and idea realisation (e.g., supporting colleagues with the application of a developed idea). For the development and the customisation of the items, we followed the steps for scale construction as proposed by Spector (1992). The content validity was assessed by verifying whether the literature-based operationalisations genuinely represented the intended content domain for each construct (Boyle, 1991; Curda, 1997; Linacre, 2006; Trochim, 2002).

Following Spector's (1992) steps for scale construction once again, twenty new items were developed as operationalisations of the sustainability dimension. The following search terms were used in the preceding literature review: Sustainability, durability, transfer, adoption, diffusion, continuation of innovations, dissemination

of innovations, institutionalisation, maintaining innovations and scalability of innovations, both in English and American orthography. Second, results (definitions of sustainability, and its features) from the literature search, were presented to experts (n = 4) in the field of educational development (a professor corporate learning in business and economics; a professor in educational sciences, and two senior researchers in educational psychology and learning and development). Collectively, the most relevant definition and features of sustainability were determined, namely improving and optimising the innovation, disseminating the innovation on a larger scale, embedding the innovation in-depth in the system of the organisation, and visualising the benefits of the innovation for stakeholders. Third, 20 items were developed in accordance to these features. The constructed items were presented to the same expert group to judge their relevance and clarity. Fourth and final, a pilot study was employed, in which the questionnaire with all five dimensions was presented to a group of teachers, who were active members of an educational research community for continious professional development in an institute for vocational education in The Netherlands (n = 10). The participants in the pilot study matched the target group of vocational teachers. Feedback on the items was processed, and in a second session, the questionnaire was scrutinized for clarity, layout and the degree to which the items subjectively appeared to measure the constructs (face validity). The pilot study resulted in minor adaptations in wording of the items and layout of the questionnaire. Furthermore the pilot study revealed that the respondents only used a restricted number of answer options. The person response patterns deviated from the intended six-point scales (1 = does not apply, 6 = fully applies). The rating scale was not adapted, due to the small size of the pilotgroup, but it led to the choice of the Rasch rating scale model (Rasch, 1960) to analyse the scale structures of the five intended dimensions. All scales are introduced by the sentence: 'To what extent do the following work activities apply to you'. The Appendix lists all IWB items (52 items).

The questionnaire also included items that measured personal background variables, such as gender, age, level of education, job tenure, working hours and job position. All these characteristics have shown to be significantly related to IWB (e.g., Baer et al., 2003; Janssen, 2005; Messmann & Mulder, 2014; Pieterse et al., 2010).

Data analysis

Preliminary analysis

The analysis was conducted in two stages. The preliminary analysis involved scrutinizing the IWB scales with the Rasch rating scale model (Rasch, 1960) to create invariant interval measures and to evaluate the construct validity of the IWB

dimensions. Also, to shed more light on the restricted person responses patterns on the items of the scale, as observed in the pilot group. The IWB survey (including its new scale sustainability) employs six-point Likert scales. Likert scales consists of ordered (ordinal) raw scores. A 6-point Likert scale consists of six ordered categories, where the second category in a scale item represents more of the attribute than the first category, the third more than the second, and so on. However it is unknown whether the psychological distances between the categories are equal to each other (e.g., is the distance from strongly agree to agree equal to the distance between agree and disagree). On top of that, it is unknown whether respondents can genuinely distinguish six substansive differences in a scale item. The fact that the response format is providing six respons options for each item, does not guarantee that all six categories are genuinely used by participants. A Rasch model can diagnose how many categories are distinguished by persons in items and across sets of items. Subsequently, the Rasch model can transform ordered raw scores into equal measurement units (interval level) if the data fit the Rasch model. Like a ruler or a thermometer, a Rasch measure is composed of equal, interval measurement units, which guarantees invariant measurements across samples. Also, Rasch models allow researchers to examine person and item measures simultaneously on the same interval scale. In our study scales and items were developed based on previous research and content related literature. Rasch analyses were used as confirmatory tests of the extent to which scales have been succesfully developed according to prior measurement criteria (Ludlow et al., 2008).

For the present study, the Rasch rating scale model was used (Rasch, 1960). The Rasch analyses were executed in WINSTEPS 4.0, which uses joint maximum likelihood estimation (JMLE; Linacre, 2017a). The transformation of ordered qualitative observations into additive measures is a Rasch model. Rasch models are logit-linear models. The polytomous Rasch rating scale model that is applied in the current study uses the following additive transformation (Linacre, 2017a, p. 34):

$$\log(P_{nij} / P_{ni}(j-1)) = B_n - D_i - F_j$$

Where P_{nij} is the probability that person n encountering item i is observed in category j; B_n is the ability of person n; D_i is the difficulty measure of item i, the point where the highest and lowest categories of the item are equally probable. F_j is the calibration measure of category j relative to category j-1, the point where categories j-1 and j are equally probable relative to the measure of the item. No constraints are placed on the possible values of F_j. To scrutinize the IWB scales, six requirements were investigated (e.g., Wolfe & Smith Jr., 2007): Rating scale effectiveness, dimensionality, reliability, item measure quality, person measure quality and item hierarchy.

Confirmatory factor analysis

The second phase of the analyses consisted of confirmatory factor analysis (CFA), with the results of the Rasch analysis, in AMOS, version 25 (Arbuckle, 2006) to analyse the structural relationship between the items and their latent variables and the intercorrelations between the variables. To assess the model fit, a variety of fit indices were used, to be able to illuminate different aspects of goodness of fit (Lomax & Schumacker, 2004). As recommended by Schermelleh-Engel, Moosbrugger and Müller (2003), we used the Chi-square test (X^2), a likelihood ratio test statistic. The chi-square statistic postulates that the specified factor loadings, factor variances, factor co-variances and error variances are valid. The chi-square/df ratio (X^2/df), provides information on model parsimony. A rule of thumb is that X^2/df values between 1-3 are indicative for parsimonious models (Tabachnick et al., 2007). The Tucker-Lewis Index (TLI) informs us of the adequacy of a nested model. A TLI >.90 represents a good fit (Byrne, 2016). The Comparative Fit Index (CFI; Bentler, 1990) also compares the specified model with the baseline model. A CFI >.95 represents an excellent fit (Byrne, 2016; Hu and Bentler, 1999). Finally the Root Mean Square Error of Approximation (RMSEA; Hair, et al., 2010) evaluates the model fit, taking into account the complexity of the model. RMSEA values <.50 indicate good fit (Hair et al., 2010).

Results

First the process of the scrutinizing the IWB-scales in the Rasch model, based on the six criteria, is described, followed by the confirmatory factor analysis in AMOS-25.

Rasch analyses

Rating scale effectiveness indicates how well each scale is functioning and, how well each of the IWB scales fits the Rasch model. As described previously, a Rasch model allows us to diagnose how many categories are distinguished by persons, in sets of items. Subsequently, if a (re-categorised) scale fits the Rasch model, the ordered raw scores can be transformed in a scale that consists of equal measurement units (interval level). These Rasch interval measures are invariant across samples, and allow researchers to examine person measures and item measures simultaneously on the same interval scale. The rating scale effectiveness was evaluated by analysing each scale's average item INFIT and OUTFIT mean square fit statistics. In survey development researchers mostly focus on item construction. Boone, Staver and Yale (2014) recommended that for items, the item outfit mean square values (MNSQ's) should be inspected. Outfit MNSQ's are sensitive to outliers in the data; infit MNSQ's are sensitive to unexpected behaviour close to the item's difficulty (or

Table 2.2 Rating scale effectiveness

	Measure	Model Error	INFIT MNSQ	OUTFIT MNSQ
Dimension opportunity exploration				
Items (n= 4) item structure 4-5-6				
Item Mean	.00 (.47)	.12	.99	1.00
Person Mean	5.07 (0.61)	1.33	.99	1.00
Dimension idea generation				
Items (n= 7) item structure 4-5-6				
Item Mean	.00 (.25)	.12	.99	.98
Person Mean	5.07 (0.61)	1.16	.98	.98
Dimension idea promotion				
Items (n=7) item structure 3-4-5-6				
Item Mean	.00 (.47)	.10	.99	.99
Person Mean	5.08 (0.60)	.94	.98	.98
Dimension idea realisation (criterion-based implementation)				
Items (n= 4) item structure 2-3-4-5-6				
Item Mean	.00 (.31)	.09	.99	.98
Person Mean	3.84 (1.01)	1.15	1.20	1.20
Dimension idea realisation (learning-based communication)				
Items (n=5) item structure 3-4-5-6				
Item Mean	.00 (.94)	.08	1.00	.96
Person Mean	4.23 (0.68)	.96	.97	.96
Dimension idea sustainability (external dissemination)				
Items (n=6) item structure 3-5				
Item Mean	.00 (.65)	.10	.99	1.21
Person Mean	3.80 (0.75)	.99	.97	1.20
Dimension idea sustainability (internal embedding)				
Items (n=11) item structure 3-5				
Item Mean	.00 (.67)	.08	1.02	.92
Person Mean	4.10 (0.63)	.73	1.00	.92

Means of Rasch items (thus also the Rasch scale means) are always arbitrarily fixed to zero. The presented scale means are average person measures. The average person means and person standard deviations (in brackets, after the person Mean) are recalibrated into the original raw Likert scores. The remaining fit statistics are expressed in logits.

person's endorse ability) level. Outfit MNSQ's, as well as infit MNSQ's of attitudinal data should be ≥ .50 and ≤ 1.5.

Mean square values ≥ 1.5 indicate noise in the data; ≤ .50 suggest dependency. Table 2 shows that the average item outfit mean squares are within the range of .92 – 1.21 logits, which demonstrates that the scale measures meet the requirements of the Rasch model.

As described previously, the Rasch model allows us to scrutinize item measures and person measures simultaneously, and on the same interval scale. The person measure quality is assessed by evaluating each scale's average person measure (the person Mean) and by evaluating each scale's person infit and outfit mean square value (Table 2.2). A scale's person Mean reflects the degree to which a scale is tuned to the target group. The person Means, which are recalibrated into their (recalibrated) Likert scores vary from 3.80 (*SD*= 0.75) to 5.07 (*SD*= 0.60). High scale person Means are indicative for scales that are too easy to endorse by the target group (e.g., the creativity constructs OE, IG and IP). In addition, also the person standard deviation should be taken into account, to diagnose how persons are dispersed along the latent variable of each scale. Table 2.2 demonstrates that the easiest scale to endorse IP, also shows the smallest spread along the underlying variable. Similar to the item fit requirements, the average person infit and outfit MNSQ's should be ≥ .50 and ≤ 1.5 (Linacre & Wright, 1994).

Dimensionality is assessed by principal components analysis of the standardised residuals of each (restructured) scale's residuals. This analysis identifies how much variance is explained by the person and the item measures. The identification of Eigen Values >2 indicate that two or more items might (also) measure something different than the latent variable. This can then be verified by a statistical comparison of the person measures of both possible dimensions. Disattenuated correlations (correlations, corrected for measurement errors) between the possible dimensions ≥ r = .70 that co-occur with ≤ 5% (max <10%) of the person measures outside the 95% confidence boundaries are strong indicators that a construct is one-dimensional (Linacre, 1998). If more than the expected 5% (max 10%) of the person responses falls outside the confidence boundaries the likelihood increases that more than one dimension is measured. Two scales showed to be two-dimensional. Idea realisation differentiated into two subscales and also idea sustainability was divided into two different subscales (see Table 2.2).

Person reliability and person strata indicate the extent to which scores are reproducable and/or the extent to which a scale can distinguish endorse ability differences between persons (see Table 2.3). *Person reliability* is expressed in Cronbach's alpha and refers to the internal consistency of a scale. Cronbach's alphas varies from .84 to .94 indicating good to excellent internal consistency for each scale. *Person strata* represent how many different endorse ability levels between persons can be distinguished which cannot be attributed to measurement errors. Person strata should at least be ≥ 2.0. All person strata meet this criterion except for idea sustainability external dissemination (1.89).

Item reliability and item strata indicate the extent to which scores are reproducable and/or the extent to which a scale can distinghuish difficulty differences across items. *Rasch item reliability* is a Rasch characteristic specification of the item-difficulty-order reproducibility. Rasch item reliability range from .76 to .99, indicating good to almost perfect item reliability. *Item strata* represent how many distinct difficulty levels between items can be distinguished, which cannot be attributed to measurement errors. Item strata should at least be ≥ 2.0. Item strata vary from 2.68 to 15.37. All item strata meet this criterion (Table 2.3).

Table 2.3 Reliability and Strata measures (n = 440)

Dimension	Reliability	Strata
Opportunity exploration (OE)		
Persons	.84	2.51
Items	.94	5.63
Idea generation (IG)		
Persons	.94	3.48
Items	.76	2.68
Idea promotion (IP)		
Persons	.94	4.19
Items	.96	6.71
Idea realisation criterion-based implementation (IRCBI)		
Persons	.93	4.21
Items	.91	4.45
Idea realisation learning-based communication (IRLBC)		
Persons	.87	3.08
Items	.99	15.37
Idea sustainability external dissemination (ISED)		
Persons	.90	1.89
Items	.98	9.28
Idea sustainability internal embedding (ISIE)		
Persons	.92	2.49
Items	.99	11.32

The person reliability is expressed in terms of Cronbach's alpha; Item reliability is a Rasch specific item-difficulty-order reproducibility statistic.

Table 2.4 Item measure quality, as demonstrated by item measure hierarchical order, item measurement errors, and the outfit mean square statistics

Item	Measure	SE	INFIT MNSQ	OUTFIT MNSQ
Dimension opportunity exploration				
OE7	.74	.11	.89	.89
OE8	-.01	.11	.85	.85
OE6	-.16	.11	.76	.76
OE5	-.57	.11	1.47	1.50
Dimension idea generation				
IG7	.40	.12	.77	.72
IG5	.29	.12	.86	.88
IG3	.08	.12	1.20	1.17
IG1	-.09	.12	1.31	1.36
IG4	-.16	.12	.96	.92
IG6	-.22	.12	.87	.86
IG2	-.30	.12	.98	.95
Dimension idea promotion				
IP7	.91	.09	1.08	1.09
IP2	.23	.09	1.03	1.00
IP1	.20	.09	1.04	1.07
IP3	-.16	.09	1.06	1.04
IP6	-.20	.09	.93	.92
IP5	-.31	.09	.99	.97
IP4	-.67	.10	.81	.82
Dimension idea realisation (criterion-based implementation)				
IR5	.37	.09	1.17	1.17
IR2	.13	.09	1.06	1.06
IR3	-.03	.09	.76	.75
IR4	-.47	.09	.96	.94
Dimension idea realisation (learning-based communication)				
IR6	1.08	.08	1.10	1.07
IR9	.54	.08	1.00	.94
IR7	.24	.08	.81	.78
IR10	-.17	.08	1.09	1.06
IR8	-1.69	.08	1.00	.96
Dimension idea sustainability (external dissemination)				
ISV4	1.04	.11	1.13	1.89
ISV3	.58	.09	1.18	1.67
ISDL4	.08	.09	.77	.71

Table 2.4 Continued

Item	Measure	SE	INFIT MNSQ	OUTFIT MNSQ
ISDL3	-.31	.09	.83	.84
ISDL1	-.49	.09	.94	1.05
ISDL2	-.90	.09	1.06	1.13
Dimension idea sustainability (internal embedding)				
ISV1	1.47	.09	1.16	.97
ISDD4	.82	.08	1.01	.90
ISV2	.59	.08	1.07	.95
ISDD3	.24	.08	.89	.85
ISIO6	-.02	.08	1.00	1.14
ISIO2	-.31	.08	1.07	1.03
ISIO1	-.45	.08	1.09	.92
ISIO7	-.46	.08	1.02	.91
ISDD2	-.49	.08	.99	.86
ISDD1	-.66	.08	1.05	1.11
ISIO8	-.73	.08	.82	.54

Rasch measures are invariant interval measures, within the boundaries of their measurement errors. Rasch measures are expressed in logits. All item calibrated measures are already hierarchically ordered from easiest to endorse (at the bottom of the scale) to most difficult to endorse (top).

Item measure quality is evaluated by examining the item hierarchy, the extent to which the items vary in difficulty, the size of the standard errors, and the degree to which the items fit the expectation of the Rasch model, see Table 2.4. *Item hierarchy* implies that items should be ordered from bottom to top, from easiest to endorse to most difficult to endorse. Items rank-order themselves in a manner that is consistent with the theory. The item hierarchical maps of all subdimensions are investigated and were hierarchically ordered, see Table 2.4.

Item difficulty calibrations encompassed ranges from -0.30 to 0.40 logits (IG) to -1.69 to 1.08 logits (IRLBC), indicating a weak to a good distribution of items along their latent variable (Table 2.4). Standard errors are small, ranging from 0.08 to 0.12 logits. OUTFIT mean square values, which are sensitive to outliers, are the most important quality indicators for items (Boon et al., 2014). Linacre and Wright (1994) suggest that outfit MNSQ's as well as infit MNSQ's for attitudinal data should preferably be ≥ 0.5 and ≤ 1.5 are ideal. Only item ISV4 and ISV3 (dimension idea sustainability external dissemination), show some noise in their OUTFIT mean square statistics (1.89 and 1.67 respectively).

Eight items out of the pool of 52 items were deleted because they did not meet the requirements of the Rasch Rating Scale model, neither in the original scale structure format, nor the restructured one (see Appendix).

Person background variables and the IWB-dimensions

As described in the scale construction section, our questionnaire also en compassed personal background variables. Previous research has reported significant relationships between IWB and personal background variables.

The Rasch model has not only provided valuable information on how IWB items should be restructured in order to produce invariant person and item measures for all hypothesised IWB scales (see Table 2.2), but also allows us to utilise these measures to get an impression of the relationships between person background characteristics and the distinct IWB-dimensions. Exclusively the significant relationships are now described below.

Significant relations between person background characteristics and IWB are differentiated across the distinct dimensions. Age correlates significantly and negatively with idea sustainability external dissemination, $r= -.134$, $p < .01$. Significant positive correlations between being a woman and the creative IWB-dimensions are found: OE, $r= .135$, $p < .01$, IG, $r= .128$, $p < .01$, and IP, $r= .100$, $p < .05$, supplemented by a significant positive correlation between being a woman and IR learning-based communication, $r= .128$, $p < .01$. A higher previous education level is significantly and positively related to all idea realisation and idea sustainability dimensions. IRCBI, $r= .126$, $p < .01$, IRLBC, $r= .129$, $p < .01$, ISED, $r= .217$, $p < .01$ and, ISIE, $r= .180$, $p < .01$. Work hours ratio is positively and significantly related to IP, $r= .105$, $p < .05$, IRCBI, $r= .133$, $p < .01$, and both idea sustainability dimensions (respectively $r= .138$, $p < .01$, for ISED and $r= .176$, $p < .01$, for ISIE). To complete with, being employed in Vocational Education (college level), as compared to being employed in a University of Applied Science is significantly, and negatively correlated with IP, $r= -.150$, $p < .01$, IRCBI, $r= -.178$, $p < .01$, IRLBC, $r= -.229$, $p < .01$, ISED, $r= -.286$, $p < .01$ and ISIE, $r= -.268$, $p < .01$.

CFA

Most researchers are more familiar with confirmatory factor analysis (CFA) than the Rasch model. Hence, to demonstrate the construct validity, the extent to which a set of measured items actually reflects the theoretical latent construct, we test the relationships between items and their latent variables (i.e., the path estimates linking the underlying variable to indicator variables) in CFA. In CFA higher loadings confirm that the indicators (items) are strongly related to the latent variable.

Significant loadings confirm construct validity. A rule of thumb suggests that the loadings should be at least .5 and ideally .7 or higher. Lower loadings suggest that an item is a candidate for deletion from the model (Hair et al., 2010). Table 2.5 shows that all loadings are between .59 -.90 which indicate good construct validity. Item means scores and standard deviations are also displayed in Table 2.5.

Further we tested the seven-factor model, containing the following dimensions: Opportunity exploration, idea generation, idea promotion, idea realisation (both criterion-based implementation and learning-based communication) and the dimension idea sustainability (both internal embedding and external dissemination). This model showed a good fit (X^2 = 1658, *df*= 864, X^2/df = 1.92, CFI = .95, TLI = .94 and RMSEA = .046).

