DISSERTATIONS IN
HEALTH
SCIENCES

MARJA RANDELIN

Sustainable Well-being at Work through Ergonomics via the Web-based Learning Program of Ergonetti

PUBLICATIONS OF THE UNIVERSITY OF EASTERN FINLAND
Dissertations in Health Sciences

UNIVERSITY OF
EASTERN FINLAND

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To be presented by permission of the Faculty of Health Sciences, University of Eastern Finland for public examination in Medistudia Auditorium ML2, Kuopio, University of Estern Finland on June 15th 2013, at 12 noon

Publications of the University of Eastern Finland
Dissertations in Health Sciences
Number 170

Institute of Biomedicine and Institute of Public Health and Clinical Nutrition, School of Medicine,
Faculty of Health Sciences, University of Eastern Finland
Kuopio
2013

Kopijyvä Oy
Kuopio, 2013

Distributor:
University of Eastern Finland
Kuopio Campus Library
P.O.Box 1627
FI-70211 Kuopio, Finland
http://www.uef.fi/kirjasto

ISBN (print): 978-952-61-1121-6
ISBN (pdf): 978-952-61-1121-3
ISSN (print): 1798-5706
ISSN (pdf): 1798-5714
ISSN-L: 1798-5706

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Randelin, Marja
Sustainable well-being at work through ergonomics via the web-based learning program of Ergonetti
University of Eastern Finland, Faculty of Health Sciences
Publications of the University of Eastern Finland. Dissertations in Health Sciences 170. 2013. 42p.

ISBN (print): 978-952-61-1121-6
ISBN (pdf): 978-952-61-1121-3
ISSN (print): 1798-5706
ISSN (pdf): 1798-5714
ISSN-L: 1798-5706

ABSTRACT

In recent years, there has been showed academic and commercial interest in promoting sustainable well-being at work within the work places. These activities benefit workers by increasing their well-being, work ability and know-how, and benefit the broader organization by increasing the workers' productivity. This thesis describes the development of a model for promoting sustainable well-being based on the systematic review (n=16) and examines the impact of the Ergonetti learning program in promoting occupational well-being. The functionality of the developed model was analyzed in terms of its impact on the model for learning in an organization, its utility in promoting occupational well-being in small- and medium-sized enterprises, and its effects when applied in a large company. Research data were gathered using theme interviews and evaluated using inductive content analysis. The interviewees included employees from companies who had completed the Ergonetti studies (n=29) and their co-workers (n=18) who participated in the Ergonetti development activities between 2004 and 2009.

Organizational learning is a central unifying feature that links sustainable development and occupational well-being, and the Ergonetti studies appear to promote occupational well-being that supports sustainable development. The development activities conducted within the studied companies were compatible with the occupational well-being model that serves as the framework of the Ergonetti learning program. According to Ergonetti students, the process-like learning method of the Ergonetti program, which is based on successive cycles involving concrete developmental work proved to be functional and useful. Moreover, the application of the system demonstrated its transferability to different work tasks and developmental targets relating to ergonomics. By participating in shared conversations, it was possible to canvas the opinions of employees in a workplace and thus access all of the available tacit knowledge.

Care should be taken when generalizing the results presented herein, since number of participants in the reported studies was small and they represented only a small fraction of all Finnish companies. Nevertheless, it is worth promoting occupational well-being in workplaces, and the Ergonetti learning program is a powerful tool for this purpose. Activities that promote occupational well-being in keeping with the objective of sustainable development should be part of the everyday operations of every workplace, and both managers and employees must commit themselves to these operations. To be successful, these activities must be allocated sufficient resources and time, with well-chosen goals and ongoing cooperative assessment.

National Library of Medicine Classification: WA 440
Medical Subject Headings: Education; Human Engineering; Occupational Health; Workplace

Randelin, Marja
Kestävää työhyvinvointia Ergonetti-opinnoista
Itä-Suomen yliopisto, terveystieteiden tiedekunta
Publications of the University of Eastern Finland. Dissertations in Health Sciences 170. 2013. 42 s.

ISBN (print): 978-952-61-1121-6
ISBN (pdf): 978-952-61-1121-3
ISSN (print): 1798-5706
ISSN (pdf): 1798-5714
ISSN-L: 1798-5706

TIIVISTELMÄ

Kestävän työhyvinvoinnin edistämistä työpaikoilla on alettu tutkia vasta viime vuosina. Työntekijän näkökulmasta kestävän työhyvinvoinnin edistämisen tavoitteena on lisätä hänen terveyttään ja osaamistaan sekä organisaation näkökulmasta lisätä työn tuottavuutta.

Tässä tutkimuksessa kehitettiin kestävää työhyvinvointia edistävä malli, jossa oppiminen nähtiin välittävänä linkkinä kestävän kehityksen ja työhyvinvoinnin välillä. Aluksi mallin toimivuutta tutkittiin systemaattisella kirjallisuuskatsauksella ja tunnistettiin oppimisen piirteitä, jotka edistävät kestävää työhyvinvointia. Systemaattinen kirjallisuuskatsaus koostui 16 tieteellisetä artikkelista. Ne analysoitiin induktiivisella sisällönanalyysilla.

Lisäksi empiirisesti tutkittiin edistävätkö Ergonetti-opinnot kestävää työhyvinvointia pienissä ja keskisuurissa yrityksissä sekä yhdessä suuressa yrityksessä. Tutkimusmenetelmänä oli teemahaastattelu ja analyysimenetelmänä induktiivinen sisällönanalyysi. Haastateltavina olivat yritysten Ergonetti-opinnot suorittaneet henkilöt (n=29) sekä heidän työtoverinsa (n=18), jotka osallistuivat Ergonetti-kehittämistoimintaan vuosien 2004–2009 aikana.

Oppiminen organisaatiossa oli keskeinen yhdistävä tekijä kestävän kehityksen ja työhyvinvoinnin välillä ja Ergonetti-opinnot edistivät kestävän kehityksen mukaista työhyvinvointia työpaikalle. Yritysten työhyvinvoinnin kehittämistoiminta eteni Ergonetin viitekehyksenä olevan työhyvinvointimallin mukaisesti. Opiskelijoiden mielestä Ergonetin prosessimainen oppiminen kehittämissyklissä ja konkreettinen kehittämistyö olivat toimiva ja hyödyllinen yhdistelmä. Kehittämissyklimalli oli lisäksi siirrettävissä soveltaen myös toisenlaisiin työtehtäviin ja ergonomian kehittämiskohteisiin. Opiskelijoiden kokemusten mukaan yhteisten keskustelujen myötä saatiin kaikkien mielipiteet esille työpaikoilla ja työntekijöiden hiljainen tieto hyödynnettäväksi.