Table 2.5 CFA results items, means, standard deviations, and factor loadings of the innovative work behaviour instrument

				Factor						
	Item wording	***M***	***SD***	**1**	**2**	**3**	**4a**	**4b**	**5a**	**5b**
	Opportunity exploration (OE)									
1	Questioning the current concepts, work processes and results with the goal to improve them#	5.08	.76	.83						
2	Discussing the possible leeway for change with colleagues#	4.94	.76	.80						
3	Questioning the effectiveness of the current way of working#	5.10	.76	.83						
4	Exchanging thoughts on recent developments or problems at work with colleagues#	5.17	.78	.59						
	Idea generation (IG)									
5	Asking critical questions about current situations at work#	5.09	.75		.72					
6	Suggesting improvements on expressed ideas^	5.01	.78		.89					
7	Exchanging ideas on concrete changes at work with one's colleagues #	5.10	.75		.85					
8	Specifying which elementary improvements can be implemented at work#	5.02	.76		.87					
9	Discuss personal ideas for improvement with one's colleagues #	5.09	.76		.84					
10	Expressing a personal opinion of underlying problems in the workplace#	5.06	. 78		.76					
11	Suggesting new ideas to solve problems in the current work situation#	5.12	.75		.82					
	Idea promotion (IP)									
12	Suggesting the new idea to key persons who are authorized to allocate resources for this new idea^	4.59	.99			.81				
13	Convincing others of the importance of a newly developed idea or solution^	4.60	.94			.81				
14	Promoting new ideas to the supervisor in order to gain his/her active support^	4.69	1.00			.82				
15	Promoting new ideas to colleagues in order to gain their active support^	4.81	.92			.87				
16	Promoting the application of a new solution within one's work context^	4.73	.93			.84				
17	Getting colleagues acquainted with the utilisation of the new idea or solution#	4.70	.93			.82				
18	Making it clear to others, how a new idea can be stepwise put into practice#	4.43	.96			.79				
	Idea realisation (criterion-based implementation, IRCBI)									
19	Defining criteria of success for the realisation of the idea^	3.81	1.19				.85			
20	Monitoring the progress during the process of putting ideas in practice^	4.03	1.19				.90			
21	Analysing the solutions that are found on undesired effects, when putting ideas into practice^	3.92	1.22				.88			
22	Testing solutions for unexpected problems that emerge, when putting ideas into practice^	3.87	1.21				.82			
	Idea realisation (learning-based communication, IRLBC)									
23	Obtaining information from people who have already put the idea into practice, about possible bottlenecks during the implementation process+	4.27	1.02					.72		
25	Reflecting critically on the actions you execute when putting the idea into practice#	4.80	.97					.73		

	Item wording	*M*	*SD*	Factor 1	2	3	4a	4b	5a	5b
26	Reflecting systematically on your experiences when putting the new idea into practice#	4.14	1.04					.78		
27	Keeping colleagues posted about the progress of the realisation of the idea^	3.86	1.01					.75		
	Idea sustainability (external dissemination, ISED)									
28	Discussing broader applications of the implemented idea with colleagues outside your team+	3.94	1.00						.81	
29	Participating in networks that have the innovation or new idea as a theme+	4.05	1.00						.79	
30	Initiating collaboration with other groups in the organisation to apply the idea in other contexts also+	3.88	.99						.80	
31	Initiating collaboration with other groups outside of the organisation to apply the idea in other contexts also+	3.76	.97						.80	
32	Communicating explicitly the returns of the implemented idea outside the team+	3.62	.93						.69	
33	Visualising the output of the implemented ideas to a broader audience+	3.52	.88						.63	
	Idea sustainability (internal embedding, ISIE)									
34	Exchanging information about bottlenecks with people who have already implemented the idea+	4.33	.94							.71
35	Comparing the results of the implemented idea with the predetermined, original goals+	4.27	.96							.68
36	Initiating quality assurance systems that support the implemented idea+	3.82	.98							.67
37	Being aware of the steps that can be made to make a success of the implementation process+	4.34	.94							.70
38	Communicating explicitly the returns of the implemented idea, in the team+	3.91	1.00							.68
39	Executing improvement activities to optimise the implemented solutions+	4.43	.91							.70
40	Organising activities for professional development for yourself and your colleagues, to continue the development of the idea+	4.16	.99							.75
41	Actively gathering results of the implemented ideas or solutions+	4.33	.95							.66
42	Showing initiative to anchor the new idea in existing procedures or structures of the organisation+	4.05	1.00							.64
43	Discussing with colleagues how implemented ideas can be embedded more firmly in the system of the organisation+	4.40	.92							.69
44	Substantiating the implemented ideas with figures+	3.61	.92							.59

Note: Items were translated into English. Scale structures were adapted based on Rasch analyses and transformed from six-point Likert scales to adapted scales. Scale structures: OE 3 point scale (4,5,6), IG 3 point scale (4,5,6), IP 4 point scale (3,4,5,6), IRCBI 5 point scale (2,3,4,5,6), IRLBC 4 point scale (3,4,5,6), ISED 2 point scale (3,5) ISIE 2 point scale (3,5)

^ Original item, Messmann and Mulder (2012) validated study

Adapted items inspired by Messmann and Mulder (2014) and oral communication, no validation study available

+ Newly developed item

General discussion

The urgent needs for innovation as well as the problems associated with the rapid pace of innovations have put the concept of IWB on the educational research agenda (Thurlings et al., 2015). However, the lack of cross-validated measurement instruments, which conceptually fit the literature on innovation (cycles), jeopardises our understanding about why innovations in educational institutions fail or succeed. Our review of the IWB measurement research has shown that over the last three decades several IWB measures have been developed, mainly based on the work of Scott and Bruce (1994). However, the studies, conducted in a variety of settings show mixed psychometric results as well as differences in the number of dimensions, due to a lack of verifying the content validity, and testing the construct validity (Table 2.1) (Boyle, 1991; Messick, 1995).

Therefore, the purpose of this study was to develop and validate an instrument to measure innovative work behaviour of teachers in vocational education, covering all aspects of IWB, including sustainability, a dimension that was neglected in previous studies. We have hypothesised that IWB consists of five dimensions, namely OE, IG, IP, IR and IS. Preliminary Rasch analyses and CFA, have confirmed our hypothesis that IWB consists of these five main dimensions. Additional Rasch dimensionality analyses have differentiated both the realisation and sustainability dimension into two sub-dimensions (e.g., idea realisation criterion-based implementation and learning-based communication and idea sustainability external dissemination and internal embedding). The differentiation of the IR dimension into an IR criterion-based implementation and IR learning- based communication dimension is in line with the study of Messmann (2012), who distinguished physical and cognitive activities, considering reflection as a crucial phase in the innovative process. In our research both physical and cognitive activities are represented in the two sub-dimensions. Also, scale structures have been adjusted to improve the scale effectiveness and to guarantee that the measures are invariant across samples. In the Rasch model we have meticulously scrutinized the six requirements, as proposed by Wolfe and Smit Jr. (2007): Rating scale effectiveness, dimensionality, reliability, item measure quality, person measure quality and item hierarchy.

The model fit of the available ordinal scores on the Likert scales had to be examined in the Rasch model. Items that did not meet the requirements of the Rasch model were removed, and, if necessary, scale structures were adjusted to improve the scale's measurement quality and to assure invariance of measurement. The scale structures developed and tested in the Rasch model were tested with CFA. This

seven factor model (containing OE, IG, IP, IR with two subdimensions and IS with two subdimensions) showed a good fit.

With respect to the newly developed sustainability dimension, the identified, literature-based main features reflecting sustainability are represented in both sub-dimensions. The items reflecting *improving and optimising the innovation*, such as updating and continuous regeneration (Coffey & Horner, 2012; Fullan, 2002, Loh et al., 2013) and *embedding the innovation in depth in the system* of the organisation (Loh et al., 2013; Fullan, 2007) are clustered in the sub-dimension internal embedding. In practice we observe that the internal embedding (the implementation) is more successful when there are meetings with teachers before and after the implementation. Such meetings make it possible to discuss the training needs of the teachers involved, and to involve them in any adjustments they deem necessary for the implementation to succeed. This approach reduces the likelihood that teachers, fall back on their former behaviour (Wolbers et al., 2017) and it emphasise the importance to invest in time after the realisation phase.

Items reflecting *disseminating the innovation on a larger scale*, like planning for project growth (Loh et al., 2013) and *visualisation of the benefits* of the innovation for stakeholders (Loh et al., 2013) are clustered in the sub-dimension external dissemination. By adding the sustainability dimension to the current conceptualisation of IWB, we are strongly in line with the innovation cycles of West and Farr (1989) and Fullan (2007), who emphasised the importance of a stabilisation or continuation phase as a vital stage to complete an innovation process. The emphasis on this sustainability phase can help schools to firmly anchor innovative ideas in their organisations, preventing that time and energy are wasted through unfinished innovations.

The newly developed and validated IWB scale may help researchers to empirically examine this phenomenon more accurately, making it possible to gain more knowledge about its antecedents and consequences.

Limitations and future research

This study has several limitations that should be addressed in future research and questionnaire validity testing. Firstly, even though we used data from a heterogeneous sample including teachers from different professional institutes, the results confirm a five-structure model of IWB in the vocational educational sector only. Hence, future studies might benefit from the validation of our instrument by utilising the measures and operationalisations in samples, consisting of professional and general college level and/or university level education. Secondly, our study

only included Dutch participants. The obtained Rasch measures are invariant, but we have not yet explored internationally composed samples. The English version, which is provided in this paper (see Appendix, and Table 2.5), will also allow other researchers to use these validated measures in other countries. Third, we have only reported self-ratings of the IWB measures. Future research could also question the perception of the direct manager, for example, however that would require a revision of the questionnaire and thus another validation. Finally, the newly developed, theory-based instrument, with its new sustainability dimension, needs to be further developed. Although it proved to be a reliable and valid instrument, items can be added to increasingly better represent the experiences with the innovation cycle in practice. Such additional items will enhance the robustness of the operationalisation of the theoretical concepts of IWB.

By providing a reliable and valid scale at the interval level to measure innovative work behaviour, we hope to stimulate and encourage other researchers in the field to engage in research aimed at understanding why innovations fail or succeed. Collecting qualitative data (e.g., focus group or interviews with teachers) could help to deepen our understanding of the quantitative data that was found. Focus on the sustainability phase may help to prevent superficial or incomplete implementations. Although a great deal of literature has addressed the importance of the role of individuals in making innovations happen, many questions remain unanswered on how to support individuals in taking up this role and how to manage sustainable innovations. The availability of the IWB scales, supplemented with a sustainability dimension, is the first step towards further development of a model that identifies the antecedents of IWB.

Appendix: Original item pool to measure innovative work behaviour

* item dropped after Rasch analysis
All scales are introduced by the sentence: 'To what extent do the following work activities apply to you?'

Opportunity exploration

Keeping yourself posted about the organisations' general structures and processes. *
Keeping yourself posted about the latest developments in the organisation. *
Keeping yourself informed about new concepts and insights in your professional field. *
Keeping yourself informed about new developments in other organisations *
Exchanging thoughts on recent developments or problems at work with colleagues
Questioning the effectiveness of the current way of working
Discussing the possible leeway for change with colleagues
Questioning the current concepts, work processes and results with the goal to improve them

Idea generation

Asking critical questions about current situations at work
Suggesting new ideas to solve problems in the current work situation
Expressing a personal opinion of underlying problems in the workplace
Discuss personal ideas for improvement with one's colleagues
Specifying which elementary improvements can be implemented at work
Exchanging ideas on concrete changes at work with one's colleagues
Suggesting improvements on expressed ideas

Idea promotion

Convincing others of the importance of a newly developed idea or solution
Suggesting the new idea to key persons who are authorized to allocate resources for this new idea
Promoting new ideas to the supervisor in order to gain his/her active support
Promoting new ideas to colleagues in order to gain their active support
Promoting the application of a new solution within one's work context
Getting colleagues acquainted with the utilisation of the new idea or solution
Making it clear to others, how a new idea can be stepwise put into practice

Idea realisation

Supporting colleagues with the application of an already developed idea*
Testing solutions for unexpected problems that emerge, when putting ideas into practice
Analysing the solutions that are found on undesired effects, when putting ideas into practice
Monitoring the progress during the process of putting ideas into practice
Defining criteria of success for the realisation of the new idea
Keeping colleagues posted about the progress of the realisation of the idea
Reflecting systematically on your experiences, when putting the new idea into practice
Reflecting critically on the actions you execute, when putting the idea into practice
Designing operational strategies for future, comparable situations
Obtaining information from people who have already put the idea into practice, about possible bottlenecks during the implementation process

Idea sustainability

Actively gathering results of the implemented ideas or solutions
Comparing the results of the implemented ideas with the predetermined, original goals
Asking directly involved colleagues for improvements of the ideas that have been put into practice*
Discussing possible crucial improvements to the solution that has been put into practice with your supervisor *
Suggesting improvements to your colleagues or supervisor, after a meticulous analysis of the results of the solution *
Organising activities for professional development for yourself and your colleagues, to continue the development of the idea
Exchanging information about bottlenecks with people who have already implemented the idea
Executing improvement activities to optimise the implemented solutions
Discussing broader applications of the implemented idea with colleagues outside your team
Participating in networks that have the innovation or new idea as a theme
Initiating collaboration with other groups in the organisation to apply the new idea in other contexts also
Initiating collaboration with other groups outside of the organisation to apply the new idea in other contexts also
Discussing with colleagues how implemented ideas can be embedded more firmly, in the system of the organisation

Being aware of the steps that can be made to make a success of the implementation process
Showing initiative to anchor the new idea in existing procedures or structures of the organisation
Initiating quality assurance systems that support the implementation of the idea
Substantiating the implemented ideas with figures
Communicating explicitly the returns of the implemented idea, in the team
Communicating explicitly the returns of the implemented idea, outside the team
Visualising the output of the implemented innovation to a broader audience

References

Arbuckle, J. L. (2006). IBM® SPSS® Amos™ 25 User's Guide

Baer, M., Oldham, G., & Cummings, A. (2003). Rewarding creativity: When does it really matter? *Leadership Quarterly, 14*, 569-586

Basu, R., & Green, S. G. (1997). Leader-member exchange and transformational leadership: An empirical examination of innovative behaviours in leader-member dyads. *Journal of Applied Social Psychology, 27*(6), 477-499.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2).

Boone, W. J., Staver, J. R., & Yale, M. S. (2014). Understanding person measures. *Rasch Analysis in the Human Sciences* (pp. 69-92). Springer, Dordrecht.

Boyle, G. J. (1991). Does item homogeneity indicate internal consistency or item redundancy in psychometric scales?. *Personality and Individual Differences, 12*(3), 291-294.

Bourgonjon, J., De Grove, F., De Smet, C., Van Looy, J., Soetaert, R., & Valcke (2013). Acceptance of game-based learning by secondary school teachers. *Computers & Education, 67*, 21-35.

Bunce, D., & West, M. A. (1995). Self-perceptions and perceptions of group climate as predictors of individual innovation at work. *Applied Psychology, 44*(3), 199-215.

Byrne, B. M. (2016). *Structural equation modeling with AMOS: Basic concepts, applications, and programming.* Routledge.

Coffey, J. H., & Horner, R. H. (2012). The sustainability of schoolwide positive behaviour interventions and supports. *Council for Exceptional Children, 78*(4), 407-422.

Curda, L. K. (1997). *Validation of a measure of teacher's self-efficacy and outcome expectations in the content domains of reading and mathematics*. University of Oklahoma, Norman, Oklahoma.

De Jong, J., & Den Hartog, D. (2010). Measuring innovative work behaviour. *Creativity and Innovation Management, 19*(1), 23-36.

Dorenbosch, L.W., Van Engen, M.L., & Verhagen, M. (2005). On-the-job innovation: The impact of job design and human resource management through product ownership. *Creativity and Innovation Management, 14*(2), 129-141.

Eteokleous, N. (2008). Evaluating computer technology integration in a centralized school system. *Computers & Education, 51*(2), 669-686.

Farr, J., & Ford, C. (1990). Individual innovation. In M. West & J. Farr (Eds.), *Managing innovation.* London: Sage.

Fullan, M. (2002). The change. *Educational Leadership*, May, 16-20.

Fullan, M. (2007). *The new meaning of educational change* (4e ed.). New York: Teachers College Press.

Gannaway, D., Hinton, T., Berry, B., & Moore, K. (2013). Cultivating change: Disseminating innovation in higher education teaching and learning. *Innovations in Education and Teaching International, 50*(4), 410-421.

George, L., & Sabapathy, T. (2011). Work motivation of teachers: Relationship with organizational commitment. *Canadian Social Science, 7*(1).

Hair, J.F., Black, W.C., Babin, B.J. & Anderson, R.E. (2010) *Multivariate Data analysis,* 7th ed. Prentice Hall, Englewood Cliffs, NJ.

Hasanefendic, S., Birkholz, J. M., Horta, H., & van der Sijde, P. (2017). Individuals in action: Bringing about innovation in higher education. *European Journal of Higher Education, 7*(2), 101-119.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55.

Janssen, O. (2000). Job demands, perceptions of effort-reward fairness and innovative work behaviour. *Journal of Occupational and Organizational Psychology, 73*, 287-302.

Janssen, O. (2005). The joint impact of perceived influence and supervisor supportiveness on employee innovative behaviour. *Journal of Occupational and Organizational.Psychology, 78*(4), 573-579.

Janssen, O., Schoonebeek, G., & Looy, V. B. (1997). Cognitions of empowerment: The link between participative management and employees' innovative behaviour. *Gedrag en Organisatie, 10*(4), 175-194.

Johnson, K., Hays, C., Center, H., & Daley, C. (2004). Building capacity and sustainable prevention innovations: A sustainability planning model. *Evaluation and Program Planning, 27*, 135-149.

Kanter, R. (1988). When a thousand flowers bloom: Structural, collective, and social conditions for innovation in organizations. *Research in Organizational Behaviour, 10*, 169-211.

Kleysen, R.F., & Street, C.T. (2001). Toward a multi-dimensional measure of individual innovative behaviour. *Journal of Intellectual Capital, 2*(3), 284–96.

Koeslag-Kreunen, M. G., Van der Klink, M. R., Van den Bossche, P., & Gijselaers, W. H. (2018). Leadership for team learning: The case of university teacher teams. *Higher Education*, *75*, 191-207.

Krause, D.E. (2004). Influence-based leadership as a determinant of the inclination to innovate and of innovation-related behaviours: An empirical investigation. *The Leadership Quarterly, 15*(1), 79-102.

Linacre, J. M. (1998). Structure in Rasch residuals: Why principal components analysis (PCA)? *Rasch Measurement Transactions, 12*.

Linacre, J. M. (2006). *Content Validity, Construct Validity and Misfitting Items.* Retrieved January 13th, 2006, from www.rasch.org/rmt/rmt121f.htm

Linacre, J. M. (2017a). Winsteps® (Version 4.0.0). [Computer Software]. Beaverton, Oregon: Winsteps.com. Retrieved June, 2017. Available from http://www.winsteps.com/

Linacre, J. M., & Wright, B. D. (1994). Chi-square fit statistics. *Rasch Measurement Transactions, 8*(2).

Loh, L.C., Friedman, S.R., & Burdick, W.P. (2013). Factors promoting sustainability of education innovations: A comparison of faculty perceptions and existing frameworks. *Education of Health, 26*(1), 32-38.

Lomax, R. G., & Schumacker, R. E. (2004). *A beginner's guide to structural equation modeling.* Psychology Press.

Ludlow, L. H., Enterline, S. E., & Cochran-Smith, M. (2008). Learning to teach for social justice beliefs scale: An application of Rasch measurement principles. *Measurement and Evaluation in Counseling and Development, 40*(4), 194-214.

Messick, S. (1995). Validity of psychological assessment. Validation of inferences from person's responses and performances as scientific inquiry into score meaning. *American Psychologist, 50*(9), 741-749.

Messmann, G.M.A. (2012). *Innovative work behaviour: Investigating the nature and facilitation of vocational teachers' contributions to innovation development.* Regensburg: Universität Regensburg.

Messmann, G.M.A. & Mulder, R. H. (2011). Innovative work behaviour in vocational colleges: Understanding how and why innovations are developed. *Vocations and Learning,4*(1), 63-84.

Messmann, G.M.A., & Mulder, R. H. (2012). Development of a measurement instrument for innovative work behaviour as a dynamic and context-bound construct. *Human Resource Development International, 15(*1), 43-59.

Messmann, G.M.A., & Mulder, R. H. (2014). Exploring the role of target specificity in the facilitation of vocational teachers' innovative work behaviour. *Journal of Occupational and Organizational Psychology, 87*(1), 80-101.

OECD (2009). *Creating effective teaching and Learning environments: First results from TALIS,* Teaching and Learning International Survey, OECD publishing.

OECD (2018). *The future of education and skills: Education 2030*. OECD Education 2030.

Pieterse, A. N., Van Knippenberg, D., Schippers, M., & Stam, D. (2010). Transformational and transactional leadership and innovative behaviour: The moderating role of psychological empowerment. *Journal of Organizational Behaviour, 31*(4), 609-623.

Radaelli, G., Lettieri, E., Mura, M., & Spiller, N. (2014). Knowledge sharing and innovative work behaviour in healthcare: A micro-level investigation of direct and indirect effects. *Creativity and Innovation Management, 23*(4), 400-414.

Rasch, G. (1960). *Probabilistic models for some intelligence and attainment tests*. Chicago: University of Chicago Press.

Reay, T., Chreim, S., Golden-Biddle, K., Goodrick, E., Williams, B. E., Casebeer, A., & Hinings, C. R. (2013). Transforming new ideas into practice: An activity based perspective on the institutionalization of practices. *Journal of Management Studies, 50*(6), 963-990.

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online, 8*(2), 23-74.

Schleicher, A. (2012). *Preparing teachers and developing school leaders for the 21st century: Lessons from around the world*. OECD Publishing. 2, rue Andre Pascal, F-75775 Paris Cedex 16, France.

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behaviour: A path model of individual innovation in the workplace. *Academy of Management Journal, 37(*3), 580-607.

Scott, S. G., & Bruce, R. A. (1998). Following the leader in R&D: The joint effect of subordinate problem-solving style and leader-member relations on innovative behaviour. *IEEE Transactions on Engineering Management, 45*(1), 3-10.

Sherry, L. (2002). Sustainability of innovations. *Journal of Interactive Learning Research, 13*(3), 211.

Sias, C. M., Nadelson, L. S., Juth, S. M., & Seifert, A. L. (2017). The best laid plans: Educational innovation in elementary teacher generated integrated STEM lesson plans. *The Journal of Educational Research, 110*(3), 227-238

Spector, P. E. (1992). *Summated rating scale construction: An introduction* (No. 82). Sage.

Spreitzer, G. M. (1995). Psychological empowerment in the workplace: Dimensions, measurement, and validation. *Academy of Management Journal, 38*(5), 1442-1465.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2007). *Using Multivariate Statistics* (Vol. 5). Boston, MA: Pearson.

Thurlings, M., Evers, A. T., & Vermeulen, M. (2015). Toward a model of explaining teachers' innovative behaviour A literature review. *Review of Educational Research, 85*(3), 430-471.

Trochim, W. M. K. (2002). *Types of Measurement Validity*. Retrieved January 13th, 2006, from http://www.socialresearchmethods.net/kb/measval.htm

Tuominen, T., & Toivonen, M. (2011). Studying innovation and change activities in KIBS through the lens of innovative behaviour. *International Journal of Innovation Management, 15*(02), 393-422.

Van de Ven, A. H. (1986). Central problems in the management of innovation. *Management Science, 32*(5), 590-607.

Verloop, N., Van Driel, J., & Meijer, P. (2001). Teacher knowledge and the knowledge base of teaching. *International Journal of Educational Research, 35*(5), 441-461.

West, M. A., & Farr, J. L. (1989). Innovation at work: Psychological perspectives. *Social Behavior, 4*, 15-30.

Wolbers, K. A., Dostal, H. M., Skerrit, P., & Stephenson, B. (2017). The impact of three years of professional development on knowledge and implementation. *The Journal of Educational Research, 110*(1), 61-71.

Wolfe, E. W., & Smith, J. E. (2007). Instrument development tools and activities for measure validation using Rasch models: Part II--validation activities. *Journal of Applied Measurement, 8*(2), 204-234.

Woodman, R. W., Sawyer, J. E., & Griffin, R. W. (1993). Toward a theory of organizational creativity. *Academy of Management Review, 18*(2), 293-321.

World Economic Forum (2016). *The future of jobs: Employment, skills and workforce strategy for the fourth industrial revolution*. New York, NY: World Economic Forum LLC.

Yidong, T., & Xinxin, L. (2013). How ethical leadership influence employees' innovative work behaviour: A perspective of intrinsic motivation. *Journal of Business Ethics, 116*(2), 441-455.

Chapter 3

When innovation in education works: Stimulating teachers' innovative work behaviour

Abstract

The 21st century labour market requires employees that proactively shape innovations and solve complex problems. Professionals in the education sector are expected to perform innovative behaviour that not only entails the generation but also the realisation and sustainable implementation of new ideas. In a sample of 458 employees in Dutch secondary and higher vocational education (abbreviated in Dutch to *MBO* and *HBO* respectively), this study investigated the relation between environmental factors (namely task variety, management support and exposure to innovation) and innovative work behaviour (IWB) across the different phases of the innovation process, including a sustainability phase. Results of hierarchical regression analyses showed that management support and exposure to innovations served as a predictor for all phases of innovative work behaviour. Teachers with supportive managers and a high degree of exposure to innovations showed higher scores on innovative behaviour across all phases. Linear regressions revealed a significant relationship between task variety and IWB. In the hierarchical model, only management support and exposure to innovations showed significant relations. Background characteristics, such as gender, age, tenure, number of working hours and type of education, for which we controlled during the analyses, played a role in how much IWB is displayed. It can be concluded that a work environment in which employees are exposed to innovation and are supported is crucial. Additionally, in view of the role background characteristics play, it is recommended to select teachers with specific profiles for the different phases of the innovation process.

THIS CHAPTER IS BASED ON:

Lambriex-Schmitz, P., Van der Klink, M. R., Beausaert, S., Bijker, M., & Segers, M. (2020). When innovation in education works: Stimulating teachers' innovative work behaviour. *International Journal of Training and Development*, *24*(2), 118-134.

Introduction

In a highly competitive and knowledge-based society, innovation is one of the key factors for the long-term success of organisations (Amabile, 1988; Kontoghiorghes et al., 2005; West & Farr, 1989). Innovation is important for remaining competitive and ensuring the viability of organisations (Mumford, et al., 2002; Wolfe, 1994). This is the case for both the private and the public sector, including educational institutes (Al-Husseini & Elbeltagi, 2014; Smith, 2002). Typically, schools have been criticised for their lack of innovation when it comes to delivering educational programmes that meet the needs of the labour market, students and society in general (Lubienski, 2009; Organisation for Economic Co-operation and Development [OECD], 2014). Higher education in particular has failed to keep pace with these needs, largely due to fragmented, out-dated, and static curricula that produce ill-equipped graduates (Frenk et al., 2010; Klimoski & Amos, 2012). In order to deal with these problems, higher educational institutions (both vocational and academic) are being urged to develop new instructional and institutional strategies. This requires teachers to demonstrate innovative work behaviour by playing an active role in the development and implementation of educational innovations (Ehlen, 2010). In this educational context, innovative work behaviour appears to be an emerging concept.

Janssen (2000) defined innovative work behaviour (IWB) as 'the intentional creation, introduction and application of new ideas within a work role, group or organization, in order to benefit role performance, the group, or the organization', (p.288). Without a doubt it is important to develop and realise innovations. However, it is equally important to ensure the sustainability of those innovations. Recent studies on educational innovations have shown that the majority of innovations fail because sooner or later, teachers abandon the newly demonstrated innovative behaviour and return to comfortable old routines (Mosadeghrad & Ansarian, 2014; Roberto & Levesque, 2005; Van Eekelen et al., 2006). The limited attention paid for the improvement and continuation of a new idea once it has been implemented is an often-mentioned explanation for the lack of the long-term success of educational innovations. However, when we take a closer look at the traditional conceptualisation and operationalisation of IWB we observe that it does not include the dimension of sustainability. Consequently, IWB studies conducted to date have not taken into account the sustainability dimension of IWB.

Therefore, building further on Janssen (2000) and, Messmann and Mulder (2012) we extended the operationalisation of IWB including a sustainability dimension (Lambriex-Schmitz et al., 2020) to address the problem of superficial innovation and to assure durable implementation. This leads to a broader definition of IWB,

namely as a multi-stage iterative process (see Table 3.1). In this process employee behaviour targets the exploration, generation, promotion, and realisation of ideas, processes, products or procedures on the one hand and their sustainable implementation on the other hand. The ideas are implemented within a role, a group or an organisation, whereby the ideas, are new (or relatively new) and intended to benefit the relevant target group. Both idea realisation and idea sustainability divided in two sub-dimensions. Idea realisation refers to criterion-based implementation (where the focus lies on the progress of the implementation) and learning-based communication, which emphasises the importance of knowledge sharing and reflection. Idea sustainability implies both internal embedding (ensuring that the innovation is securely anchored in the organisation) and external dissemination, i.e. the distribution and broader application of the newly developed ideas including networking.

Table 3.1 phases of innovative work behaviour

Phases	
Opportunity exploration	Closely observing trends and developments in order to identify problems and opportunities for innovation.
Idea generation	Generating attention for novel and useful ideas for products, services or processes.
Idea promotion	Seeking support for the ideas among colleagues and supervisors, keeping them informed about the ongoing process, negotiating with key persons about permissions, funding, and facilitation.
Idea realisation	Differentiates between criterion-based implementation and learning-based communication. Criterion-based implementation emphasises the assessment of the progress of the innovation, based on criteria. Learning-based communication stresses the importance of information sharing and reflection on innovation development and individuals' professional development.
Idea sustainability	Differentiates between external dissemination, which focuses on networking and the broader distribution of the innovative idea and internal embedding, where the innovation is anchored in the organisational system.

In recent decades, both theory and research have focused strongly on identifying factors that facilitate or hinder individual and group innovation (for reviews, see; Hülsheger et al., 2009; Hammond et al., 2011; Thurlings et al., 2015). These studies showed that influencing factors of IWB could be divided into two main categories: Individual (i.e. years of education, years of teaching experience) and organisational factors (i.e. management support, task factors, innovation climate). However, the studies reported on in the reviews have some limitations. Firstly, the vast majority of these studies perceive IWB as a one-dimensional concept (Scott & Bruce, 1994; Janssen, 2000), while other research has revealed that IWB is not a one-dimensional but a multi-dimensional concept (De Jong & Den Hartog, 2010; Krause,

2004; Messmann & Mulder, 2012). The varying operationalisation of IWB leads to contradictory results being reported in the various studies on IWB. Secondly, there is no evidence for predicting factors of IWB in the sustainability phase. Thirdly, most of the studies in these reviews address IWB in the very specific context of ICT innovations.

The review study by Thurlings et al. (2015) shows that research findings, regarding IWB in the educational sector, to date are inconclusive and fail to provide an unambiguous picture of factors that really matter. Taking these limitations into account, our study takes the next step in the research on antecedents of teachers' IWB by addressing IWB as a multi-dimensional concept, including the sustainability phase of an innovation cycle. Moreover, by including research on adaptability and adaptive expertise in our theoretical framework, we focus on three environmental factors that have been shown to have a strong predictive power in explaining individual differences in adaptive behaviour: Task variety, management support and exposure to innovation, see Figure 3.1. An important argument for taking the adaptive expertise theoretical perspective, is the vast amount of research indicating that being active in innovation requires the employee to show 'flexibility, ability to innovate, continuous learning, seeking out challenges, and creativity' or to act as an adaptive expert (Bohle Carbonell et al., 2014, p.15). We aim to ascertain whether the three predictors play an equally important role in the five dimensions of innovative work behaviour identified.

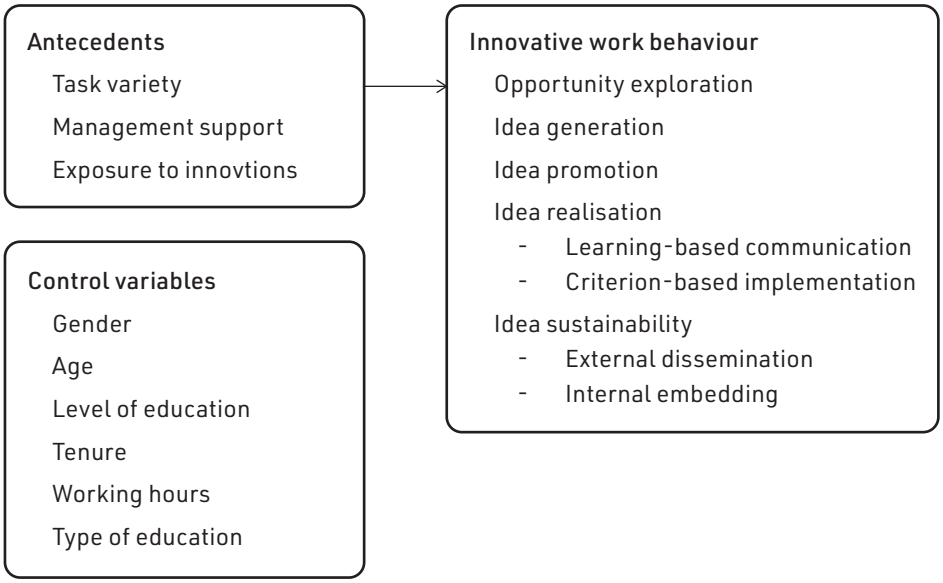


Figure 3.1 Research model

Task variety, management support and exposure to innovation

Task variety as a determinant of IWB

Task variety is defined as the degree to which the job requires an employee to perform a wide range of tasks (Morgeson & Humphrey, 2006; Sims et al., 1976). In the current work environment (both profit as non-profit organisations) it is important that an employee is not only a strong performer but also a fast, adaptive learner (Karaevli & Hall, 2006). An adaptive learner is able to modify previously experienced methods and apply existing knowledge and skills for new tasks (Smith et al., 1997). Showing adaptability requires an employee to transfer previous learning to successive tasks. There is a strong link between a wide variety of tasks and adaptive behaviour. In our conceptualisation a wide range of tasks also leads to a wider range of skills. When an employee is required to perform a wide range of tasks, knowledge has to be applied to various situations and much experience is accumulated. Task variety assumes that employees possess the range of skills needed to perform those tasks successfully.

Noefer et al. (2009) found that skill variety at one's work is a motivating factor when it comes to generating and implementing new ideas. This was in line with research findings stating that employees who experience high skill variety in their job feel free in their behaviour to develop and discuss new ideas. This behaviour is valuable for predicting creative performance and thus generating ideas (Basadur et al., 2000). Other theories show that skill variety can be seen as a part of work complexity (Shally et al., 2004). Work or job complexity shows a positive correlation with openness to change (Axtell et al., 2002), idea generation (Hatcher et al., 1989; Ohly et al., 2006) and idea implementation (Axtell et al., 2000; Axtell & Parker, 2003). Employees with an extensive variety of tasks have more different responsibilities and thus more opportunities to combine different skills and insights. This is beneficial both for generating ideas and implementing ideas. In sum, in business contexts, it is argued and found that task variety (and hence greater skill variety) leads to more innovative capability as a result of the employee using a repertoire of different behaviours that leads to the flexibility, necessary for innovation processes. Given previous research about the role of task variety in various sectors we aspect the same influence on the innovative behaviour of teachers. The following hypothesis was derived:

Hypothesis 1: Task variety predicts teachers' IWB across all phases in terms of opportunity exploration, idea generation, idea promotion, idea realisation and idea sustainability.

Management support as a determinant of IWB

In both the business and the educational domain, IWB research and adaptive expertise research have acknowledged that support from managers positively affects employees' IWB (Basu & Green, 1997; Binnewies & Gromer, 2012; De Arment et al., 2013; Eteokleous, 2008; Hammond et al., 2011; Janssen, 2005; Kimonen & Nevalainen, 2005; Krause, 2004; Loogma et al., 2012; Mohammad & Harlech-Jones, 2008; Mueller et al., 2008; Noefer et al., 2009; Schussler et al., 2007; Yang & Huang, 2008). Other studies in the educational domain have found that the absence of guidance and support by management leads to less innovative behaviour by teachers (Eteokleous, 2008; Mohammad & Harlech-Jones, 2008; Prieto & Pérez-Santana, 2014). What does support by the management entails? Firstly, research indicates that employees working in a complex work environment (both profit as non-profit organisations) demonstrate more adaptive behaviour when supported by their management (Griffin & Hesketh, 2003). Exposing employees to challenging and complex tasks and supporting them in a sufficient way helps them to develop adaptive capacity and behaviour. Secondly, a positive relationship is found between a manager who encourages innovative ideas and the innovative behaviour of employees (Janssen, 2005). In the same vein, previous studies, in both the business as the educational context, suggest that if employees feel that the manager support their innovative behaviour, they feel encouraged to demonstrate innovative behaviour, either in general or in specific phases, such as idea generation and implementation, whereas employees who perceive their manager not to be supportive feel hindered from doing so (Janssen, 2005; Krause, 2004; Loogma, 2012). Thirdly, interview findings underpin the importance of manager support in terms of providing time and money to implement ideas, adopting a friendly attitude towards innovative employees, being patient and helpful and looking out for someone's interests if problems arise (De Jong & Den Hartog, 2007). Fourthly, in the educational domain, manager support is defined as organising professional development to help teachers face change and thus increase their innovative behaviour (Kimonen & Nevalainen, 2005).

To sum up, the results of a vast range of studies suggest that employees, including teachers, need to be supported and guided by the manager or supervisor if they wish to innovate. Given the fact that many innovative initiatives do not reach the stage of a full implementation, we expect, although evidence in the educational sector is scarce, that management support is crucial to the realisation of sustainable implementation. Therefore the following hypothesis is formulated:

Hypothesis 2: Management support (facilities, resources, and management expectations) positively predicts teachers' IWB in terms of opportunity exploration, idea generation, idea promotion, idea realisation and idea sustainability.

Exposure to innovation as a determinant of IWB

Taking a role in an innovation process is only possible if a person is exposed to new ideas, involved in innovations, and believes himself/herself able to fulfil an active role in the innovations. It has been argued in the organisational literature for many years that in order to make innovations happening, exposure to innovations is important (e.g., Daft, 1978; Dewar & Dutton, 1986). It is said of the best innovation managers that they not only introduce organisational innovations but also play a pivotal role in stimulating innovation initiation at all organisational levels by exposing members to innovation. Empirical evidence on the role of exposure to innovation comes from the medical sector where it has been shown that exposure of medical practitioners to clinical trials and specific treatments increase the adoption of these treatments in the own practice (Ducharme et al., 2007). Along the same lines, in the context of education, Bourgonjon et al. (2013) have demonstrated that a critical mass positively influences innovative behaviour, implying that if a significant number of teachers in the same school use specific innovative teaching tools, other teachers will be more inclined to use those tools in their own classes.

However, whilst exposure to innovation is necessary, it offers no guarantee that employees will become active in the innovation process. Research in the domain of adaptability and adaptive expertise shows that adaptable behaviour is only likely to occur if individuals have the confidence to engage in this behaviour. Put differently, self-efficacy is an essential component of adaptive behaviour (Griffin & Hesketh, 2003). Stressing the role of self-efficacy in engaging in innovative work behaviour is in line with Bandura's theory of social learning (Bandura, 1997). He states that beliefs in own capabilities to organise and execute actions are causally related to behaviour and outcomes. When these self-efficacy beliefs are grounded in past mastery experiences, people will motivate themselves and construct efficacious courses of action in an anticipatory, proactive way.

The role of self-efficacy in innovation has been confirmed in a study on primary and secondary education (Elias et al., 2003). They observed that the small steps initially taken by the participants in the field of innovation and the accompanying internal, socio-emotional changes ultimately result in evidence-based and sustainable successful innovations. This leads to the following hypothesis:

Hypothesis 3: Exposure to innovation, including self-efficacy in innovation, positively predicts teachers' IWB in terms of opportunity exploration, idea generation, idea promotion, idea realisation and idea sustainability.

Method

Participants and procedures

The current explorative cross-sectional study was conducted among teachers in secondary and higher vocational education, in four different institutes in The Netherlands. These institutes were selected because of their strategic plan for upcoming years and the way in which they are positively oriented towards innovation. Therefore we expect a broader variance of IWB among teachers. Data were collected between November 2014 and December 2015. Supervisors introduced the questionnaire to their team members during a meeting or by sending an introduction email. Respondents were invited by their team managers or board member to participate in the study on a voluntary basis and were asked to fill out an online questionnaire. Participants received the web address by email and were directed to an introduction to the study and the questionnaire in Dutch. In total, 458 teachers completed the survey. Response rates were approximately 50% (respectively 56%, 49% and 48%). For one institution the response rate could not be calculated due to a lack of information about the size of the participating teams. More than half of the sample was female (58.2%). The average age of the participant was 48,4 years (*SD=11,6*), and they had 15.5 years of work experience (*SD=11,8*) in the educational sector. Respondents worked in various domains (i.e. management, ICT, healthcare, hospitality, education) and in different types of education (184 higher education and 274 in secondary vocational education).

Measures

Innovative work behaviour was measured with the 44-item innovative work behaviour instrument developed by Lambriex- Schmitz et al. (2020), measuring five dimensions of innovative work behaviour: Opportunity exploration, idea generation, idea promotion, idea realisation (criterion-based implementation and learning-based communication) and idea sustainability (internal embedding and external dissemination). The items were scored on a six-point Likert-scale, ranging from 1 (=strongly disagree) to 6 (=strongly agree), and analysed in the Rasch rating scale model (Rasch, 1960). Cronbach's alphas of the scales ranged from .85 to .94. Means, standard deviations and correlations are presented in Table 3.2.

Task variety was measured by asking for the number of different tasks that were undertaken. The participants could choose between six categories (teaching, development of learning materials, coordinating, participation in committees, internship guiding, other task).

Management support was measured with two items: 'To what extent is innovative work behaviour expected by the manager?' and 'to what extent is innovative work behaviour supported by the supervisor?'. The items were scored on a six-point Likert-scale, ranging from 1 (=strongly disagree) to 6 (= strongly agree). Cronbach's alpha was .70.

Exposure to innovation was measured with three items: 'To what extent have you been involved in innovations?', 'to what extent do you find yourself innovative?' and 'to what extent are innovations within your work primarily focused on improving existing products and processes?'. The items were rated on a 10-point Likert-scale, ranging from barely to extremely. Cronbach's alpha was .72.

Various control variables (gender, age, level of education, tenure, working hours and type of education) were included, based on earlier IWB studies (Ekvall & Ryhammer, 1999; Janssen, 2000, 2005; Kontoghiores et al., 2005; Loogma et al., 2012; Messmann & Mulder, 2014; Pieterse, 2010; Runhaar, 2008; Yang & Huang, 2008).

Data analysis

Firstly, descriptive analyses were conducted, followed by linear regression in SPSS version 23 to detect the main effects of environmental factors on the dependent variable, IWB (cf. Cleary & Kessler, 1982; Cohen & Cohen, 1983). Finally, hierarchical multiple regression analyses were conducted to detect main effects of personal characteristics and environmental factors on the dependent variable, IWB. The hierarchical regression consisted of two successive steps. In the first step, control variables (i.e. gender, age, level of education, tenure, working hours and educational setting) were included in the model. In step 2 factors task variety, manager support and exposure to innovation were added.

Results

The results are presented stepwise. First the means, standard deviations, and first order correlations are displayed, followed by the results of the hierarchical regression analysis.

Preliminary results

Means in the first phases of IWB (opportunity exploration, idea generation and idea promotion) were higher than in the implementation phases (idea realisation and idea sustainability). All variables under study correlated positively with each other (*r* .14 - .77). High correlations are shown between successive phases. Hence, it cannot be concluded that dimensions are redundant (multi collinearity). Moreover high correlations might be expected due to the cyclical nature of innovation processes where the different phases are connected by feedback loops. Furthermore, low mean scores are shown for task variety, see Table 3.2.

Table 3.2 Descriptives and correlations of the variables (n= 458)

Variable	M	SD	1	2	3	4	5	6	7	8	9	10
Opportunity exploration	5.07	.60	(.85)									
Idea generation	5.08	.61	.70**	(.94)								
Idea promotion	5.09	.60	.55**	.75**	(.94)							
Idea realisation (criterion-based implementation)	3.85	1.01	.42**	.54**	.69**	(.93)						
Idea realisation (learning-based communication)	4.23	.68	.44**	.53**	.65**	.77**	(.87)					
Idea sustainability (external dissemination)	3.80	.75	.20**	.27**	.43**	.51**	.54**	(.90)				
Idea sustainability (internal embedding)	4.10	.63	.34**	.40**	.56**	.68**	.68**	.73**	(.92)			
Task variety (scores 1-6)	1.86	1.13	.14**	.21**	.22**	.23**	.23**	.37**	.28**	-		
Management support (scale 1-6)	4.20	.87	.29**	.31**	.34**	.33**	.33**	.32**	.36**	.20**	(.70)	
Exposure to innovation (scale 1-10)	6.28	1.25	.34**	.44**	.53**	.47**	.46**	.36**	.46**	.29**	.45**	(.72)

Note: *** p< .001 ** p< .01 * p< .05
Cronbachs alpha between brackets
Innovative work behaviour (variable 1-7) measured with 6 point Likert

Regression analyses

Task variety

Task variety (the number of different tasks), was significantly positively related to all phases of IWB (β range between 0.137- 0.371, p<. 05), see Table 3.3. More task variation lead to higher scores on IWB. Hypothesis 1 that postulated a positive relationship with all phases of IWB was confirmed.

Management support

Management support was significantly positively related to all phases of the innovation process (β range between 0.286- 0.360, p<. 001). The more support teachers experience and the more innovative behaviour the manager expects, the higher the IWB scores. Hypothesis 2, suggesting that manager support has a significant positive relationship with IWB, was confirmed.

Exposure to innovation

Exposure to innovation was significantly positively related to all phases of the innovation process (β range between 0.340- 0.526, p<. 001). The final third hypothesis that postulated that exposure to innovation had a positive relationship with IWB was supported. All variables under study correlated significantly positively to IWB.