Tämän tutkimuksen tulosten yleistäminen pitää tehdä harkiten, koska tutkimukseen osallistuneiden Ergonetti-opiskelijoiden määrä oli pieni ja he edustivat vain pientä osaa suomalaisista yrityksistä. Kestävän työhyvinvoinnin edistämiseen tulee kuitenkin panostaa työpaikoilla ja Ergonetti on yksi hyvä mahdollisuus tässä edistämistyössä. Kestävän kehityksen mukaisen työhyvinvoinnin edistämistoiminnan pitäisi kuulua jokaisen työpaikan arkeen ja tähän toimintaan on sekä johtajien että työntekijöiden sitouduttava. Edistämistoiminta vaatii resursseja, aikaa, tavoitteiden asettelua ja jatkuvaa yhteistoiminnallista arviointia.

Yleinen Suomalainen asiasanasto: ergonomia; kestävä kehitys; opinnot; työhyvinvointi; työpaikkakoulutus

Acknowledgements

I owe my respectful and deepest gratitude to my first supervisor Professor Emeritus Veikko Louhevaara, Ph.D., University of Eastern Finland. The constant supportive and critical discussions with him helped me to keep my focus in this thesis. Moreover, his successful and long expertise and work experience in ergonomics were an excellent help in furthering the research process.

I want to especially thank my second supervisor Adjunct Professor Paula Naumanen, Ph.D., University of Oulu, Finland and Ministry of Social Affairs and Health, Finland. Her instruction and encouragement, particularly in the initial phases of the dissertation study, were significant.

I express my warmest gratitude to my third supervisor Docent Terhi Saaranen, Ph.D, University of Eastern Finland. Her deep involvement in the study and her specialized instruction significantly fostered the analyses of this study. This doctoral thesis might not have been realized without her encouragement and support in the writing process of the articles and the summary.

I want to thank the pre-examiners of my doctoral thesis, Professor Sylvie Nadeau and Professor Nina Nevala, for their careful consideration of my thesis. The valuable comments and critical feedback that you provided furthered the work on my dissertation.

I want to thank all my colleagues in the Institute of Biomedicine. I work as a lecturer in the Institute of Biomedicine, and first started my postgraduate studies in the Institute of Biomedicine and later continued them in the Institute of Public Health and Clinical Nutrition. I have received support for my work from both units. I would particularly like to thank the head of the Institute of Biomedicine, Anitta Mahonen, for the resources she arranged for my research work during its different phases and Professor Kimmo Räsänen from the Institute of Public Health and Clinical Nutrition for his help in the revision phase of my dissertation thesis.

I want to thank the Director of Education Leena Leskinen, Coordinator Merja Mäkitalo, and Study Secretary Tuula Tanskanen from the Open University of Eastern Finland for their help and support in questions regarding Ergonetti. I also want to thank Information Specialist Tuula Rissanen from the University of Eastern Finland for the considerable help I received for my questions relating to the search strategy of the systematic literature review of article I.

A warm thank you to my colleagues and fellow postgraduate students Pirjo Hakkarainen, Susanna Järvelin-Pasanen, and Sanna Kärkkäinen for lending their ear and being empathetic during the different phases of my work on the doctoral thesis.

I thank Senior Specialist Kari Ojanen from the Finnish Institute of Occupational Health for warm and compassionate moments of discussion at the beginning of dissertation work. It was thanks to you that my interest was sparked in the doctoral study, and you also helped me to collect the initial research data for my dissertation thesis.

I want to thank Heidi Antila and Elisa Launonen for editing English texts for my doctoral thesis and the Sees-editing Ltd language agency for revising the linguistic form.

I want to thank all of the Ergonetti-students, their colleagues, and the enterprises that participated in this study. Without their contribution, this study would never have happened.

I owe my loving thanks to my husband Esko. His love and faith in my abilities was the most important source of power for me to finish my study. My beloved son Ville, his beautiful wife Maija and my small grandsons Aapo and Elmo: you have brought me

sunshine and provided a necessary break from writing the doctoral thesis. The picture on the cover of this thesis was created by my dear daughter Veera. It has been a privilege to have watched you grow and develop from a young girl into a grown woman. I thank all of you for having been a part of my life.

Thank you to my siblings and Sirkka my "second" mother and all my friends. I especially thank Sirpa and Juha Kontulainen from the bottom of my heart for your friendship. You have been my closest friends for years and shared with me moments of joy and of sadness.

This study was financially supported by the Academy of Finland and the Finnish Work Environment Fund. I am gratefully appreciative to them.

Kuopio, May 2013

Marja Kandelin

List of original publications

This dissertation is based on the following original publications, referred to in the text by their Roman numerals I-IV:

I Randelin M, Saaranen T, Naumanen P and Louhevaara V. The developed hypothetical model for promoting sustainable well-being at work by learning: a systematic literature review. *Theoretical Issues in Ergonomics Science. 2012, Vol. ahead-of-p, No. ahead-of-p, pp. 1-38 doi:10.1080/1463922X.2011.648669*.

II Pitkänen M, Naumanen P, Ojanen K and Louhevaara V. The Ergonetti – Web-Based Ergonomics Studies: A Qualitative Case Study. *The Open Education Journal. 2008, 1: 29-36. doi: 10.2174/1874920800801010029*

III Randelin M, Saaranen T, Naumanen P and Louhevaara V. Towards sustainable well-being in SMEs through the web-based learning program of ergonomics. *Education and Information Technologies. 2013, 18(1): 95-111. doi:10.1007/s10639-011-9177-5*

IV Randelin M, Saaranen T, Naumanen P and Louhevaara V. The Ergonetti learning program as a tool for promoting sustainable well-being at work in a large company. (*Manuscript, to be submitted*)

Contents

Abbreviations

ECTS	European Credit Transfer System
EU	European Union
IEA	International Ergonomics Association
ILO	International Labour Organization
ISO	International Organization for Standardization
OL	Organizational learning
PE	Participatory ergonomics
SA8000®	Social Accountability, Standard
SD	Sustainable development
SFOL	Sustainability focused organizational learning
SMEs	Small- and medium-sized enterprises
UN	United Nations
WHO	World Health Organization

Key concepts

Definition of enterprises
The definition of SMEs used in this study is based on the definition by the European Union (EU), as Finland is part of the EU and follows this classification (European Commission 2005) and the enterprises participated in this study were all Finnish. In the EU, a business with a headcount of fewer than 250 is classified as medium-sized, a business with a headcount of fewer than 50 is classified as small, and a business with a headcount of fewer than 10 is considered a microbusiness.