Table 3.3 Single regression analyses using task variety, management support and exposure to innovations as predictors and dimensions of IWB as dependents [a]

Dimension	Opportunity exploration	Idea generation	Idea promotion	Idea realisation criterion-based implementation	Idea realisation learning-based communication	Idea sustainability external dissemination	Idea sustainability internal embedding
Predictors							
Task Variety	0.137*	0.207***	0.223***	0.227***	0.234***	0.371***	0.227***
R^2	0.019	0.043	0.050	0.051	0.055	0.138	0.051
Management Support	0.286***	0.305***	0.341***	0.328***	0.329***	0.321***	0.360***
R^2	0.082	0.093	0.116	0.108	0.108	0.103	0.129
Exposure	0.340***	0.435***	0.526***	0.470***	0.458***	0.360***	0.456***
R^2	0.116	0.189	0.276	0.220	0.210	0.130	0.208

Note: *** *p*< .001 ** *p*< .01 * *p*< .05 [a]= Standardised regression coefficients (Beta)

Hierarchical regression analyses

To detect, which of the environmental factors were most significant related to IWB, all environmental factors, were entered into the hierarchical model, see Table 3.4.

Task variety

In the joint model, task variety (the number of different tasks) was not significantly related to any of the phases of IWB. Thus, hypothesis 1 that postulated a positive relationship with all phases of IWB was only partly confirmed. In the linear regression, task variety was significant related to IWB, in contrast to the hierarchical model, where management support and exposure to innovation were added.

Table 3.4 Hierarchical regression analyses using control variables and individual and environmental characteristics as predictors and dimensions of IWB as dependents [a]

Dimension	Opportunity exploration	Idea generation	Idea promotion	Idea realisation criterion-based implementation	Idea realisation learning-based communication	Idea sustainability external dissemination	Idea sustainability internal embedding
Predictors							
Step 1: Control variables							
Gender	0.134*	0.137**	0.123**	0.124**	0.144**	0.046	0.111*
Age	0.162*	0.164**	0.118*	0.058	-0.002	-0.112	0.000
Level of Education	0.005	0.005	0.017	0.033	0.002	0.090	0.034
Tenure	-0.127	-0.030	0.026	0.062	0.144*	0.104	0.126*
Working hours	0.033	0.015	0.095*	0.125**	0.043	0.119*	0.170***
Type of education (MBO- HBO)	-0.107	-0.006	0.081	0.091	0.177**	0.205***	0.216***
Step 2: Environmental characteristics							
Task Variety	0.064	0.073	0.027	0.059	0.045	0.021	0.006
Management support	0.148**	0.134**	0.145**	0.148**	0.154**	0.224***	0.214***
Exposure to innovations	0.235***	0.341***	0.433***	0.353***	0.340***	0.205***	0.300***
R^2 model 1	0.036	0.044	0.074	0.081	0.101	0.126	0.138
R^2 model 2	0.154	0.231	0.335	0.283	0.291	0.259	0.325

Note: *** $p < .001$ ** $p < .01$ * $p < .05$ [a]= Standardised regression coefficients (Beta)

Management support

In the hierarchical model, management support was still significantly positively related to all phases of the innovation process (β range between 0.134- 0.224, p<. 01). The more support teachers experience and the more innovative behaviour the manager expects, the higher is the score for IWB. Thus, hypothesis 2, suggesting that manager support had a significant positive relationship with IWB, was confirmed, in the joint model with exposure to innovation.

Exposure to innovation

In the combined model, exposure to innovation was significantly positively related to all phases of the innovation process (β range between 0.205- 0.433, p<. 001). Thus, the final hypothesis that postulated that exposure to innovation had a positive relationship with IWB was supported, in a joint model with management support.

Control variables

The results from the control variables are listed below.

Gender showed significant positive correlations to all phases of IWB (β range between 0.111- 0.144, p<. 01), except for external dissemination, which is one of the subcategories of idea sustainability. Being a woman is significantly and positively related to IWB across all IWB phases, except for external dissemination.
Age was significant positively related to IWB in the creativity phases (opportunity exploration β 0.162, idea generation β 0.164 and idea promotion β 0.118, p<. 05). *Degree* (level of prior education of teachers) was not significantly related to any of the phases of innovative work behaviour. *Tenure* was only significantly positively related to idea realisation, learning-based communication (β 0.144, p<. 05) and the internal embedding sub-dimension of idea sustainability (β 0.126, p<. 05). More work experience is related to more learning-based communication and further internal embedding of the innovation.
Number of working hours was positively related to IWB in the implementation phase, specifically in idea promotion (β 0.095, p<. 01), in idea realisation, criterion-based implementation (β 0.125, p<. 001) and in the two idea sustainability sub dimensions (β 0.119, p<. 05 and 0.170, p<. 001). Employees with more working hours showed higher scores on the implementation dimensions of the innovation process. Teachers that are employed in higher vocational education demonstrated more IWB in the realisation and sustainability phases than their colleagues in secondary vocational education (β range between 0.177- 0.216).

Discussion

The purpose of this study was to examine the relationships between task variety, manager support, exposure to innovation and IWB. IWB was conceptualised as consisting of five phases: Opportunity exploration, idea generation, idea promotion, idea realisation (both criterion-based implementation and learning-based communication) and idea sustainability (both internal embedding and external dissemination). This study is innovative in various ways. Firstly, by measuring innovative work behaviour in separate stages, it is possible to detect different antecedents for the separate phases of the innovation process. Secondly, by focusing on the sustainability phase, it is possible to address the common cause of innovation failure identified by Chakravorty (2010), where innovations fade away during and after the implementation phase. Finally, in this study, both the employees and their characteristics and their environment are combined in a hierarchical model. This makes it possible to gain insight into the success factors for innovative behaviour.

This study investigates the relationship between task variety, management support, and exposure to innovations and IWB. The results of the hierarchical regression show that when taking into account all three variables at the same time, it emerges that management support and exposure to innovations play a particularly significant role in all dimensions of IWB.

These results are in line with previous studies. Both Binnewies and Gromer (2012) and Hammond et al. (2011) found evidence for a positive influence of management support on IWB in general. In our study, the most powerful correlations are observed in the sustainability phases. Previous researchers have not included a sustainability dimension in the IWB concept. Hence, this is a valuable new insight. Other research shows that managers who encourage employees to carry out innovative activities and give them opportunities to try new ideas contribute to increased innovative behaviour (Elias et al., 2003; Janssen, 2005; Noefer et al., 2009). Stoffers et al. (2018) state that participation and performance in various working groups appears to be essential for the initiation, promotion and realisation of new ideas. Stimulating this participation in social networks and thereby encouraging informal learning is found to be crucial for improving the ability to innovate and the capacity to deal with changes in the dynamic world of education (Lecat et al., 2018). Finally, empirical support for a positive connection between the provision of resources by management and innovative behaviour is widely available (Ekvall & Ryhammer, 1999).

With respect to exposure (conceptualised in terms of perceptions of own capability, involvement and a perceived innovative environment), we see strong relations with IWB. This is in line with previous studies, which found that perceptions strongly influence behaviour and attitudes (Ajzen, 2002; Burnes, 2004). The results of our study reveal that when teachers experience change in their own work setting, the extent to which they feel involved and confident about their own innovative behaviour appears to contribute to the scores on IWB. This finding is in line with research on adaptive expertise, which states that possessing particular innovative competencies fosters the proactive shaping of innovations and the solving of complex problems (Carbonell et al., 2014). When teachers are involved as a participant observer to innovative projects in their direct working environment, they will be more motivated to implement the innovation (Gorozidis & Papaioannou, 2014). This is also in line with other theoretical notions. Rogers's theory (2003), for example, states that modelling and imitation are key elements in the diffusion process. Ducharme et al. (2007), and Bourgonjon et al. (2013), identify the role of the critical mass through exposure to innovations. In addition, the study of Bourgonjon et al. shows that teacher' beliefs regarding their ability to be innovative and their innovative experiences are predictors of the innovative behaviour. This fits Bandura's theory of social learning (1997), where self-efficacy leads to more proactive and anticipatory behaviour.

Task variety shows contrasting results. Although previous studies have shown that task variety might play a role when it comes to IWB, this study indicated that, when taking into account all three variables (task variety, management support and exposure to innovations) at the same time, only management support and exposure to innovations play a significant role in all IWB dimensions.

The control variables show interesting results. *Gender*, for example, positively affects IWB in all phases except idea sustainability external dissemination. Women rated themselves higher on their IWB across all phases than men. Previous studies have reported mixed findings (e.g., Janssen, 2005), or non-significant relations between gender and IWB (e.g., Pieterse, 2010). In the majority of these studies, there is an overbalance of male respondents, making it impossible to draw firm conclusions. In the creativity phase (opportunity exploration, idea generation and idea promotion) *Age* is a positive predictor of IWB. More mature teachers rate themselves higher on exploring and generating ideas. This is in line with the theory that as individuals acquire knowledge and gather experiences, they develop greater and more integrated knowledge structures, which in turn generate more response possibilities, which include facts, concepts and schemata.

This makes them better able to think creatively and come up with out of the box solutions to the problems they face (Amabile, 1983; Hammond et al., 2011).

Other patterns emerge with respect to the implementation phases (idea realisation and idea sustainability). *Tenure* (more years of experience in education), a higher *number of working hours* and a higher *type of education (working in higher vocational education rather than secondary vocational education)* leads to higher IWB scores in the realisation phase and the sustainability phases. A teacher with a lot of experience in education knows the structure of the organisation and is better able to find ways to embed the idea into the organisation. This is in line with previous studies that have found a positive connection between tenure and innovation (Hammond et al., 2011). This underlines the importance of including more experienced teachers in innovation teams. Teachers with more working hours who are familiar with the organisation and its current processes show higher IWB scores in the implementation phase. To embed an innovation into the organisation, a wide social network within that organisation is necessary. Building and maintaining this network is time-consuming. It follows that working many hours is beneficial for building strong networks. Teachers employed in higher vocational education demonstrate more IWB in the implementation phases than their colleagues in secondary vocational education. An explanation may be that teachers working in higher education are more familiar with conceptual models and might therefore be better equipped to capture more aspects of a sustainable realisation. In order to implement an idea, it is important to develop protocols that tally to the organisational structures and procedures, which requires a particular form of abstract thinking.

Limitations and suggestions for future research

There are four limitations that deserve additional attention. Firstly, whilst for the implementation phases in particular we found high levels of explained variances, the percentage of explained variance in opportunity exploration was quite modest. Therefore future research should include other predictive factors, such as learning climate, which might influence teacher's IWB in the creativity phases. Secondly, in our study we used self-reporting. Although this may lead to biased findings, there appears to be a strong relationship between self-reported behaviour and managers' perceptions on the implementation of innovations (e.g., Axtell et al., 2000). Triangulation is beneficial but is difficult to achieve in educational settings, since supervisors and managers often have insufficient insights into their teachers' behaviour. Close colleagues, such as team members, may be an alternative source for gathering data on teachers' IWB. Thirdly, longitudinal research designs would help us to further our insight into the causality of relationships. Finally, evidence about the levels of innovative behaviour of teachers in higher education is scarce.

Most of the studies in the educational context have been carried out in primary education or secondary vocational education (Thurlings, 2015). In future, school contexts and differences between school sectors should be taken into account.

Implications

This study provides evidence for the significance of environmental factors influencing IWB while controlling for individual factors. Here we present four implications. Firstly, the results show that managers should create a supportive work environment in which IWB is expected, teachers feel free to develop and discuss new ideas and teachers are given the opportunity to participate in innovative projects. Secondly, managers should provide the right preconditions, such as time and resources, to work on innovations. By providing the necessary time and resources to work on innovations, managers are expressing the belief that innovation is important, which in turn lead to a more innovative climate. Thirdly, teachers' perceptions of their own capability, involvement and perceived innovation environment are the strongest predictors of innovative behaviour. It follows that it is advisable to invest in a supportive and innovative climate, where teachers feel, autonomous, competent and involved in the innovation processes (Messmann et al., 2017). Managers should communicate with their teaching teams about the innovative idea in a clear, consistent and continuous manner, thereby establishing and maintaining strong relationships with teachers (Keesing- Styles et al., 2014). As a result, teachers will feel more involved with innovations and will recognise innovations more quickly in their environment, thereby increasing their exposure to innovation. Finally, managers should pay attention to the composition of innovation teams. Our study suggests that teachers with different profiles are needed in the different phases of the innovation process. More mature teachers are essential in the creativity phases while teachers with more experience in teaching and a considerable number of working hours are crucial for the implementation phases.

Conclusion

In the near future, the need for innovative teachers will increase substantially since education at all levels is facing changes that require huge transformations. To keep pace with the fast changing job market, the roles of teachers are changing since critical and creative thinking, lifelong learning and showing adaptive behaviour becomes crucial. In other words, a paradigm shift from learning what to know to learning how to learn requires different behaviour (De Bruijn et al., 2017; Soderstrom & Bjork, 2015). Nowadays, teachers must not only be professionally trained, but they are also expected to be able to teach students as optimally as possible, from a didactical, pedagogical, socio-psychological and ICT perspective. Examples of specific innovations teachers in higher and vocational education have to deal with are: Course and curriculum redesign and thus new domain-specific content, the use of ICT as a didactic tool (e.g., smart boards, virtual reality and flipped classrooms) and new roles such as doing research or coaching.

These changes will only succeed if teachers possess the innovative attitude and competencies needed to cope with changes in their work. However, it is certainly not self-evident that teachers possess these competencies. The study seeks to describe, explain and predict teachers' innovative work behaviour and the factors that impact their behaviour, as a means of generating insights into how to develop appropriate contexts and initiatives to further encourage innovative work behaviour. Furthermore, we can increase the success of innovations in the long run by paying attention to the sustainability phase.

This leads to the final conclusion that the combination of selecting the right employees for each innovation phase and creating resourceful work environments in which teachers feel autonomous and competent will stimulate innovative behaviour, thereby increasing the likelihood of achieving successful, sustainable innovations in education.

References

Aiken, L. S., West, S. G., & Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions*. Sage Publications, Newbury Park.

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology*, *32*(4), 665-683.

Al-Husseini, S., & Elbeltagi, I. (2016). Transformational leadership and innovation: A comparison study between Iraq's public and private higher education. *Studies in Higher Education*, *41* (1), 159-181.

Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology*, *45*(2), 357.

Amabile, T. M. (1988). A model of creativity and innovation in organizations. *Research in Organizational Behavior*, *10*(1), 123-167.

Axtell, C.M., Holman, D. J., Unsworth, K. L., Wall, T. D., Waterson, P. E., & Harrington, E. (2000). Shopfloor innovation: Facilitating the suggestion and implementation of ideas. *Journal of Occupational and Organizational Psychology*, *73*(3), 265-285.

Axtell, C. M., & Parker, S. K. (2003). Promoting role breadth self-efficacy through involvement, work redesign and training. *Human Relations*, *56*(1), 113-131.

Axtell, C., Wall, T., Stride, C., Pepper, K., Clegg, C., Gardner, P., & Bolden, R. (2002). Familiarity breeds content: The impact of exposure to change on employee openness and well-being. *Journal of Occupational and Organizational Psychology, 75*(2), 217-231.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Basadur, M., Runco, M. A., & Vega, L. A. (2000). Understanding how creative thinking skills, attitudes and behaviors work together: A causal process model. *The Journal of Creative Behavior, 34*(2), 77–100.

Basu, R., & Green, S. G. (1997). Leader-member exchange and transformational leadership: An empirical examination of innovative behaviors in leader-member dyads. *Journal of Applied Social Psychology, 27*, 477-499.

Binnewies, C., & Gromer, M. (2012). Creativity and innovation at work: The role of work characteristics and personal initiative. *Psicothema*, *24*(1)

Bourgonjon, J., De Grove, F., De Smet, C., Van Looy, J., Soetaert, R., & Valcke, M. (2013). Acceptance of game-based learning by secondary school teachers. *Computers & Education*, *67*, 21-35.

Burnes, B. (2004). Kurt Lewin and the planned approach to change: A re-appraisal. *Journal of Management Studies*, *41*(6), 977-1002.

Chakravorty, S. S. (2010). Where process-improvement projects go wrong. *Wall Street Journal (January 2010)*.

Cleary, P. D., & Kessler, R. C. (1982). The estimation and interpretation of modifier effects. *Journal of Health and Social Behavior*, 159-169.

Daft, R.L. (1978). A dual-core model of organizational innovation. *Academy of Management Journal*, *21*(2), 193-210.

De Arment, S. T., Reed, E., & Wetzel, A. P. (2013). Promoting adaptive expertise: A conceptual framework for special educator preparation. *Teacher Education and Special Education*, *36*(3), 217-230.

De Bruijn, E., Billett, S., & Onstenk, J. (Eds.). (2017). *Enhancing Teaching and Learning in the Dutch Vocational Education System: Reforms Enacted* (Vol. 18). Springer.

De Jong, J. P., & Den Hartog, D. N. (2007). How leaders influence employees' innovative behavior. *European Journal of Innovation Management*, *10*(1), 41-64.

De Jong, J., & Den Hartog, D. (2010). Measuring innovative work behavior. *Creativity and Innovation Management*, *19*(1), 23-36.

Dewar, R. D., & Dutton, J. E. (1986). The adoption of radical and incremental innovations: An empirical analysis. *Management Science*, *32*(11), 1422-1433.

Ducharme, L. J., Knudsen, H. K., & Roman, P. M. (2007). Emotional exhaustion and turnover intention in human service occupations: The protective role of coworker support. *Sociological Spectrum*, *28*(1), 81-104.

Ehlen, C. (2010). Duurzame onderwijsinnovatie: Organische co-creatie met sociaal kapitaal. *Journal of Social Intervention: Theory and Practice*, *19*(2).

Ekvall, G., & Ryhammer, L. (1999). The creative climate: Its determinants and effects at a Swedish university. *Creativity Research Journal, 12,* 303-310.

Elias, M. J., Zins, J. E., Graczyk, P. A., & Weissberg, R. P. (2003). Implementation, sustainability, and scaling up of social-emotional and academic innovations in public schools. *School Psychology Review*, *32*(3), 303-319.

Eteokleous, N. (2008). Evaluating computer technology integration in a centralized school system. *Computers & Education*, *51*(2), 669-686.

Frenk, J., Chen, L., Bhutta, Z. A., Cohen, J., Crisp, N., Evans, T., Fineberg, H., Garcia, P., Ke, Y., Kelley, P., Kistnasamy, B., Meleis, A., Naylor, D., Pablos-Mendez, A., Reddy, S., Scrimshaw, S., Sepulveda, J., Serwadda, D., & Zurayk, H. (2010). Health professionals for a new century: Transforming education to strengthen health systems in an interdependent world. *Lancet* (London, England), *376*(9756), 1923–1958.

Gorozidis, G., & Papaioannou, A. G. (2014). Teachers' motivation to participate in training and to implement innovations. *Teaching and Teacher Education*, *39*, 1-11.

Griffin, B., & Hesketh, B. (2003). Adaptable behaviors for successful work and career adjustment. *Australian Journal of Psychology*, *55*(2), 65-73.

Hammond, M. M., Neff, N. L., Farr, J. L., Schwall, A. R., & Zhao, X. (2011). Predictors of individual-level innovation at work: A meta-analysis. *Psychology of Aesthetics, Creativity, and the Arts,* 5, 90-105.

Hatcher, L., Ross, T. L., & Collins, D. (1989). Prosocial behavior, job complexity, and suggestion contribution under gainsharing plans. *The Journal of Applied Behavioral Science*, *25*(3), 231-248.

Hülsheger, U. R., Anderson, N., & Salgado, J. F. (2009). Team-level predictors of innovation at work: A comprehensive meta-analysis spanning three decades of research. *Journal of Applied Psychology*, *94*(5), 1128.

Janssen, O. (2000). Job demands, perceptions of effort-reward fairness and innovative work behavior. *Journal of Occupational and Organizational Psychology, 73(3)*, 287-302.

Janssen, O. (2005). The joint impact of perceived influence and supervisor supportiveness on employee innovative behavior. *Journal of Occupational and Organizational Psychology*, *78*(4), 573-579.

Karaevli, A., & Hall, D. T. T. (2006). How career variety promotes the adaptability of managers: A theoretical model. *Journal of Vocational Behavior*, *69*(3), 359-373.

Keesing- Styles, L., Nash, S., & Ayres, R. (2014). Managing curriculum change and 'ontological uncertainty' in tertiary education. *Higher Education Research & Development*, *33*(3), 496-509.

Kimonen, E., & Nevalainen, R. (2005). Active learning in the process of educational change. *Teaching and Teacher Education*, *21*(6), 623-635.

Klimoski, R., & Amos, B. (2012). Practicing evidence-based education in leadership development. *Academy of Management Learning & Education*, *11*(4), 685-702.

Kontoghiorghes, C., Awbrey, S. M. & Feurig, P. L. (2005). Examining the relationship between learning organization characteristics and change adaptation, innovation, and organizational performance. *Human Resource Development Quarterly, 16(2)*, 185–212.

Krause, D. E. (2004). Influence-based leadership as a determinant of the inclination to innovate and of innovation-related behaviors: An empirical investigation. *The Leadership Quarterly*, *15*(1), 79-102.

Laine, M., van der Heijden, B. I., Wickström, G., Hasselhorn, H. M., & Tackenberg, P. (2009). Job insecurity and intent to leave the nursing profession in Europe. *The International Journal of Human Resource Management*, *20*(2), 420-438.

Lambriex-Schmitz, P., Van der Klink, M. R., Beausaert, S., Bijker, M., & Segers, M. (2020). Towards successful innovations in education: Development and validation of a multi-dimensional innovative work behaviour instrument. *Vocations and Learning*, *13*, 313-340.

Lecat, A., Beausaert, S., & Raemdonck, I. (2018). On the relation between teachers'(in) formal learning and innovative working behavior: the mediating role of employability. *Vocations and Learning*, *11*, 529-554.

Loogma, K., Kruusvall, J., & Ümarik, M. (2012). E-learning as innovation: Exploring innovativeness of the VET teachers' community in Estonia. *Computers & Education*, *58*(2), 808-817.

Lubienski, C. (2009). 'Do quasi-markets foster innovation in education? A comparative perspective.' *OECD Education Working Papers*, (25).

Messmann, G., & Mulder, R. H. (2012). Development of a measurement instrument for innovative work behavior as a dynamic and context-bound construct. *Human Resource Development International*, *15*(1), 43-59.

Messmann, G., & Mulder, R. H. (2014). Exploring the role of target specificity in the facilitation of vocational teachers' innovative work behavior. *Journal of Occupational and Organizational Psychology*, *87*(1), 80-101.