Large organization's headcount is more than 250.

E-learning and web-based learning
E-learning or web-based learning refers in this thesis to same issue, to the distance learning which occurs out of classroom and via the web.

Ergonetti
Ergonetti is a web-based learning program of ergonomics (25 ECTS) in the Open University of Eastern Finland.

Learning by experiences
Learning by experiences holds that learning is a cycle-like process in which knowledge is created by molding experiences and learning by doing. People's experiences and their willingness to learn function as the starting points for everything. They then require time to reflect on new facts and information, which are processed and converted into knowledge. This is followed by an attempt to understand the knowledge, i.e. to internalize it. Learning by experience also includes abstract conceptualization. In this case, new knowledge emerges as a result of thinking and is used to interpret the individual's experiences**.** The final step is the application of the new knowledge, in which the internalized knowledge is applied in practice and tested in different contexts.

Learning organization and organizational learning (OL)
Learning organization focuses on how workplaces develop into learning organizations.

Organizational learning (OL) deals with the processes by which learning occurs within organizations.

Organizational knowledge: explicit knowledge and tacit knowledge
Explicit knowledge is objective: it consists of formal rules, tools, and processes and is thus relatively easy to transfer and share.

Tacit knowledge is subjective, intuitive, and unarticulated, and is founded on individual experience.

OL levels: individual, team and organizational learning
OL occurs on an individual, group, and organization level and these levels are connected to each other dynamically. The dynamics of OL can be also seen as "feed-forward" or "feedback" learning flows. The feed-forward learning flows from individuals to groups and from groups to organizations, and describes the assimilation of new learning. The feedback learning flows from organizations to groups and from groups to individuals, and describes the use of what has been already learned.

OL types: single-loop learning, double-loop learning, deutero learning and triple-loop learning
Single-loop learning (errors are detected and corrected but the organization remains focused on its existing policies and goals; learning is action-oriented and basic).

Double-loop learning (in addition to the detection and correction of errors, organizations question and modify their current policies, norms, goals, mental models, and procedures).

Deutero learning (learning how to learn more effectively).

Triple-loop learning (relationships or partnering among and between organizations).

On-the-job learning, work-related learning and workplace learning
On-the-job learning, work-related learning or workplace learning refers in this thesis to the same issue, i.e., learning in workplaces. On-the-job learning is tied to concrete situations at a workplace and also requires constant sharing and reflection among workers.

Participatory ergonomics
Participatory ergonomics programs or interventions seek to maximize the involvement of the workers because a worker is an expert on his or her job. Usually, workplaces carry out participatory ergonomics interventions when they need to decrease the number of work-related accidents or mitigate risk factors for such events.

Work ability and wellbeing at work
Work ability is often considered more from the viewpoint of individual workers, whereas well-being at work' is understood as more extensive, focusing not only on the diversity of the work context (work environment, work conditions, work community, psycho-social atmosphere, leadership and professional competence) and on the quality of working life, but also including the diversity of the individual worker regarding his or her capabilities and competence.

1 Introduction

The nature of work in modern society is changing rapidly, and competition in the job market is getting more intense. This requires competence from workers and demands them to update their knowledge, skills, and attitudes in order to remain productive and retain their attractiveness in the job market (Gijbels et al. 2012, Wang et al. 2007). On the other hand, skillful employees are a company's most important competitive assets, and so it is worth training them and looking after their well-being (WHO 2007).

In the world as a whole, the population is ageing. This will affect both developed and developing countries (ILO 2009). In Finland, there are currently approximately 2.3 million people of working age (between 15 and 64 years) (Statistics Finland 2009). Due to ageing, the number of population of working age is predicted to decrease from the current 65 percent to 58 percent by the year 2030, and to 57 percent by 2060 (Statistics Finland 2012). Indeed, sustainable work systems should be developed for the ageing workforce, so that their long work experience and expertise can be utilized (Weichel et al. 2009). For example, workers who have been involved in working life for a long time will have acquired a lot of different kinds of know-how that can perhaps not be found in books, namely so-called tacit knowledge. Communication between junior and senior workers is an important component in sustainable work because it helps new workers to acquire tacit knowledge, and to pick up the culture and habits of the organization. In the business world, tacit knowledge has been described as human capital, whose utilization is pivotal in the increasingly competitive environment (e.g., Saru 2007).

The promotion of sustainable well-being in the workplace is a relatively new research topic. Sustainable development has its roots in the 1970s, when the first congress for the improvement of the living conditions of water fowl was organized in Ramsar, Iran (The International Conference on Conservation of Wetlands and Waterfowl 1971). However, the sustainability of working life did not become a topic of discussion until the 1990s by WHO: "A healthy, productive and well-motivated worker is the key agent for overall socio-economic development" (WHO 1994).

From a worker's point of view, the purpose of national programs for the promotion of sustainable well-being at work is to increase their health, the number and quality of the resources available to help them cope with their work, and their competence (The Finnish Ministry of Environment 2009).

For businesses and other organizations, the promotion of sustainable occupational well-being at workplaces demands commitment and the implementation of changes, which are furthered by good leadership (Dellve et al. 2007, Heward et al. 2007, The Finnish Ministry of the Environment 2009) and organizational learning (OL) (Crutz et al. 2006, Hjort and Bagheri 2006, Molnar and Mulvihill 2003). The role of occupational health services is also crucial when promoting sustainable well-being at work (WHO 1994, WHO 2006, Lund 2004).

OL can be realized in workplaces in different ways, and e-learning has proven to be a focal practice in supporting learning at workplaces (Chen et al. 2008, Cheng et al. 2012, Wang et al. 2007). With the help of modern information technology, including e-learning environments, it is possible to support learning by both individuals and organizations and thereby improve companies' effectiveness and profitability. Moreover, internet-based training in workplaces appears to be more lucrative (Toole 2011) and consumes fewer natural resources than training based on contact learning (Barratt 2006).

The Ergonetti studies is a Finnish learning program for promoting occupational well-being that is conducted entirely via the internet (Ergonetti 2012). The Ergonetti operations model is the so-called developmental cycle, in which participants study the promotion of occupational well-being in theory and practice. It provides a functional, web-based learning environment that encourages students to develop their working environment (Ropponen 2009).

In this study, the learning characteristics which promote sustainable well-being at work were initially identified based on a systematic literature review. Subsequently, the Ergonetti learning program was empirically studied as a method for developing sustainable well-being at work.

2 Review of the literature

2.1 SUSTAINABLE DEVELOPMENT AND OCCUPATIONAL PROTECTION

The basic idea of sustainable development is that it "meets the needs of the present without compromising the ability of the future generation to meet their own needs". The concept was first introduced in a Report by the Brundtland Commission titled "Our common future" in 1987 (Bruntland 1987). Moreover, a global action plan for sustainable development known as Agenda 21 was formulated during the so-called Earth Summit (the United Nations (UN) Conference on Environment and Development) held in Rio de Janeiro in 1992.

The term sustainable development has been used to refer to different things in different contexts and parts of the world, but efforts to establish sustainable ways of living and working generally require cooperation in three separate areas: 1) economic growth and equity, (2) the conservation of natural resources and the environment, and (3) social development (Johannesburg Summit 2002). The promotion of sustainable development requires systematic thinking in preserving natural resources, in eliminating poverty, and in increasing equality, controlling population growth, and improving people's general quality of life (Seiffert and Loch 2005).

Occupational protection was first introduced into the general discussion of sustainable development in the declaration of the 1992 Rio Summit (UN Conference on Environment and Development 1992). The promotion of sustainable development in workplaces requires that occupational health services ensure the health, safety, working capacity, and well-being of the workforce. Moreover, by encouraging high-quality and productive work, one can ensure that materials, goods, and services are produced and delivered in a clean and healthy way that accommodates the principles of sustainable development for the working life (WHO 1994, WHO 2007). The WHO's global agenda for workers' health as articulated in the 2006-2010 work plan (WHO 2006) incorporated educational and technical material as well as training programs directed towards these ends. The concept of sustainability is thus very important in the development of current work activities and will remain so for the foreseeable future.

Several crucial factors that promote both sustainable development and well-being at work have been identified, such as a clean work environment (Veleva et al. 2001, WHO 1994), clean production (Veleva et al. 2001, Veleva and Ellenbecker 2001), the health and safety of workers (WHO 2007), the presence of an effective work organization and leadership (Kira 2008, Svensson and Wood 2006), and the availability of collaborative learning processes (Cruz et al. 2006, Docherty et al. 2009, Hjorth and Bagheri 2006). In workplaces, the development of environmental, economic, and social sustainability is a continuous, time-consuming, and evolutionary process that encompasses everything from goal setting to the assessment of performance and output (Veleva et al. 2001, Hjorth and Bagheri 2006). Occupational health care is also considered to play a pivotal role in the promotion of sustainable well-being among workers (Lund 2004, Saaranen et al. 2007, WHO 2007).

2.2 SUSTAINABLE WELL-BEING AT WORK

Promoting well-being at work in the context of sustainable development is a complex and dynamic issue (Fresner and Engelhardt 2004, Hasle and Jensen 2006, Oerlemans and Assouline 2004). However, it can also be seen as a challenge and opportunity for organizations and all their partners, for example, customers and stakeholders, to achieve goals, such as a "healthy working place without depleting natural resources" (UN Conference on Environment and Development 1992, WHO 1994).

The promotion of well-being at work is multidimensional and can be depicted through activities that require both strengthening of a worker's individual resources, including professional competence, and developing the content of work, as well as the working environment, which includes physical and psycho-social aspects (Ilmarinen 2006).

The terms 'well-being at work' and 'work ability' are confusing and comprehensive, and no consensus exists about their contents and determinants. 'Well-being at work' was generalized in the 21st century. Previously, the concept of 'work ability' was used more often. Along with the development of society, several models, concepts, and frameworks for describing 'well-being at work' and 'work ability' have been constructed and reported since 1990 (Ilmarinen et al. 2008). According to Ilmarinen (2006), the concept of 'work ability' has recently been replaced by the term 'well-being at work', especially in Finland, whereas the concept of 'work ability' is a fairly well known term globally (Anttonen et al. 2008). 'Work ability' is more likely to be considered from the viewpoint of individual workers, whereas 'well-being at work' is understood to be more extensive, focusing on the diversity of the work context (work environment, work conditions, work community, psycho-social atmosphere, leadership, and professional competence) and on the quality of working life, but also including the diversity of the individual worker regarding his or her capabilities and competence (Ilmarinen 2006).

In this study, the concept of 'Well-being at work' is used to refer to the "Promotion of Work Ability 45+ Concept", a model developed by Ilmarinen and Rantanen (1999) and "Maintenance of Work Ability Model" that was developed by Ilmarinen (2006). "Promotion of Work Ability 45+ Concept"model describes the multidimensional aspects of work ability. Specifically, these are the Health, Functional capacity and Professional competence of the worker, Adjustment of the physical work environment, and Adjustment of the psychosocial work environment (Ilmarinen and Rantanen 1999, Tuomi et al. 2001). In the "Maintenance of Work Ability Model the promotion of well-being at work requires both the strengthening of workers' individual resources (including their professional competence) and the development of working processes and the work environment, in both physical and psycho-social terms. The model is tetrahedral with four dimensions, two of which describe the resources of the worker (capabilities and professional skills and knowledge) while the other two describe work-related factors (work equipment, methods, conditions, organization, community, and leadership) (Ilmarinen 2006).

There is relatively little empirical data on sustainable well-being at work. From an employee's perspective, a sustainable worker is "highly complex" and has a wide range of knowledge with many skills relating to the management of different situations. They also have different views and are able to perceive world as a multi-dimensional entity. This helps them to operate and use their various skills in different situations, in both their personal life as well as in the workplace. However, to ensure that workers continue to perform well in a sustainable fashion, they must be motivated and interested in working with others (Kira and Eijnatten 2009). To achieve this, organizations must be willing to promote their employees' growth in terms of their ability to solve new problems by giving them opportunities to function and learn within different work situations, and to ensure that their employees' work will be meaningful both in the present and in the future (Gallie 2007, Kira and Eijnatten 2009).

An organization can be considered sustainable if its members have the opportunity to integrate into appropriate work groups, teams, and networks in which they can work collectively and share their know-how. These groups must have a shared vision and values on how an organization should operate, as well as a deep and wide understanding of the different ways in which one can act in work situations. The growth of employees and organization towards sustainability can be promoted by leaders who provide space for shared activities and give employees the opportunity to make an impact, and who do not work alone when deciding the direction of those they are leading (Kira and Eijnatten 2009). The development of sustainable occupational well-being must be undertaken as a long-term exercise that requires commitment and time (Haug and Talwar 2010).

From the workers' perspective, the purpose of promoting sustainable well-being at work is to increase their health and know-how. This benefits the organization by increasing the productivity of its employees (WHO 1994, WHO 2007).