Messmann, G., Stoffers, J., Van der Heijden, B., & Mulder, R. H. (2017). Joint effects of job demands and job resources on vocational teachers' innovative work behavior. *Personnel Review*, *46*(8), 1948-1961.

Ministerie van Onderwijs, Cultuur en Wetenschap, 2015. *Rijksjaarverslag 2015 VIII.*

Morgeson, F. P., & Humphrey, S. E. (2006). The Work Design Questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design and the nature of work. *Journal of Applied Psychology*, *91*(6), 1321.

Mohammad, R. F., & Harlech-Jones, B. (2008). Working as partners for classroom reform. *International Journal of Educational Development*, *28*, 534–545.

Mosadeghrad, A.M., & Ansarian, M. (2014). 'Why do organisational change programmes fail?' *Int. J. Strategic Change Management, 5*(3), 189-218.

Mueller, J., Wood, E., Willoughby, T., Ross, C., & Specht, J. (2008). Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. *Computers & Education*, *51*(4), 1523-1537.

Mumford, M. D., Scott, G. M., Gaddis, B., & Strange, J. M. (2002). Leading creative people: Orchestrating expertise and relationships. *The Leadership Quarterly*, *13*(6), 705-750.

Noefer, K., Stegmaier, R., Molter, B., & Sonntag, K. (2009). A great many things to do and not a minute to spare: Can feedback from supervisors moderate the relationship between skill variety, time pressure, and employees' innovative behavior? *Creativity Research Journal*, *21*(4), 384-393.

OECD (2014), *Measuring Innovation in Education: A New Perspective*. Educational Research and Innovation, OECD Publishing.

Ohly, S., Sonnentag, S., & Pluntke, F. (2006). Routinization, work characteristics and their relationships with creative and proactive behaviors. *Journal of Organizational Behavior*, *27*(3), 257-279.

Onderwijsraad (2014). *Meer innovatieve professionals.* Den Haag: Onderwijsraad

Pieterse, A. N., Van Knippenberg, D., Schippers, M., & Stam, D. (2010). Transformational and transactional leadership and innovative behavior: The moderating role of psychological empowerment. *Journal of Organizational Behavior*, *31*(4), 609-623.

Prieto, I., & Pilar Perez-Santana, M. (2014). Managing innovative work behavior: the role of human resource practices. *Personnel Review*, *43*(2), 184-208.

Rasch, G. (1960). *Probabilistic models for some intelligence and attainment tests.* Chicago: University of Chicago Press.

Roberto, M. A., & Levesque, L. C. (2005). The art of making change initiatives stick. *MIT Sloan Management Review*, *46*(4), 53-60.

Rogers, E. M. (2003). *Diffusion of Innovations* (fifth ed.). New York: The Free Press of Glencoe.

Runhaar, P. R. (2008). *Promoting teachers' professional development* (Unpublished doctoral dissertation). University of Twente, Enschede, Netherlands.

Schussler, D. L., Poole, I. R., Whitlock, T. W., & Evertson, C. M. (2007). Layers and links: Learning to juggle 'one more thing' in the classroom. *Teaching and Teacher Education*, *23*, 572–585.

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal*, *37*(3), 580-607.

Shalley, C. E., Zhou, J., & Oldham, G. R. (2004). The effects of personal and contextual characteristics on creativity: Where should we go from here? *Journal of Management*, *30*(6), 933-958.

Sherry, L. (2002). Sustainability of innovations. *Journal of Interactive Learning Research*, *13*(3), 211.

Sims, H. P., Szilagyi, A. D., & Keller, R. T. (1976). The measurement of job characteristics. *Academy of Management Journal*, *19*(2), 195-212.

Smit, G.P. (2002), *The new leader: Bringing creativity and innovation to the workplace,* Conyers: Chart Your Course.

Smith, E. M., Ford, J. K., & Kozlowski, S. W. J. (1997). Building adaptive expertise: Implications for training design strategies. In M. A. Quiñones & A. Ehrenstein (Eds.), *Training for a rapidly changing workplace: Applications of psychological research*, 89–118. American Psychological Association.

Soderstrom, N. C., & Bjork, R. A. (2015). Learning versus performance: An integrative review. *Perspectives on Psychological Science*, *10*(2), 176-199.

Stoffers, J. M., Van der Heijden, B. I., & Jacobs, E. A. (2018). Employability and innovative work behavior in small and medium-sized enterprises. *The International Journal of Human Resource Management*, 1-28.

Thurlings, M., Evers, A.T., & Vermeulen, M. (2015). Toward a model of explaining teachers' innovative behavior: A literature review. *Review of Educational Research, 85*(3), 430-471.

Van Eekelen, I. M., Vermunt, J. D., & Boshuizen, H. P. A. (2006). Exploring teachers' will to learn. *Teaching and Teacher Education*, *22*(4), 408-423.

West, M. A., & Farr, J. L. (1989). Innovation at work: Psychological perspectives. *Social Behavior, 4*, 15-30.

Wolfe, R. A. (1994). Organizational innovation: Review, critique and suggested research directions. *Journal of Management Studies*, *31*(3), 405-431.

Yang, S. C., & Huang, Y. F. (2008). A study of high school English teachers' behavior, concerns and beliefs in integrating information technology into English instruction. *Computers in Human Behavior*, *24*(3), 1085-1103.

Chapter 4

Towards sustainable innovations in education: The role of learning climate for vocational teachers' innovative work behaviour

Chapter 5

Team innovative work behaviour in education unravelled

Chapter 6

General discussion and conclusion

Introduction

This dissertation began with the observation that many innovations in education are not implemented sustainably, thus resulting in substantial losses of resources, time, effort, and finances. However, it is necessary that education moves in line with societal developments - after all, the labour market requires employees who can proactively shape innovations and anticipate questions from society. This also applies to teachers in vocational and higher education who play a key role in innovations in education. Examples of educational innovations include dealing with new technology, and introducing new educational or pedagogical insights (Thurlings et al., 2015). Lecturers themselves shape innovations in education by identifying innovation opportunities, generating and promoting new ideas, realising new modules, methods or new processes and embedding them sustainably within education. The behaviour that is required for these challenges is known as innovative work behaviour (IWB).

Based on a review of the IWB literature, prior research has tended to primarily focus on initiating innovations, i.e., opportunity exploration, idea generation and execution. This is also reflected in the way in which IWB is defined. For example, Janssen (2000, p.288) defines IWB as 'the intentional creation, introduction and application of new ideas within a work role, group or organization in order to benefit role performance, the group or the organization'.

None of the previously-formulated definitions refer to sustainability. This is remarkable for several reasons. First, pivotal innovation cycles, such as those of West and Farr (1989), contain a stabilisation phase that refers to embedding the innovation in the processes and procedures of the organisation in order to make innovations sustainable. Moreover, institutionalisation has been frequently discussed in the innovation literature within the education domain (Fullan, 2007). Institutionalisation is established when organisations systematically support, stimulate, and warrant new products or processes. 'Institutionalization comes down to the establishment, the standardization and making routine of the new practice' (Rikkerink et al., 2016, p. 61). Where the innovation literature does consider sustainability to be an important phase, this is not reflected in the traditional definitions of IWB. Therefore, we propose a new definition:

'*Innovative work behaviour is a multi-stage iterative process in which employee behaviour targets the exploration of opportunities, idea generation, idea promotion, idea realisation and the sustainable implementation of these ideas, processes,*

products or procedures within a role, a group or an organisation, whereby the ideas are (relatively) new and intended to benefit the relevant unit of adoption'.

Based on this definition, we sought to explore our observation that many innovations in education are not sustainable. More specifically, this dissertation seeks to contribute to answering the following question: How can educational organisations support teachers and teacher teams in displaying IWB so that innovations are implemented sustainably rather than disappear within dusty folders or forgotten servers?

This main research question was investigated through four studies. In the first, we explored how to conceptualise and measure IWB as a multi-dimensional concept which would include sustainability. By making use of a newly developed questionnaire measuring sustainable IWB, the second and third studies investigated which factors may influence teachers' sustainable IWB. Personal related characteristics, task variety, and the influence of the learning climate (learning environment, management support and exposure to innovation) were examined.

In these three quantitative studies, we measured IWB at the individual teacher level. However, in educational settings, innovation projects (being collaborative) are often assigned to a team of teachers. After all, you teach alone, you train and develop together. Accordingly, the fourth study is on team IWB (TIWB), which is to say, which IWBs occur within a team of teachers.

In this last and final study, we aimed at acquiring deeper insights into how TIWB occurs in the various phases of the innovation process, as well as the dynamic interplay between them and their sequencing, when observing a team that designs, develops and implements a new education module. Through observing a teacher team during the innovation project and coding the displayed IWBs, we were able to generate data that measures IWB beyond perceptions and study them in depth.

The four studies are presented in Chapters 2 to 5. In sum, the studies focus on the following research questions:

1. How to conceptualise and measure IWB? (Study 1, Chapter 2)
2. How does Learning climate (three dimensions) influence teachers' IWB? (Studies 2 and 3, Chapters 3 and 4)
3. How does task variety influence teachers' IWB? (Study 2, Chapter 3)
4. Which TIWBs emerge within the different phases of an innovation project? (Study 4, Chapter 5)
5. Do TIWBs proceed in an iterative, fluid or linear manner? (Study 4, Chapter 5)

Overview of the main results

This section summarises the key empirical findings based on the five main research questions and the results obtained from the four empirical studies (Chapters 2 – 5). Three main themes are discussed: The conceptualisation and measurement of IWB, the factors that influence teachers' IWB, and the unravelling of TIWB. Figure 6.1 depicts how the four studies in this dissertation are related.

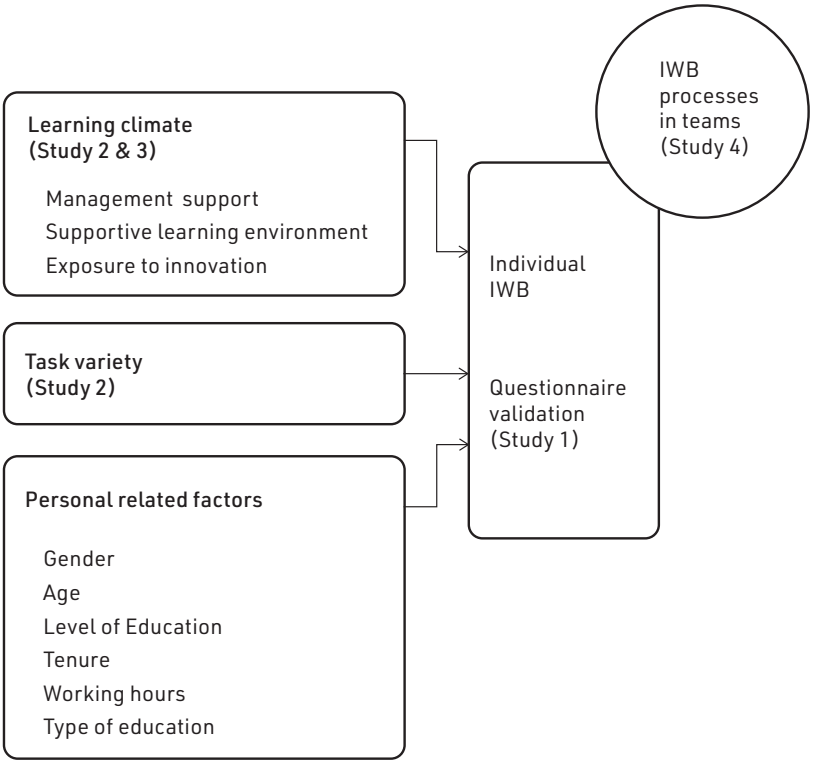


Figure 6.1 Research model

Conceptualisation and measurement of innovative work behaviour

The concept of IWB has been researched for many decades. This study builds on previous research by adding a fifth dimension to the concept of IWB, that is, idea sustainability.

The purpose of Study 1 was to develop and validate an instrument to measure innovative work behaviour of teachers in an educational setting, covering all dimensions of IWB, including a sustainability dimension. Based on a thorough and

comprehensive conceptualisation of IWB, we first collated, adapted and extended the items of previously published instruments consisting of the four dimensions of IWB, i.e. opportunity exploration, idea generation, promotion, and realisation (Messmann & Mulder, 2012, 2014), followed by our development of new items for a sustainability dimension. Second, we tested the construct validity of this newly developed multi-dimensional IWB instrument in a Dutch context (n = 440). We conducted Rasch analyses to test the extent to which scales have been successfully developed according to prior measurement criteria (Ludlow et al., 2008). To validate the IWB scales, six requirements were investigated (Wolfe & Smith, 2007): Rating scale effectiveness, dimensionality, reliability, item measure quality, person measure quality, and item hierarchy. The findings showed that the validated measurement was in line with the conceptualisation of IWB, which distinguishes five main dimensions (including one for sustainability). This sustainability scale appeared to consist of two subscales: Internal embedding and external dissemination. Internal embedding refers to the way in which the innovation is anchored in the organisational system, whereas external dissemination refers to the broader distribution of the innovative idea in the professional network. The behaviour reflected in both subscales is important for innovation to occur in a sustainable manner, where a new idea is firmly embedded and irreversible. This is in line with Askell et al.'s (2020) vision of sustainable innovation, who stated that 'the implementation of an effective initiative over a context-dependent timeframe leads to irreversible desirable system change'. The findings allowed for a further fine-tuning of the scales that were previously applied in other studies. Our findings revealed that the idea realisation dimension entails two sub-dimensions: Criterion-based implementation and learning-based communication. Criterion-based implementation emphasises the assessment of the progress of the innovation, based on criteria. Learning-based communication stresses the importance of information sharing and reflection on innovation development and individuals' professional development.

This study led to the development and validation of a questionnaire measuring all five phases of IWB. Aside from idea sustainability, the other four dimensions are: Opportunity exploration, idea generation, idea promotion, idea realisation.

Factors that influence teachers' innovative work behaviour

A great number of studies have focused on identifying factors that facilitate or hinder individual or group innovation. This study progressed research on the antecedents of teachers' IWB by addressing IWB as a multi-dimensional concept, including the sustainability phase of the innovation process.

Therefore the purpose of our study was to investigate how different context- related antecedents, more specifically learning climate (supportive learning environment, manager support, exposure to innovation), task variety, and personal-related factors support all five dimensions of IWB (including sustainability) in the context of vocational (higher) education (n= 458 teachers).

Learning climate

Our findings showed that a learning climate significantly positively relates to the IWB of vocational teachers, meaning that the presence of a learning climate fosters innovative work behaviour among teachers. However, a distinction must be made between the three dimensions of a learning climate studied due to their different relations to the various IWB phases. In this dissertation, we specifically focus on three dimensions of a learning climate: A supportive environment, management support, and exposure to innovations. Accordingly, our results enabled us to draw three main conclusions. Firstly, a supportive learning climate plays an important role in fostering teachers' IWB. Significant positive correlations where found for all phases of IWB except for idea sustainability (external dissemination). Experiencing a *supportive learning environment* seemed especially important for the creative phase of IWB (opportunity exploration and idea generation). Teachers who work in an environment wherein they feel safe to express new ideas and where differences are appreciated dare to show innovative behaviours. This is in line with previous research on climate and learning, where it was found that a climate that builds on psychological safety, openness to new ideas, appreciation of differences, and time for reflection stimulates learning (Garvin et al., 2008; Singer et al., 2012). This is also reflected in prior research on innovative working climates, which places a greater emphasis on the characteristics of the school climate that stimulates innovations and the creativity of their employees than on the development and implementation of a specific innovation (Molenaar et al., 2010).

Secondly, the findings showed that *management support* in terms of providing time and money to implement ideas, adopting a friendly attitude towards innovative employees, being patient and helpful, and paying attention to people's interests when problems arise was significantly positively related to all phases of IWB. In our study (see Chapters 3 and 4), management support is of significant importance - especially in the sustainability phases. We found that managers who are positive towards innovations and facilitate their occurrence ensures that their teachers show more innovative behaviour in both the creative and implementing phases. This builds further on Lecat et al.'s (2018) study, which found that formal learning activities (i.e., training) are significantly related to teachers' idea generation. Managers who show positive attitudes towards innovations and stimulate their teachers to attend

training sessions might increase teachers' creativeness and, consequently, their idea generation. Other researchers (e.g., Janssen, 2005; Loogma et al., 2012) have stated that managers who support teachers in showing IWB help them improve their IWB when generating and implementing new ideas. Therefore, having a supportive manager is important for achieving sustainable change behaviour in teachers.

Thirdly, it can be concluded that *exposure to innovations* stimulates the IWB of teachers. Assuming a significant role in an innovation process is only possible if a person is exposed to new ideas, involved in innovations, and believes themself to be capable of fulfilling an active role in the innovations. For decades, the business literature has argued that exposure to innovations is crucial for enabling them to occur (e.g., Daft, 1978; Dewar & Dutton, 1986). Teachers should be exposed to - and involved in - innovation processes in order to allow them the opportunities to learn from these experiences. These findings are in line with previous research conducted in both medical and educational settings (Ducharme et al.,2007; Fullan, 2007; Mulder & ten Cate, 2006). For example, Fullan (2007) argued that, when innovating, the most effective motivational resource for teachers is other teachers. He stated that educational change depends on 'what other teachers do and think. As such, it is important to expose teachers to new ideas and increase their enthusiasm for innovations, thereby changing the way they think and act, which could in turn affect their colleagues. Ultimately, it is the teacher who is the key to innovation's long-lasting success.

Task variety

We found that task variety was significantly positively related to all phases of IWB. More task variety (as the degree to which the job requires an employee to perform a wide range of duties) lead to higher scores on all dimensions of IWB, including the two sub-dimensions of idea sustainability. Although previous studies have suggested that task variety might play a positive role in fostering IWB (Noefer et al., 2009; Axtell et al., 2002; Ohly et al., 2006), this study (see Chapter 3) indicated that, when taking a combination of variables (task variety, management support and exposure to innovations) into account at the same time, only management support and exposure to innovations play a major role for all IWB dimensions. Therefore, when considering multiple predictors, task variety was not significantly related to any of the phases of IWB. When interested in fostering IWB, it is most important to invest in management support and exposure to innovation, not in rotating tasks, for example.

Personal related factors

Finally, we found that some personal-related factors, such as age, tenure, gender, number of working hours, and type of education, played a role in how much IWB is displayed. Firstly, *age*, was significantly positively related to the creativity stages of IWB (opportunity exploration and idea generation), meaning that older teachers rated themselves higher on exploring and generating ideas than their younger colleagues. This is in line with Amabile's (1983) notion that individuals who acquire knowledge and gather more life experiences have larger and more integrated knowledge structures of response possibilities, including facts, concepts, and schemata. In turn, this leads to more creative ideas and out-of-the box thinking when facing problems (Hammond et al., 2011). Secondly, *tenure* was significantly negatively related to the opportunity exploration phase. In other words, teachers with less work experience in education have greater levels of engagement in idea exploration. This emphasises the value of stimulating relatively new teachers to share their experiences and ideas on what works and (and what does not) within the school, as well as the opportunities they identify for successful change. Their fresh view is an important lever for innovation. Thirdly, *gender* positively affected IWB in all phases except for idea sustainability (external dissemination). Our female participants rated themselves higher on their IWB across all phases than their male counterparts. Previous studies have reported mixed findings (e.g., Janssen, 2005), or non-significant relations between gender and IWB (e.g., Pieterse et al., 2010). The majority of these studies had an overbalance of male respondents, making it impossible to draw firm conclusions. In our studies (see Chapters 3 and 4) approximately 58% of the sample were female.

Other patterns emerged with respect to the implementation phases (idea realisation and idea sustainability). *Tenure* (more years of experience in education), a greater *number of working hours,* and a higher *type of education* (i.e., working in higher vocational education rather than secondary vocational education) led to higher IWB scores in the realisation and the sustainability phases. It is likely that an increase in tenure is accompanied by more comprehensive insights into how the organisation actually functions. Accordingly, tenure provides insights into ways to embed innovations in a more sustainable manner. Similar findings were reported by Hammond et al. (2011), who identified a significant positive relationship between tenure and innovation. This underlines the importance of including more experienced teachers in innovation teams. The number of working hours was positively linked to higher scores on the IWB implementation phases. To embed an innovation into the organisation, a wide and strong professional network within that organisation is necessary. Building and maintaining this network is time-consuming, but can be aided by an increased number of working hours. Teachers employed in higher

vocational education demonstrated more IWB in the implementation phases than their colleagues in secondary vocational education. An explanation for this could be that teachers working in higher education experience more freedom to develop their own protocols than those who teach in secondary vocational education, who tend to be more tied to national education programmes and thus could feel less ownership when implementing. Additionally, we observed that teachers working in higher education appeared to be more familiar with conceptual models and might therefore be better equipped to capture more aspects of a sustainable realisation.

In sum, Studies 2 and 3 provide evidence for the important role of a supportive learning climate for IWB. More specifically, having managerial support and exposure to innovation are important factors in fostering teachers' IWB. Our findings also revealed that various background factors are significantly positively linked to displays of IWB. Age and tenure were related to the scores on the creative phases of IWB (opportunity exploration and idea generation). Furthermore, teachers' tenure and working hours were significantly positively linked to the implementation phases of IWB.

Unravelling team innovative work behaviour

In recent years, innovation research has shifted its focus from the individual to the team (Widmann et al., 2016; Widmann et al., 2019). Only a limited number of qualitative studies have investigated in detail the processes and various phases of IWB in teams. In addition, the sustainability dimension was notably absent from these studies.

Accordingly, we sought to acquire more insights into how TIWB occurs in the various phases, as well as into the dynamic interplay between the phases and their sequencing, through a longitudinal qualitative approach. Moreover, our study was situated in a more specific, and less explored, context, namely TIWB within course design in higher education. We found that some IWBs occur more regularly than others. More specifically, idea generation and idea realisation (i.e., criterion-based implementation and learning-based communication) were more frequently observed. Within idea generation, both critical analysis and generating ideas were detected. A constant interplay occurs between the two types of idea generation behaviour, meaning that ideas are expressed after they have been analysed or, after an idea has been expressed, critical questions are asked about this idea. We also detected this interplay within the idea realisation phase (criterion-based implementation). Here, critical evaluation behaviour is followed by an adjustment proposal which can been seen as implementation-related idea generation behaviour. Both idea generation and idea realisation together accounted for over 90% of all innovative behaviours.

In contrast, we hardly observed behaviours targeting opportunity exploration and idea sustainability. Indeed, less than 5% of all behaviours were targeted at idea sustainability, which could explain why innovations in education do not endure in the long term. Furthermore, our findings showed that the dimensions of IWB follow each other consecutively, thus indicating a linear process, in accordance with the three different phases of the innovation project: Design and develop, implementation, and evaluation. This contrasts with findings reported in previous studies (Messmann & Mulder, 2012), which have considered IWB to be a multi-stage iterative process. On the surface, without looking specifically at the content or subject of the actions, the process appears to consist of several phases with feedback loops. When the content or theme with which a team is working is analysed, largely linear phases can be observed. Further analyses of the findings revealed that, for certain themes or topics of the innovation at hand, separate linear processes were initiated beside the main linear process. For example, the development and implementation of student assessment began later in the process and followed a linear path.

Based on study 4, we can conclude that some behaviours are displayed more often than others. Indeed, idea generation and idea realisation were observed most, opportunity exploration and idea sustainability were observed less. IWB processes are more linear than often assumed. However, linear processes might exist in parallel. In order to have more sustainable implementations of innovations, creating a more iterative process could well be a positive initial step.

Theoretical contributions

Innovative behaviour is receiving increasing attention, both in (international) educational policies and in school organisations. It is therefore important to be able to properly gain insights into the IWB of teachers. To be able to do this, a measurement instrument that can validate and reliably measure all dimensions of IWB is a necessity. Our first study provided a validated questionnaire measuring all five phases of IWB, namely opportunity exploration, idea generation, idea promotion, idea realisation, and idea sustainability. Many scholars have stressed the importance of studying innovative behaviour and its interaction with individual and contextual characteristics, such as a learning climate in schools (Thurlings et al., 2015). However, to the best of our knowledge, our study is the first to examine the factors that influence the sustainability dimension of IWB. Our second and third studies (Chapters 3 and 4) represented the first step towards understanding which factors are associated with the sustainability dimension of IWB by using the newly developed multi-dimensional IWB questionnaire. These studies provided evidence for the important role of the learning climate for IWB. More specifically, having managerial support and exposure to innovation is crucial in fostering teachers' IWB.

Moreover, managers should pay attention to the composition of innovative teams. Our findings showed how IWB is related to background characteristics of employees, thus indicating that teachers with different profiles (characteristics) are needed in the different phases of an innovation process.

Furthermore, in the last few years a paradigm shift has been seen in IWB research. The success or failure of an innovation is no longer linked to solely the individual, but rather an entire team must assume responsibility for creating, promoting, developing, and implementing an innovation. There is a need for qualitative, longitudinal research. Study 4 took a first step in this direction through the use of a case study in which a teacher team implementing an innovation was observed throughout the innovation process.

It transpired that Study 4's longitudinal data collection method was highly successful. This case study approach allowed us to investigate the team behaviour in all its complexity throughout the various project phases in a real- life setting. Further to this, the study included content which ensured that hitherto undetected secondary processes could be uncovered. By choosing a longitudinal approach which included a content analysis, we were able to identify new avenues for researching IWB.

Practical implications

It is important for schools and their managers to know how to stimulate teachers' IWB, as well as and how to implement innovations and organise the innovation process more effectively. Ultimately, the way a school evolves and deals with ongoing environmental changes depends primarily on the school's human capital, its teachers, and how they deal with such changes (Sherry, 2002).

First, the results from Studies 2 and 3 (Chapters 3 and 4) show that managers play an important role. More specifically, a manager that expects and stimulates innovative behaviour has a positive influence on IWB. Managers could be trained to foster their teacher teams' IWB by providing insights into the IWB processes and by holding leadership behaviour training courses (see the questionnaire items for further details). They can make sure that teachers are exposed to, and feel involved in, innovation processes. To ensure that more teachers are exposed to innovations, teachers can be encouraged to visit the workplace, to contact with other educational institutions where innovations have already been implemented, or attend network meetings. Moreover, sufficient time and space should be allotted to fit this into teachers' work schedules. Involvement can be stimulated by organising regular meetings between teachers and students regarding the most suitable next steps, or by organising regular contact between students, labour market representatives,

alumni, and teachers to discuss the future of education. This exposure and feeling of ownership determines IWB and could also positively influence teachers' self-efficacy. Managers can also play a key role in establishing a supportive learning environment. First, managers should create an environment in which teachers feel psychological safe, where differences are appreciated, where teams learn from their mistakes, and where opportunities and activities are created to promote learning. This state of psychological safety allows learning processes to occur and could lead to different levels of work outcomes (Edmondson, 1999; Edmondson et al., 2007). Teachers who work in such an environment would be more likely to display innovative behaviours. Managers can foster bonds between team members and stimulate a climate in which team members dare to admit their errors in order to learn in a collective way (Newman et al., 2017). This supportive environment is especially important for the creative phase of IWB.

Second, managers can pay attention to how they compose teacher teams, since the background characteristics of the teachers play a role in the prevalence of IWB in the innovation process. For example, older teachers with less experience in education are essential in the creativity phases, whereas more experienced teachers and a considerable number of working hours are crucial for the implementation phases. Striving for a variety of profiles is positive for fostering IWB.

Third, the results from Study 4 (Chapter 5) show that less than 5% of all behaviours were targeted at idea sustainability. This could well explain why innovations in education do not endure in the long term. It also stresses the importance of paying sufficient attention to the process of the innovation itself and, in particular, to the sustainability of the innovation early on in the process. Accordingly, team members should be aware of the behaviours that matter most in each phase of the innovation. Managers and team leaders should be informed about the process of an innovation in order to provide suitable support – which could take the form of professional development or composing the perfect team for a particular step of the process. Moreover, sufficient attention should be paid to the sustainability phase from the start of the innovation process. Indeed, teams should pay particular attention to professionalisation activities, networking, and communicating regarding the results and benefits. By organising professionalisation activities earlier in the process, teachers have the opportunity to grow into their new role, and changing their behaviours and routines slowly. After all, change as part of an innovation process takes time, and it is crucial to adopt the new behaviour in order to permanentely change teachers' routines. Therefore, it is important to involve all stakeholders in the innovation project plan from the start and to take direct account of the organisation in which the development is taking place.

Fourth, in educational settings there is a tendency to ignore the conditions (e.g., time and finances) for the sustainability phase. Therefore, managers should be aware of spreading available resources and finances over a longer period, including a period in which the innovation disseminates into the deeper structure of the organisation through institutionalisation. As such, project planning should include particular steps to strengthen the infrastructure necessary to sustain an innovative idea, such as updating and continuous regeneration so as to avoid implementation dips. This could be achieved through capacity building for securing adequate resources, and visualisation of the innovation's benefits and outcomes for stakeholders by stimulating community participation and communicating a longer-term vision (Coffey & Horner, 2012; Loh et al., 2013).

Fifth, our developed questionnaire – and, especially, its sustainability items (Appendix, Chapter 2) - can form a helpful tool to measure teachers and school's level of innovativeness. Teams can complete the questionnaire at the start of an innovation process as a first step to learning of each phase's necessary behaviours. In doing so, each necessary behaviour can be firmly in mind at the project's outset. Next, the scores can be used to detect possible improvement or compose the perfect mix of teammembers for each phase.

Limitations and avenues for future research

The research reported and discussed in this thesis has certain limitations and can set directions for future research. Three main themes are discussed below: The conceptualisation and measuring of IWB, the factors that influence teachers' IWB, and the unravelling of TIWB.

Conceptualisation and measurement of IWB

Although we used data from a heterogeneous sample which included teachers from four different vocational educational institutes, the results confirmed a five-structure model of IWB in the vocational educational sector only. Hence, future studies could benefit from the validation of our instrument by using the measures and operationalisations in samples consisting of professionals in other educational institutes (e.g., primary schools, secondary schools, universities). Moreover, the questionnaire could even be applied to other professional contexts, such as profit or non-profit organisations oriented towards innovation. Secondly, our study only included Dutch participants. The obtained Rasch measures are invariant, but we have not explored internationally composed samples. The English version, which is provided in the appendix, could allow other researchers to apply these validated measures to other countries. Third, we have used self-ratings of IWB. Although this may lead to biased findings, previous research has indicated a strong relationship

between self-reported behaviour and managers' perceptions (e.g., Axtell et al., 2000). Future research could focus on triangulations between observations and self-reported data through the use of a mixed-methods approach. This could lead to deeper insights about innovation processes.

Factors influencing IWB

In order to reduce the over-estimation drawback from self-reports, we would advise future researchers to conduct interviews in addition to survey research. Interview data can provide more details as to why teachers see themselves as high or low scoring in terms of IWB, as well as how the learning climate plays a role in the various IWB phases. For example, qualitative research could focus on the role of the manager for IWB, i.e., how managers can stimulate exposure to innovations or create a supportive learning climate. Both variables are strongly related to high IWB scores.

Our research also shows that such background variables as age, gender, and tenure play a role in the creative phases of IWB. Indeed, we found in Studies 2 and 3 that age was significantly positively related to exploration and idea generation. Surprisingly, tenure was significantly negatively related to opportunity exploration. In other words, older teachers with less work experience in education have a greater engagement in the creativity phase. Their fresh views are an important value for innovation. We also found that women display more IWB in almost all phases, except for idea sustainability (external dissemination). The majority of previous studies have reported mixed findings (Janssen, 2005) or non-significant relations between gender and IWB (Pieterse et al., 2010). However, it should be noted that most of these had an overbalance of male respondents, making it impossible to draw firm conclusions. For the implementation phase, tenure and number of working hours were found to be important factors. In this phase, teachers with many years of experience and a larger number of working hours scored more highly on IWB. To firmly embed an innovation into the organisation, a wide social network is very helpful. Future research could study in more detail how gender, age, and experience determine IWB in the different phases. Additionally, the relation of other person-related variables, such as motivation, future time perspective, and personality to IWB could be a promising avenue for future research.

Given the influence of the person-related variables, future research could explore the composition of innovation teams, and its role in IWB and the various innovation phases in order to further unravel TIWB.

Unravelling TIWB

One of our foci was on the dynamic interplay of TIWB dimensions and their sequencing in the context of higher education at both the individual and team levels. It should be noted that we did not include the organisational level. Future research could focus on IWB at an organisational level by, for example, studying different organisations, the prevalence of IWB, and its determining factors. It may also be interesting to investigate TIWB in non-educational organisations, with a particular focus on the factors that play a role in the sustainable implementation of innovations. In order to further generalise our findings, we suggest that similar, longitudinal, qualitative case studies (as in Study 4) will be applied to other teams and contexts. It would be interesting to analyse cases which differ in terms of sustainability by comparing IWB in settings where innovations were either implemented well or not sustainably.

Due to how Studies 2 and 3 showed the importance of a learning climate to promote IWB among individual teachers, we propose that further research could be conducted into the role of the manager or team leader in promoting TIWB. Team leadership behaviour is often considered essential for stimulating team learning behaviour to work towards educational change (Koeslag- Kreunen et al., 2018).

In addition, it would be interesting to investigate whether having knowledge about innovation processes and IWB helps in the sustainable implementation of innovations. Insights into the innovation process, the behaviours associated with each phase, and which aspects play a role can help managers and teams to take the right steps and also to regularly reflect on the innovation process itself.

As Study 4 showed that IWB is more linear than previously thought, it would be interesting to conduct an intervention study that stimulates a more fluid or iterative form of IWB, whereby attention would be paid to sustainability earlier in the process. For example, going through professionalisation in-company in line with the innovation.

Conclusion: The way to sustainable innovations

We began this dissertation with the observation that many innovations in higher or vocational education are not implemented sustainably, thus resulting in substantial resources, time, effort, and finances being lost or wasted. The results of all four studies help to answer the main question underlying this dissertation: How can we ensure that teachers implement innovations sustainably by displaying innovative work behaviour.

The studies have shown that innovation processes in education are complex and that teachers are important players in this process. If teachers demonstrate IWB within all five phases, innovations can be implemented more sustainably. In order to sustainably implement these innovations, it is important to take sustainability aspects into account from a project's outset. Sufficient time and money should be reserved for the sustainable implementation phase and team professionalisation activities shoud be invested in. It is also important to carefully compose the innovation team. After all, each phase requires different competencies or characteristics, and are highly dependent on the personal- related characteristics of the teacher. A balanced mix of team members can help achieve satisfying results. By focusing on a strong, supportive environment - particularly by providing management support and exposing teachers to innovations – educational innovations could be prevented from disappearing on a shelf or server.

References

Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology*, *45*(2), 357.

Askell-Williams, H., & Koh, G. A. (2020). Enhancing the sustainability of school improvement initiatives. *School Effectiveness and School Improvement*, *31*(4), 660-678.

Axtell, C. M., Holman, D. J., Unsworth, K. L., Wall, T. D., Waterson, P. E., & Harrington, E. (2000). Shopfloor innovation: Facilitating the suggestion and implementation of ideas. *Journal of Occupational and Organizational Psychology*, *73*(3), 265-285.

Axtell, C., Wall, T., Stride, C., Pepper, K., Clegg, C., Gardner, P., & Bolden, R. (2002). Familiarity breeds content: The impact of exposure to change on employee openness and well-being. *Journal of Occupational and Organizational Psychology*, *75*(2), 217-231.

Coffey, J. H., & Horner, R. H. (2012). The sustainability of schoolwide positive behavior interventions and supports. *Exceptional Children*, *78*(4), 407-422.

Daft, R. L. (1978). A dual-core model of organizational innovation. *Academy of Management Journal*, *21*(2), 193-210.

Dewar, R. D., & Dutton, J. E. (1986). The adoption of radical and incremental innovations: An empirical analysis. *Management Science*, *32*(11), 1422-1433.

Ducharme, L. J., Knudsen, H. K., Roman, P. M., & Johnson, J. A. (2007). Innovation adoption in substance abuse treatment: Exposure, trialability, and the Clinical Trials Network. *Journal of Substance Abuse Treatment*, *32*(4), 321-329.

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly*, *44*(2), 350-383.

Edmondson, A. C., Dillon, J. R., & Roloff, K. S. (2007). 6 three perspectives on team learning: Outcome improvement, task mastery, and group process. *Academy of Management Annals*, *1*(1), 269-314.

Fullan, M. (2007). *Leading in a Culture of Change*. John Wiley & Sons.

Garvin, D. A., Edmondson, A. C., & Gino, F. (2008). Is yours a learning organization?. *Harvard Business Review*, *86*(3), 109.

Hammond, M. M., Neff, N. L., Farr, J. L., Schwall, A. R., & Zhao, X. (2011). Predictors of individual-level innovation at work: A meta-analysis. *Psychology of Aesthetics, Creativity, and the Arts*, *5*(1), 90.

Janssen, O. (2005). The joint impact of perceived influence and supervisor supportiveness on employee innovative behaviour. *Journal of Occupational and Organizational Psychology*, *78*(4), 573-579.

Koeslag-Kreunen, M., Van den Bossche, P., Hoven, M., Van der Klink, M., & Gijselaers, W. (2018). When leadership powers team learning: A meta-analysis. *Small Group Research*, *49*(4), 475-513.

Lecat, A., Beausaert, S., & Raemdonck, I. (2018). On the relation between teachers'(in) formal learning and innovative working behavior: The mediating role of employability. *Vocations and Learning*, *11*(3), 529-554.

Loh, L. C., Friedman, S. R., & Burdick, W. P. (2013). Factors promoting sustainability of education innovations: A comparison of faculty perceptions and existing frameworks. *Education for Health*, *26*(1), 32.

Loogma, K., Kruusvall, J., & Ümarik, M. (2012). E-learning as innovation: Exploring innovativeness of the VET teachers' community in Estonia. *Computers & Education*, *58*(2), 808-817.

Ludlow, L. H., Enterline, S. E., & Cochran-Smith, M. (2008). Learning to teach for social justice-beliefs scale: An application of Rasch measurement principles. *Measurement and Evaluation in Counseling and Development*, *40*(4), 194-214.

Messmann, G., & Mulder, R. H. (2012). Development of a measurement instrument for innovative work behaviour as a dynamic and context-bound construct. *Human Resource Development International*, *15*(1), 43-59.

Messmann, G., & Mulder, R. H. (2014). Exploring the role of target specificity in the facilitation of vocational teachers' innovative work behaviour. *Journal of Occupational and Organizational Psychology*, *87*(1), 80-101.

Moolenaar, N. M., Daly, A. J., & Sleegers, P. J. (2010). Occupying the principal position: Examining relationships between transformational leadership, social network position, and schools' innovative climate. *Educational Administration Quarterly*, *46*(5), 623-670.

Mulder, R., & ten Cate, R. (2006). *Innovatief Ondernemen*. Pearson Education.

Newman, A., Donohue, R., & Eva, N. (2017). Psychological safety: A systematic review of the literature. *Human Resource Management Review*, *27*(3), 521-535.

Noefer, K., Stegmaier, R., Molter, B., & Sonntag, K. (2009). A great many things to do and not a minute to spare: Can feedback from supervisors moderate the relationship between skill variety, time pressure, and employees' innovative behavior? *Creativity Research Journal*, *21*(4), 384-393.

Ohly, S., Sonnentag, S., & Pluntke, F. (2006). Routinization, work characteristics and their relationships with creative and proactive behaviors. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *27*(3), 257-279.

Pieterse, A. N., Van Knippenberg, D., Schippers, M., & Stam, D. (2010). Transformational and transactional leadership and innovative behavior: The moderating role of psychological empowerment. *Journal of Organizational Behavior*, *31*(4), 609-623.

Rikkerink, M., Verbeeten, H., Simons, R. J., & Ritzen, H. (2016). A new model of educational innovation: Exploring the nexus of organizational learning, distributed leadership, and digital technologies. *Journal of Educational Change*, *17*(2), 223-249.

Sherry, L. (2002). Sustainability of innovations. *Journal of Interactive Learning Research*, *13*(3), 211-238.

Singer, S. J., Moore, S. C., Meterko, M., & Williams, S. (2012). Development of a short-form learning organization survey: The LOS-27. *Medical Care Research and Review*, *69*(4), 432-459.

Thurlings, M., Evers, A. T., & Vermeulen, M. (2015). Toward a model of explaining teachers' innovative behavior: A literature review. *Review of Educational Research*, *85*(3), 430-471.

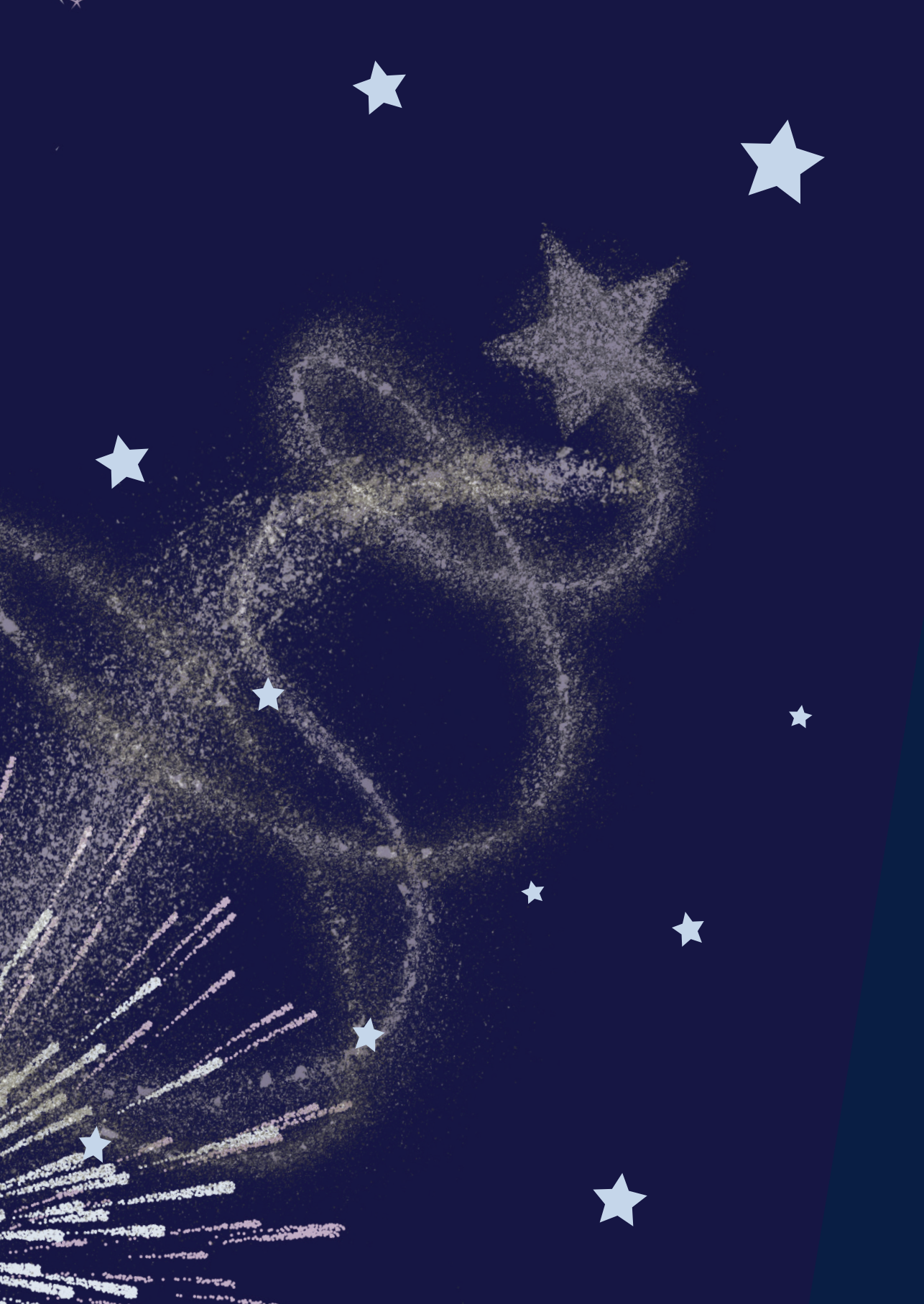
West, M. A., & Farr, J. L. (1989). Innovation at work: Psychological perspectives. *Social Behaviour*, *4*, 15-30.

Widmann, A., Mulder, R. H., & König, C. (2019). Team learning behaviours as predictors of innovative work behaviour–a longitudinal study. *Innovation*, *21*(2), 298-316.