2.3 LEARNING AND SUSTAINABLE WELL-BEING AT WORK

Organizations can enhance their orientation for sustainable development and improve their environmental and social performance through the learning process (Docherty et al. 2009). A sustainable learning organization is an organization that has acquired, and has a sufficient amount of, sustainable knowledge, and knows how to operate using this knowledge. A sustainable organization knows how to account for the risks encountered in its working environment and how to prevent, eliminate, or minimize them in a way that strengthens its profitability (Velazquez et al. 2011).

Sustainability-focused organizational learning (SFOL) refers to the process whereby companies simultaneously engage in sustainable development and OL (i.e. they learn from their past experiences) to change their organizational culture. The prerequisites for SFOL are a mutually shared vision of sustainability and the opportunity for workers to share their opinions on business-related matters. Moreover, sustainable education programs strengthen the processes of team learning and require the strong participation of workers (Molnar and Mulvihill 2003). However, this requires commitments from the organization's leadership; for such processes to be effective, the organization as a whole must be truly committed to promoting sustainable growth (Velazquez et al. 2011).

The concept of learning at workplaces is usually based on the theory of on-the-job learning (e.g., Pohjonen 2002), which is strongly associated with learning by experience as defined by Dewey (1955), Kolb (1984), and Nonaka and Takeuchi (1995), and on the theory of OL proposed by Argyris and Schön (1978).

Kolb's (1984) ***learning by experiences*** model is one of the most well-known basic models of the learning process**.** It holds that learning is a cycle-like process in which knowledge is created by molding experiences and learning by doing. People's experiences and their willingness to learn function as the starting points for everything. They then require time to reflect on new facts and information, which are processed and converted into knowledge. This is followed by an attempt to understand the knowledge, i.e. to internalize it. Learning by experience also includes abstract conceptualization. In this case, new knowledge emerges as a result of thinking and is used to interpret the individual's experiences**.** The final step is the application of the new knowledge, in which the internalized knowledge is applied in practice and tested in different contexts (Kolb 1984).

The concepts of ***on-the-job learning***, work-related learning and workplace learning all refer to the same issue, i.e., learning in workplaces (see e.g., Gijbels et al. 2012, Mirchandani 2012, Rausch 2012, van Gog et al. 2010). On-the-job learning includes not only what people learn in relation to their jobs, but also the work of defining oneself as a worker (Mirchandani 2012). Two types of on-the-job learning can be defined: formal learning (i.e. learning at school) and informal learning, which occurs outside classroom (Gijbels et al. 2012). E-learning via internet-based courses occurs outside classrooms and can be done at

any time and place that is convenient (van Gog et al. 2010), and has been identified as an important practice in supporting learning in the workplace because it has the potential to address problems arising within that environment (Atack 2003, Chen et al. 2008, Cheng et al. 2012).

Factors that promote e-learning at work and increase employees' commitment to their studies include the support of their managers and the broader organization (Cheng et al. 2012, Wang et. al. 2010), the organizational learning culture, the availability of technical support for their studies (Korhonen and Lammintakanen 2005), and the availability of financial and personal support for studying (Li et al. 2008). An e-learning environment should provide theoretical information on the topic of study, support the interpretation of indirect information, and encourage cooperation and experience sharing between workers (Falconer 2006, Tynjälä and Häkkinen 2005).

Learning organization and ***organizational learning (OL)*** are two separate things. Research into learning organization focuses on how workplaces develop into learning organizations. Conversely, OL research deals with the processes by which learning occurs within organizations, among other things (Van Grinsven and Visser 2011). This thesis takes OL as its frame of reference. The main goal of OL is to produce new information and to control information already in existence so that company productivity is increased and the know-how of its employees grows (Argyris and Schön 1996).

OL can be seen as a process that changes the thoughts and actions of organizations (Crossan et al. 1999). OL involves problem solving, but its effectiveness is dependent on critical self-evaluation and reflection on the behavior of workers and managers (Argyris and Schön 1996). Moreover, OL can be seen as a process that builds on knowledge provided by individuals and incorporates it into the organization's knowledge base. If individuals do not share their knowledge with other individuals and groups, the beneficial impact of the process on organizational effectiveness will be limited (Nonaka and Takeuchi 1995).

Organizational knowledge can be either explicit or tacit (Bucic et al. 2010, Nonaka and Takeuchi 1995). Explicit knowledge is objective: it consists of formal rules, tools, and processes and is thus relatively easy to transfer and share. Tacit knowledge is subjective, intuitive, and unarticulated, and is founded on individual experience (Anand et al. 2010). It essentially refers to things we know (i.e. know-how) but cannot precisely explain (Kimmerle et al. 2010). Tacit knowledge includes things such as knowledge relating to the social situations within a workplace, and is generally interwoven into the practices within the workplace. This makes it difficult to transfer and share. However, the sharing of tacit knowledge is vital for the ongoing development of the organization (Becerra et al. 2008, De Long and Fahey 2000, Dyck et al. 2005, Reychav and Weisberg 2009). In the business world, tacit knowledge has been regarded as human capital whose exploitation is essential in the increasingly competitive modern environment (Saru 2007).

OL can be defined in different ways. It can be realized on the individual, team, and organizational levels (Bucic et al. 2010, De Long and Fahey 2000). When moving towards a more sustainable organization, individual learning does not guarantee that the organization will also learn. Organizations learn when experiences are shared and changes are made by multiple individuals or teams working together (Lifvergren et al. 2009, Lozano 2008, see also Crossan et al. 1999). If the culture of an organization is hierarchical and rigid rather than malleable, and knowledge is not shared among individuals and groups, OL will have relatively little impact on organizational effectiveness (Dyck et al. 2005; Nonaka and Takeuchi, 1995). Therefore, sharing of knowledge is essential in OL. It also enhances the creativity of organizations by promoting collaborations between individuals and increases their capacity to innovate (Alegre and Chiva 2008, Ipe 2003, Reychav and Weisberg 2009).

Four types of OL have been defined and described: (1) single-loop learning (errors are detected and corrected but the organization remains focused on its existing policies and goals; learning is action-oriented and basic), (2) double-loop learning (in addition to the detection and correction of errors, organizations question and modify their current policies,

norms, goals, mental models, and procedures,) (Argyris and Schön 1996, Van Grinsven and Visser 2011), (3) deutero learning (learning how to learn more effectively) (Argyris and Schön 1978), and (4) triple-loop learning (relationships or partnering among and between organizations) (Ameli and Kayes 2011). It should however be noted that no precise definition of deutero learning has yet been established (Visser 2007).

The implementation of sustainable development in an organization is a challenging task. Therefore, among other things, work processes and productization must be rethought. OL and the acquisition of new information are both essential for this to be done effectively (Siebenhüner and Arnold 2007). The changes in sustainability that occur through learning encourage communal learning environments that do not merely convey information, but also increase the expertise of the learners (Docherty et al. 2009, Molnar and Mulvihill 2003). E-learning environments can be classified as such learning environments.