Widmann, A., Messmann, G., & Mulder, R. H. (2016). The impact of team learning behaviors on team innovative work behavior: A systematic review. *Human Resource Development Review*, *15*(4), 429-458.

Wolfe, E. W., & Smith Jr, E. V. (2007). Instrument development tools and activities for measure validation using Rasch models: Part I--instrument development tools. *Journal of Applied Measurement, 8(1), 97–123.*

Wolfe, E. W., & Smith Jr, E. V. (2007). Instrument development tools and activities for measure validation using Rasch models: Part II--validation activities. *Journal of Applied Measurement*, *8*(2), 204-234.



Chapter 7

Valorisation addendum

Valorisation addendum

During my job as a teacher in higher education, I saw many new initiatives that received considerable attention and financial resources. Then, however, I saw those same innovative ideas fade away or be quietly relegated to the bin. This development is not only visible within the educational sector, but is also reflected in society as a whole. Many innovative initiatives turn out to be hardly sustainable (Onderwijsraad, 2011). Fortunately, in recent years, increasing attention has been paid to improving the sustainability of innovations and to the employees who can make this possible. After all, they are the social capital of a company or educational institute.

This was the reason which prompted me to research the innovative behaviour of teachers and the way in which sustainable educational innovations can be stimulated. Teachers from different educational institutions participated in this research (VET-HE-University), but the valorisation activities mainly related to Zuyd University (HE) in which I myself had various roles (teacher, researcher, advisor, and manager).

This valorisation addendum both discusses the transfer of our findings into past valorisation activities that formed part of my PHD project and describes present and future valorisation opportunities.

Past valorisation activities

Since the start of my PhD course, I have participated in a wide range of activities that have jointly contributed to boosting change within specific study programmes and across Zuyd as a whole. In this chapter, I describe the most impactful activities.

The educational innovation and continuous professional development (Lectoraat Professionalisering van het Onderwijs) research centre, of which I am a member, has the objective of conducting research into Zuyd University's own education in order to develop and disseminate new insights, both within and outside this university. The centre has the ambition of fulfilling the R&D function for educational questions within Zuyd. This involves both research into the benefits of educational innovations (e.g., student learning outcomes), the way in which innovation processes (ideally) take place, and the supporting conditions, including the professional development of teachers. By conducting this research, knowledge has been developed on how to measure the innovative work behaviour of teachers, what supporting factors there are, and what actions can be taken to strengthen IWB. This knowledge was shared with members of the research centre, key persons within Zuyd, and interested parties outside of the university. Presentations were given at both national and international conferences (e.g., ORD, EAWOP, EAPRIL, EARLI SIG) and, on request,

I have provided tailored advice to consultants, directors, training managers, and teacher teams. Through my work in this research centre, I have helped to design a number of innovations within Zuyd. One of these innovations was the beginning of 'Succesvol Studeren' [improving student success], a university-wide programme launched in 2017. Until the start of the programme, local projects were initiated. The programme opted for a programmatic approach with a long-term perspective and a joint focus. As a member of the programme's core team, I developed an approach that stimulates teacher teams to demonstrate IWB, which is accompanied by activities aimed to boost the professional development of teacher teams. The knowledge gained from my research, namely the focus on sustainability by creating a supportive learning environment in which IWB is expected, and providing the right preconditions, such as time and resources, to work on innovations and stimulate professional development, has hereby been taken into account. For a detailed description of this programme, I refer to the publication 'Een ander hoe, studiesucces als veranderproces' (Kwakman et al., 2019).

The development of the 'Successvol Studeren' programme and the focus on sustainability is aligned with the conclusions from Study 2.

Quote from the conclusion of Study 2:
'The study seeks to describe, explain, and predict teachers' IWB and the factors that impact their behaviour as a means of generating insights into how to develop appropriate contexts and initiatives to further encourage such behaviour. Furthermore, we can increase the long-term success of innovations by paying attention to the sustainability phase'.

In my role as the programme's educational advisor, I have guided and advised my colleagues, including in terms of programme management. Moreover I was involved in advising various teacher teams in order to improve curricula that are more effective in terms of student success, and at the same time fit the needs of the teachers and university. For a detailed description of the programme and its impact, please see the following links:

https://www.youtube.com/watch?v=R5B58Mt3OW8
https://www.youtube.com/ watch?v=LgdnF8ZC8Nc
https://www.youtube.com/watch?v=WLQSnvoM2oY

At the Business school, I provided support to both the management and the teaching team (e.g., members of the project teams, coaching writing groups, organising study days, and individually coaching teachers). The advices I gave to the management included how to create a supportive work environment, the effective use of time and resources, the composition of writing teams, and clear communication about the renewal process (e.g., during study days). Additionally, I also contributed to the content of the study days with the entire teaching team, where much emphasis was placed on their professional development.

Quote from Tamara Mayer, Business School Manager:
'We really see the support from the 'Succesvol Studeren' programme as 'working together' with Peggy Lambriex on the quality of our education. Thanks to this approach, we have improved our courses in many ways. A wonderful blueprint for the new curriculum as a starting point for the curriculum committee in the coming years and the professional development of the teaching team are good examples of this. This helps us for the future, but certainly also in the present where online education plays a very important role'.

Within the Law school, I have worked as a supervisor/advisor collaborating with the management team to build a supportive learning environment and to inspire the teaching team by conducting professional development activities aiming at their understanding of active learning.

Quote from Annemie Heuts, Former Manager of the Law School:
'Making innovative work behaviour more sustainable is a 'must' in guaranteeing high-quality education. The contribution of the 'Succesvol Studeren' programme is essential in this regard'.

In the coaching of both schools, the role of the manager or the management team, the creation of a supportive learning environment, and teacher professional development were the main foci. My advice (e.g., creating a supportive work environment in which IWB is expected) provided the right preconditions, such as time and resources, to work on innovations and stimulate professional development were grounded in the research results and implications of my thesis.

Quote from the implications of Study 2:
'This study provides evidence for the significance of environmental factors influencing IWB while controlling for individual factors. Here we present four implications. Firstly, the results show that managers should create a supportive work environment in which IWB is expected, teachers feel free to develop and discuss new ideas, and teachers are given the opportunity to participate in innovative projects. Secondly, managers should provide the right preconditions, such as time and resources, to work on innovations'.

With practice-based research, our research centre contributes to the development of expertise in the field of three interrelated themes: [1] active learning in a (digital) learning environment, [2] educational development, and [3] sustainable implementation in teams. The expertise gained in my PhD research contributed to the evolution of the research activities related to the third theme. Whereas the theme previously focused on 'teacher teams', the emphasis is now on 'sustainable implementation in teams'. This shift shows that this research theme is mainly concerned with educational innovation in a team context, and in particular with developing knowledge about the sustainability of innovations - precisely because the perpetuation of innovations appears to be problematic. As the main person responsible for this research theme, I am the driving force behind various research projects. An example is a literature study on sustainable innovations (Van Genugten, 2022). This research is closely linked to the literature study and the results of Study 1.

Quote from the general discussion in Study 1:
'By adding the sustainability dimension to the current conceptualisations of IWB, we strongly accord with the innovation cycles of West and Farr (1989) and Fullan (2007), who emphasised a stabilisation or continuation phase as a vital stage to completing an innovation process. The emphasis on this sustainability phase can help schools firmly anchor innovative ideas in their organisations, preventing losses of time and energy through unfinished innovations'.

My research also has an impact outside of Zuyd University [Zuyd Hogeschool]. I regularly meet with researchers from all over the country who are working on the theme of IWB or sustainable implementation. One of these meetings resulted in being the starting point of a research path of the Landstede (practoraat) research group, 'Teaching professionalism' (a research group within VET). Landstede developed and implemented a research box based on the IWB phases. This research box won the incentive prize for most innovative research method at the MBO (VET) Research Day 2021. Later, an article was published: 'De onderzoekbox; op creatieve wijze mbo-docenten uitdagen en prikkelen' (Korsmit, 2021). It is pleasing to see that our research on the phases of innovative work behaviour and the emphasis on sustainability has inspired new initiatives.

Quote form Ceciel Korsmit, Landstede Researcher:
'We had contact with each other quite some time ago. At the time, I was in the exploratory phase of my research on the innovative capacity of VET teachers. [MBO docenten]. Your investigations [this dissertation] and the phases of IWB have become a starting point in my line of research.
Since your dissertation source has been a wonderful input, I am happy to share it with you. And of course thank you very much for that!'

Besides the national impact, my research has also received international attention - especially for the validated IWB questionnaire. A group of Turkish researchers has transferred the scales into Turkish and conducted a validation-reliability study in their country. They concluded that the scales are valid and reliable (Muhammet & Balaman, 2021).

Quote from the limitations and future research section of Study 1:
'Firstly, even though we used data from a heterogeneous sample including teachers from different professional institutes, the results confirm a five-structure model of IWB in the vocational educational sector only. Hence, future studies might benefit from the validation of our instrument by using the measures and operationalisations in samples consisting of professional and general college level and/or university level education. Secondly, our study only included Dutch participants. The obtained Rasch measures are invariant, but we have not yet explored internationally composed samples'.

In addition, the number of citations (50 in total, spread over 2 years) to my articles demonstrate the appreciation of my work on IWB and the developed measuring instrument.

Present valorisation activities

During my PhD trajectory, I also noticed a change in myself. As an advisor and supervisor of the 'Succesvol Studeren' programme, I was able to learn a great deal about stimulating and activating teaching teams, group dynamics, and innovation processes. Through these learning experiences, I began to feel that I wanted to take a more leading role in innovation projects rather than merely provide advice or guidance from the side-lines. It became my dream to be able to manage a team myself an create a learning environment in which all team members would be inspired to give their best in order to achieve maximum team performance. That opportunity came in 2020. Within Zuyd, a position became vacant as education manager of the Academy for Speech and Language Therapy. Since then, I have been fulfilling my dream, and working with my team towards a sustainable new curriculum that inspires both teachers and students to learn, and teachers to guide our students within a simple organisational structure. I have combined this management role within my work as a researcher at the educational innovation and continuous professional development (Lectoraat Professionalisering van het Onderwijs) research centre. This is a perfect combination because I can immediately apply the knowledge I gain in research and because this practical knowledge also provides input for new research. I also share the knowledge gained from all the research conducted by our research group with the team of education managers within the health and welfare domain.

Quote from the practical implications of Study 3:
'*More specifically, if principals offer support for, and expose their teachers to, various innovations, sustainable innovations are more likely to succeed. In other words, a supportive management that facilitates learning and structures the way in which employees are brought into contact with innovations is of crucial importance to the long-term success or failure of innovations. The manager is key to creating the learning climate needed for successful innovation*'.

Future valorisation activities

My work as a principal researcher for the theme of 'sustainable implementation in teams' will be continued by initiating future projects aimed at, gaining insights into the role of managers in creating supportive learning environments, how professional development can contribute to more sustainable educational innovations, and the formation of teams that are highly capable of achieving sustainable innovations.

> Quote from the practical implications of Study 3:
> *'For schools and their principals, it is important to know how each distinct learning climate dimension relates to their teachers' IWB and in which phases. Ultimately, the way that the school evolves and deals with ongoing environmental change depends primarily on the school's human capital, that is, its teachers (Sherry, 2002)'.*

Having conducted this research, I would like to apply for a Comenius grant for one of the topics indicated above. A Comenius grant would allow me to collaborate with education professionals and other universities to conduct an innovation project that would contribute to improving higher education. In order to generate even more attention for the sustainability of innovations, I am going to publish a magazine about my research that targets managers, HR staff, and teachers. This magazine will focus on the phases of innovative behaviour, the attention for sustainability from the start of a project, and what is needed to promote sustainability. It will also contain concrete tips and tricks to promote sustainable IWB, such as reflection on the process itself rather than on the content of the innovation.

> Quote from the practical implications of Study 4:
> *'Second, it was found that teachers seem to marginally reflect on the innovation process, steps to be taken, and the innovation behaviours required. Through short evaluations at the end of every meeting or even through the use of reflection tools, teacher teams could be stimulated to reflect on these aspects. Moreover, special attention could be paid to ensuring the sustainability of the innovation, from the start of the project onwards'.*

In my role as manager of the Academy of Speech and Language Therapy, I will continue to focus on sustainable innovations, together with my team and my fellow managers from both within and outside the domain. By spreading project funds over

a longer period of time, deploying team members in those phases of a project where they are at most value, paying attention to professional development, and, above all, by focusing on the team members and offering them a safe and stimulating learning climate, I hope to implement educational innovations more sustainably. I will be able to use the practical insights gained directly in my work within our research centre.

A combination that keeps me working at Zuyd University is the wonderful mix of new challenges and pleasant meetings with colleagues who offer a lot of inspiration for both the present and future.

References

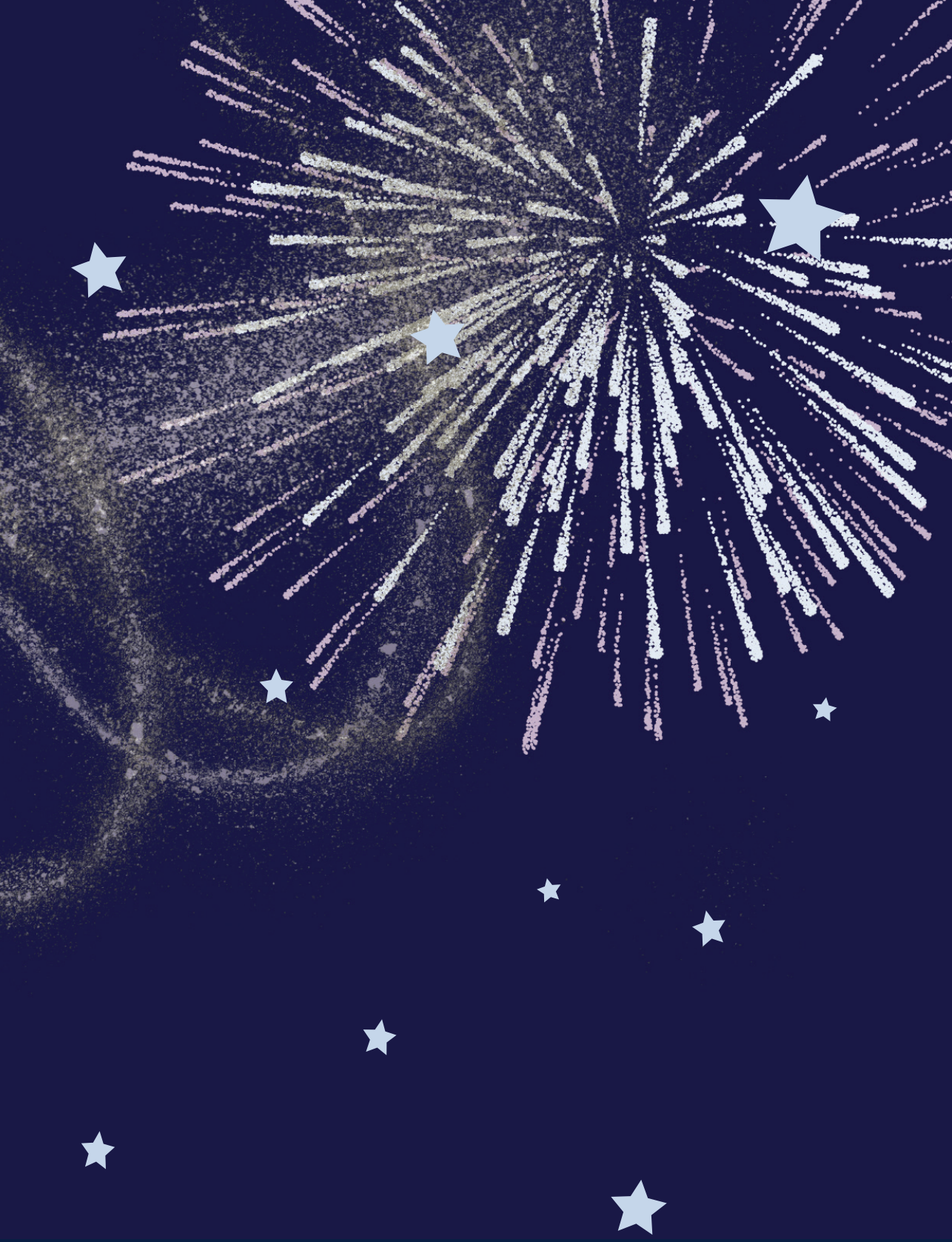
Korsmit, C. (2021). *De onderzoeksbox; op creatieve wijze mbo-docenten uitdagen en prikkelen.* Landstede Groep.

Kwakman, K., Mars, A., Theunissen, N., & Van der Klink, M. (2019). *Een ander hoe, studiesucces als veranderproces.* Heerlen: Zuyd Hogeschool.

Muhammet, B. A. Ş., & Balaman, F. (2021). Yenilikçi İş Davranışı Ölçeği'nin Türkçeye Uyarlanması: Geçerlik-Güvenirlik Çalışması. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, *17*(3), 485 - 510.

Onderwijsraad, (2011). *Ruim baan voor stapsgewijze verbetering.* Onderwijsraad.

Van Genugten, K. (2022). *Sustainability of innovations in higher education: A literature exploration.* Zuyd Hogeschool.



Appendices

Summary
Samenvatting
About the author
List of publications
Dankwoord

Summary

While the 21th-century labour market requires employees that proactively shape innovations and solve complex problems, professionals in the education sector are expected to show innovative behaviour that not only entails the generation of new ideas, but also the realisation and sustainable implementation.

Current IWB conceptualisations and operationalisations are in need of further attention. This call is supported by how prior studies have demonstrated that existing measurements miss empirical evidence of the construct validity and moreover do not include a sustainability dimension. Therefore, in Study 1, a multi-dimensional innovative work behaviour (IWB) instrument was developed and validated to measure teachers' IWB. Accordingly, we first adapted and extended items of previously used instruments, and developed new ones for the sustainability dimension. Second, we tested the construct validity of this newly developed multi-dimensional IWB instrument in a Dutch context, where the psychometric characteristics were examined in a sample of teachers working in vocational education (n= 440). The analysis revealed five dimensions of IWB, namely opportunity exploration, idea generation, idea promotion, idea realisation (differentiated in two sub-dimensions: Criterion-based implementation and learning-based communication) and idea sustainability (differentiated in two sub-dimensions: External dissemination and internal embedding). This new instrument, which builds on recent conceptualisations of IWB, as well as on the pivotal innovation models of West and Farr (1989) and Fullan (2007), offers a conceptually sound and valid tool with which to validate explanatory models of innovative teacher behaviour. Moreover, this study also offers the opportunity to accurately diagnose the necessary IWB conditions for an educational innovation to succeed.

In a sample of 458 employees in Dutch secondary and higher vocational education (abbreviated in Dutch to MBO and HBO, respectively), Study 2 investigated the relation between environmental factors (task variety, management support, and exposure to innovation) and the five dimensions of IWB (sustainability included).

A (Hierarchical) regression analysis showed that management support and exposure to innovations were significantly positively related to all phases of IWB. Teachers with supportive managers and a high degree of exposure to innovations showed higher scores on innovative behaviour across all phases.

There was a significant relationship between task variety and IWB. In the hierarchical regression model, only management support and exposure to innovations showed

significant positive relations with IWB. Background characteristics, such as gender, age, tenure, number of working hours, and type of education - for which we controlled during the analyses - played a role in how much IWB is displayed. We can thus conclude that a work environment in which employees are supported and exposed to innovation is crucial. Additionally, given their role, teachers' background characteristics should be taken into account when forming teams working on innovations.

Given the idea of a dynamic environment, teachers are expected to show IWB, (i.e., generating, promoting, implementing, and sustaining new ideas). However, IWB might depend on characteristics of the work environment often referred to as learning climate.

In Study 3, we explored the relation between a learning climate (defined as a supportive learning environment, management support, and exposure to innovation) and IWB. This study was conducted among teachers from two Dutch vocational colleges (n= 206). We found that learning climate had a significantly positively relation to IWB. More specifically, a supportive learning environment was significantly positively related to the generation of new ideas (opportunity generation and idea generation). Both management support and exposure to innovation are significantly and positively related to idea generation and the implementation phases (idea promotion, realisation, and sustainability). This study provides insight into how schools can stimulate teachers' IWB. However, IWB can be studied at both the individual and team levels.

Sustainable innovations also demand teams with the ability to demonstrate team innovative work behaviour (TIWB). Thus far, TIWB has been assumed to be an iterative process, and has predominantly been researched among individual team members with survey-based, cross-sectional methodologies. Through Study 4's use of a longitudinal qualitative approach, we sought to delve deeper into how IWB occurs in teams across various phases and how these interact.

A case study was conducted involving a teacher team working at a Dutch university that had to design, develop and implement a new educational module. Team meetings were audiotaped and transcribed. We used a codebook for the analysis based on the definitions of the five main dimensions of IWB and the items of the validated questionnaire (Lambriex-Schmitz et al., 2020). In contrast to what was expected, the results revealed that TIWB appears to be a rather linear process rather than an iterative one wherein not all phases were detected. Idea generation and idea realisation were frequently observed, yet little-to-no attention was paid

to opportunity exploration and idea sustainability. In line with theory, specific innovative work behaviours were identified per phase. This study offers more in-depth insights into TIWB processes and the specific behaviours team members show in each phase. It also offers fruitful insights into how to foster the success of sustainable innovations in teacher teams.

Samenvatting

De huidige arbeidsmarkt vraagt om werknemers die proactief innovaties vormgeven en complexe problemen oplossen. Ook van professionals in het onderwijs wordt verwacht dat ze innovatief werkgedrag (IWB) vertonen dat zowel gericht is op het genereren, promoten en het realiseren van nieuwe ideeën als op de duurzame implementatie ervan. Vooral de duurzame implementatie van innovaties is niet altijd vanzelfsprekend. In het onderwijs worden dan ook vaak op zich waardevolle innovaties opgestart die na verloop van tijd een stille dood sterven. Ondanks de ruime aandacht in de literatuur voor het begrip innovatief werkgedrag, is het opmerkelijk dat in zowel de huidige conceptualisatie als in het beschikbare meetinstrumentarium, het aspect duurzaamheid ontbreekt.