2.4 LEARNING OF ERGONOMICS

According to International Ergonomics Association (IEA), "ergonomics (or human factors) comes from the Greek words ergon (work) and nomos (laws) and is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data, and methods of design in order to optimize human well-being and overall system performance" (IEA 2000).

Definitions of ergonomics are as follows: physical ergonomics, cognitive ergonomics, and organizational ergonomics. Physical ergonomics deals with human anatomical, anthropometric, physiological, and biomechanical characteristics as they are related to physical activity. Cognitive ergonomics deals with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system. Organizational ergonomics deal with the optimization of sociotechnical systems, including their organizational structures, policies, and processes (IEA 2000).

Ergonomics is a multidisciplinary science that aims to increase well-being at work or work ability. Consequently, learning about ergonomics can be a source of potential solutions or methods for promoting well-being at work (Scott 2009), and is associated with crucial processes that promote sustainable development at work. Furthermore, ergonomics is assumed to be one of the main tools for promoting well-being at work because the discipline aims to balance and optimize the interaction between the requirements of the task, the working conditions, and the worker's capabilities (Louhevaara 1999, Scott 2009).

Lean thinking is closely connected to ergonomics. Studying work processes is at the core of lean thinking, and it aims at continuous improvement of work functions by shared activities in working communities. On the other hand, continuous improvement has been noted to improve the efficiency of work and satisfaction with work, and to increase communication and cooperation between workers (Reijula and Tommelein 2012).

According to Kirsten (2010), there has been relatively little published research on programs that have been successful in promoting workers' health on a global level. He has also noted that in order to achieve good health for employees and growth in company productivity, health promoting programs in companies must consider the health of all their employees and should not focus exclusively on workers who are ill or at clear risk of becoming ill. Secondly, more emphasis should be placed on psychosocial factors, in addition to factors that promote personal health. He also argues that these factors have been more thoroughly incorporated into well-being studies and programs in the Scandinavian countries than elsewhere (Kirsten 2010).

Participatory ergonomics (PE) training has been the focus of some research interest and the results are different. For example, there is no evidence that training with or without lifting equipment is effective in the prevention of back pain or consequently disability (Martimo et al. 2008). On the other hand, PE interventions seem to led to improvements in

musculoskeletal disorderes-related symptoms, injuries or claims, and sick leave and lost workdays (Rivils et al. 2008). According to van Eerd et al. (2010), there is no 'one best way' to implement a PE program or intervention. Usually, workplaces carry out PE interventions when they need to decrease the number of work-related accidents or mitigate risk factors for such events. A strength of the PE approach is that it can be applied to work tasks and employees according to the need for intervention within the workplace. Sustainable PE interventions can only be achieved by evaluating the effects of alleviatory and preventive factors at every stage of the process, during both planning and implementation. Factors that promote the successful and sustainable PE interventions include the support of management and workers; the availability of adequate resources in terms of time, personnel, and ergonomic training; and good communication (van Eerd et al. 2010).

2.5 LEARNING OF ERGONOMICS VIA THE WEB-BASED LEARNING PROGRAM

Current information and communication technology allows organizations to achieve, process, store, and exchange information, for instance, on the Internet (Cegarra-Navarro et al. 2007). The Internet also works as an effective tool or system that enables distance teaching and learning, and as a means to share acquired knowledge and experience on workplaces. Distance teaching and learning is also economic and energy efficient which are two important elements of sustainable development (Barratt 2006).

Web-based, time and place-independent distance learning may replace traditional classroom teaching (Clulow and Govan-Brace 2003, Young and Norgard 2006). Wireless access to Internet has become common in university campuses in reset years (Chuang et al. 2010). Flexibility regarding time and place is one of the most often reported positive features of web-based learning (Chuang et al. 2010, Young and Norgard 2006). On the other hand, students need clear guidelines and instructions about when and how often they are expected to communicate with each other and with a tutor or teacher (Clulow and Govan-Brace 2003). In addition, students with more experience were dissatisfied with the technical environment and support provided with web-based courses (Young and Norgard 2006). Web-based learning goals and activities should be clear and informative, and linked to the students' needs (Yu and Yang 2006, Song et al. 2004).

The study presented in this thesis focused on the impact of ergonomics training using the Ergonetti learning program (Ergonetti 2013). Ergonetti is a web-based, basic level learning program in ergonomics developed by the Open University of Eastern Finland. In total, 1705 students have participated in the Ergonetti program since its inauguration in 2000. Approximately one third of this group (602 students) have completed their studies and been awarded a basic diploma in ergonomics (as of the 10th of May, 2013).

The studies in the Ergonetti follow the criteria stipulated by the CREE (Centre for Registeration European Ergonomist) (CREE 2012) and it's content follow the definitions of IEA (physical ergonomics, cognitive ergonomics and organizational ergonomics) (IEA 2000).

The first web-based Ergonetti learning program, worth 25 ECTS (European Credit Transfer System) credit points, was developed between 1998 and 2000 at the Open University of Kuopio, Finland (since 2010, the University of Eastern Finland) with the assistance of Finnish specialists and teachers of ergonomics and occupational health and safety. A second updated version of the Ergonetti learning program was launched in 2004 based on the results and experiences that were gained during the use of the first version.

The aim of Ergonetti is to enable students to learn how to improve, both in theory and practice, health and well-being in their workplaces in a multidisciplinary manner. The web pages provide a technical learning environment, and students apply the theory they learn in their workplaces. Ergonetti focuses on training and improving ergonomics in order to

increase the work capacity of individuals within the students' own workplaces or in target jobs acquired through the studies.

The theoretical framework underpinning the Ergonetti learning program was influenced by the Finnish concept of workplace health promotion (Ilmarinen and Rantanen 1999, Ilmarinen 2006) (Figure 1), the theory of on-the-job learning (e.g., Pohjonen 2002), and Kolb's developmental cycle (Kolb 1984).

Since 2009, the Ergonetti learning program has consisted of five learning modules: Keys for the development of work (4 ECTS credit points), Work environment (4 ECTS credit points), Work community and competence (7 ECTS credit points), Diverse strain at work (7 ECTS credit points) (before 2009, this module consisted of two different modules: 'Diverse strain at work' and 'Work and the individual'), and Summary (3 ECTS credit points). The Ergonetti learning modules focus on the diverse loads and strains at work, such as physical and psychological load and strain, work and the work environment, work organization and leadership, and professional competence (Figure 1).

Figure 1. The Ergonetti learning modules (modified Pitkänen et al. 2005).

Students can enroll in the program as a whole or in separate module, in which case completing the program is not the goal. Students can continue suspended studies whenever suitable for them. Students' study attainments are registered in an information system of the University of Eastern Finland.

The objectives (or learning outcomes) of each module have been built with respect to Bloom's taxonomy (Bloom and Krathwohl 1984) which is widely used method for defining learning objectives in the University of Eastern Finland. The objectives of the modules are the following: *Keys for the development of work*: After the completion of the learning module, a student can identify and entitle/name/determine the main principles of ergonomics, and the promotion of work ability and well-being at work. *Work environment*: After the completion of the learning module, a student can identify and evaluate risks of the work environment. *Work community and competence:* After the completion of the learning module,

a student can entitle/name/determine factors affecting well-being at work and analyze their interactions/relationships. *Diversity of load and strain at work:* After the completion of the learning module, a student can identify (identifies) the main workload factors and describe the principles of healthy and safe work. In addition, the student can entitle/name/determine the dimensions of the functional capacity, measure the functional capacity, and explain the associations between the functional capacity and job/work demands. *Summary:* After the completion of the learning module, a student can prepare a written proposal/plan for developing the workplace (Perusopetuksen opetussuunnitelma 2012).

Each module includes discussion areas and tasks that relate to its topics and goals. A tutor is assigned for all of the modules to provide the students with additional input relating to the tasks. However, the role of the tutor is to offer advice rather than to act as a teacher, and the students are treated as active subjects and participants rather than passive entities. Each module follows the Kolb's (1984) development cycle including four phases: identification, analyzing, understanding and solving of the problems (Figure 2).

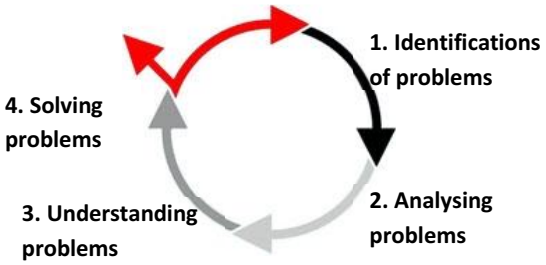

Figure 2. The Ergonetti development cycle.

The studies undertaken within the Ergonetti development cycle (Figure 2) are based on recognizing genuine targets for development in a workplace by using different measurements (analyzing the current situation), identifying the most important subjects from the point of view of the workplace (analyzing and choosing development targets, in collaboration with employees), understanding the reasons behind, and consequences of, the chosen problem areas (understanding the target for development by familiarizing oneself with the learning material in the Ergonetti Library), and presenting measures to solve the problems (finding potential solutions). The resulting solutions are evaluated based on the measurements used at the start of the process.

In other words, students perform practical developmental work in their own workplaces with their co-workers. According to Lammintakanen and Rissanen (2003), learning by doing is the most effective way to succeed in online studies.

Moreover, students make their development activities transparent by carrying out a task in the learning environment at each stage of the cycle according to instructions provided in their current Ergonetti module. Only the tutor and the student can view the task. The tutor comments on the tasks and provides instructions for completing or reworking them if needed before approving them. After tasks have been approved, students are instructed to discuss them with their co-workers and managers. There are detailed guidelines for each stage of the cycle, including descriptions of each task's requirements and how they relate to the learning environment. Students are encouraged to print these out for their own use if they so desire.

The promotion of health, work ability, and well-being in the Ergonetti learning program is considered to be a comprehensive and participatory process with concrete aims that is implemented through logical processes. In actual workplaces, the different views and experiences of individual workers are discussed and canvassed, and improvements are implemented after the establishment of a consensus.

2.6 SUMMARY OF THE LITERATURE

Sustainable well-being at work has rarely being in focus on empirical research and, according to literature presented here, there is need to recognize and describe the role of learning as the connecting and mediating link in promoting sustainable well-being at work.

Studying of ergonomics is an opportunity to promote occupational well-being in workplaces and it would appear to be also linked to the promotion of sustainable development at work. However, there is little researched information on studying ergonomics and particularly on web-based studies of ergonomics and sustainable development. Therefore, it is important to recognize benefits and disadvantages of the web-based studies of ergonomics, the Ergonetti studies, and to study the Ergonetti learning program as a method for developing sustainable well-being at work in different enterprises.

3 Aims of the study

This study is positioned in the frame of the promotion of well-being at work and organizational learning. At first, a model for promoting sustainable well-being at work was developed in this study and the relevance of the model was studied with a systematic literature review (Article I). Subsequently, the web-based learning program of ergonomics, "the Ergonetti", was evaluated in this study as a method for developing sustainable well-being in different enterprises (Article II, III and IV).

The specific aims of the study were:

1. To evaluate the relevance of the developed hypothetical model in which learning is proposed to be a mediating link between SD and well-being at work, and to identify and classify learning characteristics that promote sustainable well-being at work (Article I).

2. To evaluate the benefits and disadvantages of the Ergonetti program by considering feedback from Ergonetti students and their work colleagues relating to the development of occupational well-being in SMEs by students as they went through the program (Article II).

3. To identify and describe the characteristics of the Ergonetti learning program that promote sustainable well-being at work when implemented in SMEs (Article III).

4. To describe the sustainable well-being at work in a large company through the Ergonetti learning program from the viewpoint of the Ergonetti students (Article IV).

4 Methodological basis and solutions of this study

4.1 METHODS

This research was a qualitative study whose data (Table 1) consisted of a systematic literature review (Article I) and theme interviews with Ergonetti students (Articles II, III and IV), who worked in SMEs and in one large company.

Table 1. Data gathered in this study.

Article	Data	Year of data collection	Data size
I	Systematic literature review	2008	16 articles
II	Thematic interviews	2004	174 pages
III	Thematic interviews	2005 and 2006	151 pages
IV	Thematic interviews	2009	108 pages

A systematic literature review was performed because there was a need to recognize and describe the role of learning as the connecting and mediating link in promoting sustainable well-being at work.

All data gathered in these studies were evaluated using qualitative inductive content analysis (Denscombe 2010b, Krippendorff 2004, Patton 2002), which is suitable to the analysis of both scientific articles (Denscombe 2010b) and interviews (Huberman and Miles 1994, Krippendorff 2004, Patton 2002). Content analysis is the analysis which aiming to identify prominent themes and patterns among themes. It is a systematic technique for compressing many words of text into fewer units, coding and naming the units according to the content they represent, and grouping coded material based on shared concepts (Polit and Beck 2012). A sentence or an idea functioned as units of analysis, as there was a desire to keep the original idea.