Daarom wordt in *studie 1* de ontwikkeling en validering van een multi-dimensionaal meetinstrument om het IWB van docenten te meten, gerapporteerd. De items van eerder gebruikte instrumenten werden aangepast en uitgebreid en nieuwe items voor een duurzaamheidsdimensie werden ontwikkeld. Daarnaast hebben we de constructvaliditeit van dit nieuw ontwikkelde instrument getest in een Nederlandse context bij een steekproef van docenten die werkzaam zijn in het middelbaar en hoger beroepsonderwijs (n= 440). Uit de analyse kwamen vijf dimensies van IWB naar voren namelijk, idee exploratie, idee generatie, idee promotie, idee realisatie en idee verduurzaming. Idee realisatie bestaat uit twee sub-dimensies namelijk, criterium gebaseerde implementatie en op leren gerichte communicatie. Idee verduurzaming kent de sub-dimensies interne inbedding en externe disseminatie.

Dit nieuwe instrument, dat voortbouwt op recente conceptualisaties van IWB en op veel geciteerde innovatiemodellen van West and Farr (1989) en Fullan (2007), biedt een conceptueel verantwoord en valide instrument om innovatief werkgedrag van docenten te meten en daarbij in kaart te brengen welke IWB dimensies meer aandacht behoeven opdat onderwijsinnovatie zou slagen.

Voortbouwend op de conceptualisatie en operationalisering van IWB in studie 1, richten we ons in studie 2 en 3 op de antecedenten van IWB.

In *studie 2* namen we het theoretisch perspectief van adaptieve expertise als uitgangspunt. We onderzochten de relatie tussen de omgevingsfactoren (taakvariatie, managementondersteuning en innovatiegereedheid) en de vijf hoofddimensies van het innovatief werkgedrag. De steekproef bestond uit 458 docenten in het Nederlandse middelbare en hoger beroepsonderwijs (MBO en HBO). (Hiërarchische) regressieanalyse toonde aan dat managementondersteuning

en een omgeving waarin docenten openstaan voor innovaties en zich hiervoor bekwaam voelen (innovatiegereedheid) significant positief gerelateerd waren aan alle fasen van IWB. Docenten met ondersteunende managers en een hoge mate van innovatiegereedheid lieten in alle dimensies hogere scores zien op innovatief gedrag. Achtergrondkenmerken, zoals geslacht, leeftijd, dienstverband, aantal werkuren en type opleiding, waarvoor we tijdens de analyses controleerden, speelden een rol in hoeveel IWB werd getoond. Geconcludeerd kan worden dat een werkomgeving, waarin docenten openstaan voor innovaties en zich hiervoor bekwaam voelen (innovatiegereedheid) en waarin zich gesteund voelen door de manager, cruciaal is. Daarnaast impliceren de resultaten het belang om rekening te gehouden met de achtergrondkenmerken van docenten bij het vormen van teams die aan innovaties werken.

Voor het meten van de IWB antecedenten vertrekken we in *studie 3* van het perspectief leren en ontwikkelen. Innoveren vereist van professionals dat ze investeren in het verweven van nieuwe kennis, vaardigheden, en beroepshoudingen, kortom in leren. Daarom is de focus in studie 3 de relatie tussen een leerklimaat (gedefinieerd als een ondersteunende leeromgeving, managementondersteuning en innovatiegereedheid) en IWB. Het onderzoek is uitgevoerd onder docenten van twee Nederlandse mbo-scholen (n= 206). Deze studie heeft aangetoond dat alle dimensies van het leerklimaat significant positief gerelateerd zijn aan IWB. Meer specifiek is een ondersteunende leeromgeving significant positief gerelateerd aan het genereren van nieuwe ideeën (het exploreren van innovatiekansen en het genereren van ideeën). Zowel managementondersteuning als innovatiegereedheid zijn significant positief gerelateerd aan het genereren van ideeën en de implementatiefasen (idee promotie, realisatie en duurzaamheid van ideeën). Dit onderzoek geeft inzicht in hoe scholen het IWB van docenten kunnen stimuleren.

IWB kan zowel op individueel als op teamniveau worden bestudeerd. Duurzame innovaties vragen immers om docententeams waarin niet elk individu IWB vertoont maar ook het team als geheel. Dit wordt team innovatief werkgedrag (TIWB) genoemd. Tot nu toe werd aangenomen dat team IWB een iteratief proces is en dit werd meestal onderzocht onder individuele teamleden met op enquêtes gebaseerde, cross-sectionele methodologieën. Door het gebruik van vragenlijsten worden voornamelijk percepties gemeten.

Studie 4 heeft als doel om meer inzicht te krijgen in hoe IWB in teams voorkomt over de verschillende fasen heen en hoe deze op elkaar inwerken. Dit met behulp van een longitudinale kwalitatieve benadering, waarbij gekeken wordt naar concreet gedrag. Er is een casestudy uitgevoerd bij een docententeam van een Nederlandse

universiteit dat de opdracht had een nieuwe onderwijsmodule te ontwerpen, ontwikkelen en implementeren. Teamvergaderingen werden opgenomen en getranscribeerd. Voor de analyse is gebruik gemaakt van een codeboek, gebaseerd op de definities van de vijf hoofddimensies van IWB en op basis van de items van de gevalideerde IWB-vragenlijst (Lambriex-Schmitz et al., 2020). In tegenstelling tot wat werd verwacht, bleek uit de resultaten dat TIWB een vrij lineair proces lijkt te zijn in plaats van een iteratief proces waarbij niet alle fasen werden gevonden. Idee generatie en idee realisatie werden vaak geobserveerd, maar er werd weinig tot geen aandacht besteed aan idee exploratie en de duurzame implementatie van ideeën. In lijn met de theorie werden per fase van het innovatieproces specifieke innovatieve werkgedragingen geïdentificeerd. Deze studie biedt meer diepgaand inzicht in het TIWB-proces en het specifieke gedrag dat teamleden in elke fase vertonen. Het biedt ook bruikbare inzichten in hoe het succes van duurzame innovaties in docententeams kan worden bevorderd.

Tot slot, heeft dit onderzoek een aantal inzichten en opbrengsten gebracht. Ten eerste dat het concept innovatief werkgedrag in de huidige vorm niet compleet is. Naast de dimensies idee exploratie, generatie, promotie en realisatie is de duurzame implementatie van een idee een belangrijke dimensie van IWB. Dit onderzoek heeft een gevalideerde vragenlijst opgeleverd waarmee het innovatieve werkgedrag met al zijn vijf dimensies gemeten kan worden. Ten tweede dat IWB geen gegeven is maar vraagt om een omgeving die gekenmerkt wordt door ondersteuning van het management, die open staat voor nieuwe ideeën en die een stimulerend leerklimaat heeft. Als derde werd duidelijk dat de samenstelling van het team in de verschillende fasen een belangrijke rol speelt.

Als laatste heeft dit onderzoek het inzicht gebracht dat er vanaf de start van een innovatieproject rekening gehouden moet worden met de stappen die nodig zijn om te komen tot een duurzame innovatie.

About the author

Peggy Lambriex-Schmitz's professional and academic career is driven by her ongoing interest in connecting people, and getting the best out of people. She started her professional career as a Speech and Language therapist (Bachelor's degree in 1998, Zuyd University of Applied Sciences, Heerlen, The Netherlands). In 1999, next to her job as speech therapist she started as a candidate teacher in the bachelor's programme Speech and Language Therapy in Heerlen where she was immediately inspired by the power of education. After obtaining her teacher qualification (in 2000, Fontys University of Applied Sciences) she fully focused on education related tasks. During this period, Peggy had various roles within the programme Speech and Language Therapy at Zuyd as, among others, teacher Speech Therapy and Biometrics, member curriculum committee, year coordinator, mentor, chair examination committee. In all rolls Peggy focused on challenging students, teaching professionals and herself to achieve sustainable desired outcomes.

Peggy also guided teams and educational advisors in curriculum development and in the implementation of educational innovations, in various vocational training courses. In addition, she was the project leader of the 'succesvol studeren' programme, which aims to ensure that programmes within Zuyd have a high-quality and sustainable curriculum.

Since 2020 Peggy is manager of the Academy Speech and Language Therapy at Zuyd University of Applied Sciences.

Peggy's academic career started in 2010 when she started her Master's degree at the School of Health Professions at the Faculty of Health, Medicine, and Life Sciences at Maastricht University. In 2011 she started as a part-time junior researcher at the Research Department for Educational Innovation and Continuous Professional Development at Zuyd University of Applied Sciences. Her Master thesis: 'Factors affecting teachers' intentions to participate in professional development activities', was conducted in the context of Zuyd and in 2012 she obtained her Master degree (cum laude) in Health Professions Education (MHPE).

In 2014 Peggy began her part-time PhD programme as an external PhD candidate at the Educational Research and Development Department (ERD) of the School of Business and Economics at Maastricht University in The Netherlands, and is now senior researcher, for the theme of 'sustainable implementation in teams', within the Research Department for Educational Innovation and Continuous Professional Development at Zuyd University.

Peggy has expertise in the field of course and curriculum development, implementing educational innovations and teacher professionalisation. Her PhD research focuses on how innovations in education can be implemented in a sustainable way and what this requires of teachers and team leaders. In her work, she is inspired by insights from both educational and organisational sciences.

List of Publications

Articles in refereed journals

Lambriex-Schmitz, P., Van der Klink, M. R., Beausaert, S., Bijker, M., & Segers, M. (2020). Towards successful innovations in education: Development and validation of a multi-dimensional innovative work behaviour Instrument. *Vocations and Learning*, *13*(2), 313-340.

Lambriex-Schmitz, P., Van der Klink, M. R., Beausaert, S., Bijker, M., & Segers, M. (2020). When innovation in education works: Stimulating teachers' innovative work behaviour. *International Journal of Training and Development*, *24*(2), 118-134.

Presentations

Lambriex-Schmitz, P.; Klink, Van der M. and Segers, M. (2016). *Measuring innovative work behaviour in Vocational Education: Scale development and validation, an extended view on innovative work behavior.* Presentation at the Educational Research Days, 14-16 September, Neerglabbeek, Belgium.

Poster presentations:

Lambriex-Schmitz, P.M.M., Van der Klink, M.R., Beausaert, S.A.J., & Segers, M. S. R. (2017, May). *Innovative behavior for sustainable innovation.* Poster presented at the EAWOP Conference, Dublin, Ireland.

Paper presentations:

Lambriex-Schmitz, P.M.M., Van der Klink, M., Gerken, M., & Segers, M. (2015, February). *Innovative work behaviour of teachers in Higher Education: An extended view; a first exploration.* Paper presented at the International Scientific Nursing and Midwifery Congress Care4, Antwerp (Belgium)

Lambriex-Schmitz, P.M.M., Van der Klink, M., & Segers, M. (2015). *Innovative work behaviour of teachers in Higher Education: An extended view; a first exploration.* Paper presented at the EAPRIL, 24-27 November, Belval, Luxembourg

Lambriex-Schmitz, P.; Klink, Van der M., and Segers, M. (2016). *Measuring innovative work behavior in Vocational Education: Scale development and validation.* Presentation at the EARLI SIG 14, 24-26 August, Regensburg, Germany.

Lambriex-Schmitz, P.; Klink, van der M., Beausaert, S., and Segers, M. (2017). *When innovation in education works: Selecting and stimulating teachers in different stages of change.* Presentation at the EARLI SIG 14, 12-14 September, Genève, Switzerland.

Lambriex-Schmitz, P., Van der Klink, M., Beausaert, S., Bijker, M., Segers, M. (2019). *Towards sustainable innovations in education: the role of environmental factors for teachers' innovative work behavior*. Paper presented at the EAWOP 2019, Italy, Turino.

Lambriex-Schmitz, P., Van der Klink, M., Beausaert, S., Bijker, M., Segers, M (2019). *The role of environmental factors for vocational school teachers' innovative work behavior.* Paper presented at the ORD 2019. The Netherlands, Heerlen.

Dankwoord

'It takes a village to raise a child, but it took the universe to finish my PhD'.

Wat een geweldige tijd heb ik mogen ervaren. Nu we aan het einde gekomen zijn van dit promotietraject kijk ik terug op een lange reis. Een tijd waarin ik geweldig veel ervaringen heb opgedaan, waarin ik veel nieuwe mensen heb mogen ontmoeten, waarin ik mezelf vele malen ben tegengekomen, waarin ik werd uitgedaagd mijn comfortzone te verlaten en ook een tijd waarin ik heel veel steun en begeleiding heb gekregen. Graag wil ik eenieder bedanken die op welke wijze dan ook heeft bijgedragen aan de totstandkoming van dit proefschrift. Daarbij wil ik een aantal mensen in het bijzonder bedanken.

Allereerst wil ik Zuyd Hogeschool bedanken voor de kans om mezelf te mogen ontwikkelen tot de professional en onderzoeker die ik nu geworden ben. In het bijzonder wil ik Kitty Kwakman, Marcel van der Klink en Peter Hilderink bedanken die dit destijds mogelijk gemaakt hebben.

Zonder mijn promotieteam was dit uiteraard nooit gelukt. Mien, sinds onze eerste afspraak voelde ik direct dat wij een goede klik hadden. Jij was aan de ene kant kritisch maar gaf mij ook het gevoel dat ik het kon. Ook ben ik jou dankbaar voor jouw steun in een moeilijke periode in mijn leven. Marcel, fijn dat jij in mijn team zat. Vooral jouw gevleugelde uitspraak 'Hou het simpel, met vlag en wimpel', zal ik mijn leven niet meer vergeten. Steeds als ik weer teveel in mijn hoofd ging zitten kwam jij met een praktische oplossing waardoor weer een eerste stap werd gezet. Jij gaf mij de ademruimte die soms hard nodig was en liet mij inzien dat werk niet het allerbelangrijkste is. Simon, zodra ik jou voor het eerst ontmoette, wist ik dat wij op dezelfde golflengte zaten. Ik voelde mij bij jou op mijn gemak en durfde elke vraag te stellen. Jij zorgde ervoor dat feedback op hoofdlijnen werd vertaald in concrete acties waar ik mee aan de slag kon. Daarnaast leek het of jij 24 uur per dag werkte. Op welk moment van de dag ik jou ook mailde of appte, vaak kwam er al binnen het half uur antwoord waardoor ik weer verder kon. Mien, Marcel en Simon, bedankt voor jullie vriendschap en onvoorwaardelijke steun.

Alle docenten die de moeite hebben genomen hun kostbare tijd te investeren in dit onderzoek. Ik ben jullie allemaal zeer dankbaar, immers zonder respondenten geen data, en zonder data geen proefschrift.

Mijn dank gaat uit naar de leescommissie: Prof. Dr. Wim Gijselaers, Prof. Dr. Regina Mulder, Prof. Dr. Marjan Vermeulen, Prof. Dr. Diana Dolmans. Ontzettend bedankt voor alle tijd en moeite die jullie investeerden in het lezen en beoordelen van dit proefschrift, en voor jullie waardevolle feedback.

Ik denk met veel plezier terug aan mijn promotietijd door de vele leuke en lieve collega's die ik bij ERD van de Universiteit Maastricht heb leren kennen. Ik voelde me direct welkom, heb veel van hen mogen leren en we hebben samen de nodige ervaringen opgedaan. Een bijzonder dankjewel voor: Mieke, Therese, Maike, Selma, Jeannette, Michael, Sonja, Stephanie, Janina, Eva, Inken, Samantha, Wendy, Laura, Henny, Piet, Jan, Paul, Niels, Manon.

Van deze collega's wil ik er een aantal extra bedanken: Maike, voor de hulp bij de start van mijn promotie en al jouw heerlijke baksels. Therese, voor alle creativiteit en zorg bij bijzondere gebeurtenissen (verjaardagen, geboorten, promoties). Jij maakt dat iedereen zich bijzonder voelt. Mieke en Selma voor de meest epische roadtrip naar Regensburg. Diepgaande gesprekken maar ook tranen van het lachen. Gemiste presentatie, rijden met de achterklep open en vergeten koffie op het dak van de auto, kortom een geweldig congres. Mieke, Michael en Sonja, voor alle avonturen in Dublin. Sonja, voor de geweldige tijd in Turijn. Henny, voor jouw steun, organisatietalent en al onze fijne gesprekken. Sonja en Stephanie, 'the new academics', voor al jullie motiverende woorden, de gezellige etentjes en het delen van onze dromen. Niels voor jouw hulp bij het transcriberen en Inken, voor het kritisch meedenken en coderen bij studie 4.

Ook de collega's van het lectoraat 'Professionalisering van het onderwijs' wil ik graag bedanken voor de inspiratie, kennisdeling, feedback en steun tijdens de hele reis. Erica, Sylvia, Yvonne, Dominique, Mieke, Joyce, Miriam, Hester, Monique, Chris, Jan, Evelien, Ellen, Frits, Hanneke, Klaartje, Erik, Guus, Mare, Miekie, Daan, dankjewel. En Sandra, voor alle waardevolle ondersteuning.

In het bijzonder wil ik Monique Bijker bedanken voor al haar hulp met de Rasch analyses, en daarnaast de persoonlijke astrologische analyses en haar man Hans voor de kopjes koffie, en lunches. Helaas is de reis van Monique te vroeg geëindigd en staat zij nu zelf als ster te stralen aan het firmament. Dominique, voor al jouw inspiratie, enthousiasme, onderwijskundige kennis en fijne gesprekken. Klaartje, voor alle gesprekken over het thema duurzame innovaties en het mooie rapport. Mieke en Joyce, voor de bijzondere reis naar Geneve, waar bleek dat fietsen met posterkoker en koffer nog behoorlijk wat vaardigheid vereist.

Alle opleidingsteams en managers die ik de afgelopen jaren heb mogen begeleiden vanuit het programma 'succesvol studeren' waardoor ik enerzijds waardevolle inzichten heb opgedaan en anderzijds de kans kreeg resultaten van dit proefschrift te valoriseren. Een bijzonder dankjewel aan Tamara, Rob, Laurens, Astrid, Annemie, Martijn en Martijn, Cindy, Ursula, Vivian en Femke, en alle inspirerende docenten, superhelden die ik heb mogen leren kennen.

Alle collega's die betrokken waren bij het programma 'succesvol studeren'. Samen pionieren heeft mij het vertrouwen gegeven dat ik nodig had om te kunnen groeien en ontwikkelen tot de professional die ik nu ben. Nicole, Annemarie, Kitty, René, Patrick, Alexandra, Angelique, Mieke, Hans, Yvonne, Josien, Mare, Brigitte en Henk.

Mijn team van de academie logopedie wil ik graag bedanken. Zij zorgen voor de broodnodige verbinding tussen onderwijs, onderzoek en werkveld. Bij onze academie zie ik dagelijks superhelden aan het werk die zich met enorme passie en toewijding toeleggen op het opleiden van onze studenten. Zij zijn letterlijk mijn inspiratie en zorgen voor de klei om in te staan waardoor ik steeds gemotiveerd blijf onderzoek te doen naar de professionalisering van ons onderwijs.

Dankjewel collega's van Zuyd en opleidingsmanagers en directeuren van het domein gezondheid en welzijn voor alle inspiratie en bemoedigende woorden.

Sonja ik ben blij dat jij mijn paranimf wil zijn. Vele jaren trokken wij samen op en zeker de laatste jaren was jij een steun voor mij. Jij inspireerde mij inhoudelijk maar zeker ook op persoonlijk vlak. Miriam, jij trok mij letterlijk over de eindstreep. De laatste loodjes voelden ook echt als lood. Jij zorgde voor het licht aan het einde van de tunnel, voor focus en voor kleine stapjes vooruit. Ik wil jou dan ook vanuit de grond van mijn hart bedanken en ik ben blij met jou als paranimf.

Ook wil ik buiten de werkkring mensen bedanken, want de steun die ik op vele fronten heb gevoeld heeft mij geholpen dit traject tot een einde te brengen. Het liefst zou ik hier iedereen persoonlijk bedanken, maar ik ben gezegend met zo veel lieve mensen om mij heen dat het teveel zou worden om ieder afzonderlijk te bedanken. Daarom hierbij: Dankjewel lieve vrienden en (schoon)familieleden voor jullie interesse, steun, (bijna) wandelingen, gezelligheid en de nodige ontspanning al die jaren. Bellinda, lieve vriendin, fijn dat je er altijd voor me bent. Hopelijk kunnen we nog veel uurtjes, met een wijntje erbij, doorbrengen.

Papa en mama, bedankt voor het warme en veilige nest dat jullie mij hebben geboden en voor jullie jarenlange steun om mezelf verder te ontwikkelen. Door deze stevige

wortels heb ik kunnen worden wie ik nu ben. Ik vind het verdrietig dat papa het laatste deel van mijn reis niet meer bij ons was. Toch reist hij met mij mee, in mijn hart.

De laatste alinea bewaar ik voor de belangrijkste mensen in mijn leven. Jullie maken mijn leven zoveel mooier. Mijn kinderen, Thom, Daan en Lars die mij vaak hebben moeten missen en die mij ook doen beseffen wat echt belangrijk is in het leven. En mijn man en beste vriend, Istvan. Zonder jouw enorme steun zou ik niet staan waar ik nu sta. Omdat ik zelf de woorden niet kan vinden die uitdrukken hoe dankbaar ik ben dat jij in mijn leven bent heb ik een songtekst gevonden die dit wel kan.

Liedje '**de vleugels van mijn vlucht'**, 1993

Tekst: Coot van Doesburgh
Zang: Paul de Leeuw

"Het is vast heel eenzaam in de schaduw
En nooit eens wat zon op je gezicht
Jij doet altijd een stapje terug, want zo ben je
Jij in het donker, ik in 't licht

Dus ik krijg altijd de volle aandacht
En jij hebt de zorg en alle pijn
Jouw mooi gezicht bleef anoniem, al die tijd
Mijn waarheid in al die schone schijn

Maar weet je dan niet dat jij me kracht geeft
Mijn zon in mijn hemelsblauwe lucht
En jij bent degene die alle macht heeft
Want jij bent de vleugels van mijn vlucht

Waarschijnlijk heeft niemand in de gaten
Hoe jij met me meereist in mijn hart
Hoeveel ik werk'lijk van je hou, want dat doe ik
'K zou niet meer kunnen zonder jou

Want weet je dan niet dat jij me kracht geeft
Mijn zon in mijn helderblauwe lucht
En jij bent degene die alle macht heeft
Want jij bent de vleugels van mijn vlucht

Opgenomen met goedkeuring van de auteur: Coot van Doesburgh