In the literature review and the three subsequent studies, the data gathered were initially read through several times to obtain a general overview of their contents. After this, questions regarding the relationship between the data and the aims of the study were presented and simplified expressions were formulated based on the original data. The qualitative analysis program atlas.ti 5.2 (atlas.ti 2013) was then used to analyze data. The simplified expressions were combined and used to define subcategories, which were assigned names. The subcategories were then grouped to form upper categories, which were further grouped to form main categories. The category formation process is illustrated in Appendix 1.

Article I focused on identifying learning characteristics that promote sustainable well-being at work. These characteristics were related to the workers' capabilities and competence, the work organization and environment, and the organization's leadership. Article II evaluated the benefits and disadvantages of the Ergonetti program in the development of occupational well-being in SMEs, with particular reference to the role of

the program in collaboratively solving problems associated with occupational well-being in workplaces. Article III focused on identifying and describing the outcome and action characteristics of the Ergonetti learning program that promote sustainable well-being at work in SMEs. Article IV describes the importance of learning to the Ergonetti students themselves and other workers in their company; to the organization and the working environment; and to the leadership, and how learning occurred and was achieved in one large company.

4.2 DATA AND DATA COLLECTION

4.2.1 Systematic literature review (Article I)

The data of the systematic review consisted, altogether 848 references, from which 16 articles that satisfied the selection criteria for the analysis were identified.

The information search for the systematic literature review was based on the developed hypothetical model that describes the role of learning as a connecting and mediating link that promotes sustainable well-being at work.

Information for the review was retrieved between August and September of 2008, by searching for material published between January 1990 and July 2008. The following electronic databases were searched: PubMed (US National Library of Medicine), SocINDEX (Sociology research database), Web of Science, Sociological Abstracts and PsycINFO (EBSCO, database of psychological literature). Science Direct journal articles were also included in the electronic search.

Two combinations of keywords were used: 'sustainable development' and 'job satisfaction', and 'sustainable development' and 'learning'. The term 'well-being at work' was replaced with the term 'job satisfaction' because 'well-being at work' was not found in the index terms of the databases but 'job satisfaction' was recommended based on the databases' search indexes.

Our analysis indicated that 'job satisfaction' was understood in a way that corresponds to the definition of well-being at work, with its four dimensions that describe the capabilities and competence of individual workers, work, and the work environment, and organization and leadership. Sustainable development was used as a free term because it was not found in the search indexes of most of the databases. When all three terms were included simultaneously, no references were found. Therefore, the two combinations were used to obtain a richer set of hits. The information search was carried out with help of information specialistis.

The selection criteria required that the articles: (1) were published between January 1990 and July 2008; (2) had been subject to peer-review and were original; (3) focused on the adult working population; (4) described field studies at a workplace; (5) cohort study; and (6) discussed 'sustainable development', 'learning', and 'well-being at work' or 'job satisfaction' on the individual or organizational levels, using those terms. The titles and abstracts did not have to mention all three concepts named in (6). It was considered sufficient that one of these was covered. However, the articles chosen for the final analysis had to meet all of the aforementioned criteria. The articles also had to be written in English or Swedish. The year of publication was used as the only limit when searches were carried out in different databases, as there was a desire to get fertile search results.

4.2.2 Interviews of the students of web-based learning program of ergonomics (Articles II, III and IV)

The data for article II consisted of theme interviews with Ergonetti students (n=7) who worked in SMEs. Their work colleagues (n=18) who had participated in Ergonetti development work were also interviewed. The Ergonetti students in group 1 were a so-called pilot group who participated in the Ergonetti program during the development of its second version between 2002 and 2003. They represented six different SMEs (Table 2).

Table 2. Background information on the Ergonetti students from group 1 (n=7).

Branch of business	Gender	Age	Education	Position in the SME	Headcount of the SME
Furniture industry	Male	32	Vocational high school	Maintenance manager	181
Nursery gardening	Male	47	Vocational school	Production manager	63
Furniture industry	Male	40	University	Teacher (no contract)	7
Clothing industry[1]	Female	45	Vocational school	Production manager (owner)	23
Clothing industry[1]	Female	61	Vocational courses	Managing director (owner)	23
Service home	Female	51	Vocational high school	Entrepreneur (owner)	10
Service home	Female	53	Vocational high school	Manager	20

[1]same SME

In group 1, three of the Ergonetti students were male and four were female. Their average age was 47 (ranging from 32 to 61 years). Based on their headcounts, four of the enterprises in which the group 1 employees worked were classified as small-sized enterprises employing 7-23 workers and two were medium-sized enterprises of 63 and 181 workers, respectively (European Commission 2005). Eight male and ten female workers from the companies participated in group interviews; the group sizes ranged from one and six people.

The data for article III consisted of a second round of theme interviews with the group 1 Ergonetti students and also interviews with a second group of Ergonetti students, giving 14 interviews in total. The data was gathered in 2005 and 2006 and the students have completed their Ergonetti studies 2 months—2.5 years before the interviews.

Group 2 (n=7) studied the Ergonetti program between 2004 and 2006, and represented four different SMEs (Table 3).

Table 3. Background information on the Ergonetti students from group 2 (n=7).

Branch of business	Gender	Age	Education	Position in the SME	Headcount of the SME
Engineering works	Male	31	Vocational high school	Development engineering	156
Service home[1]	Female	45	Vocational courses	Nursing staff	29
Service home[1]	Female	43	High school	Nursing staff	29
Service home[2]	Female	49	Vocational high school	Manager	19
Service home[2]	Female	40	High school	Nursing staff	19
Service home[2]	Female	40	Vocational school	Kitchen maid	19
Corner shop	Female	48	University	Entrepreneur (no contract)	33

[1-2]same SME

One of the Ergonetti students from group 2 was male and six were female. Their average age was 42 (ranging from 31 to 49 years). Based on their headcounts, three of the enterprises in which the group 2 employees worked were classified as small-sized enterprises employing 19-33 workers, and one was a medium-sized enterprise with 156 workers (European Commission 2005).

The data for article IV consisted of theme interviews with Ergonetti students from group 3. Group 3 studied the Ergonetti program between 2007 and 2009, and were all employed by a single large company (Table 4).

Table 4. Background information on the Ergonetti students from group 3 (n=15).

Gender	Age	Education	Position in the company	Work experience in the company, years
Male	49	Vocational high school	Designer	29
Male	43	Vocational school	Designer	25
Male	43	Vocational high school	Designer	24
Male	49	University studies, vocational courses	Designer	23
Male	47	Vocational school	Designer	30
Male	55	Vocational high school, managerial studies	Designer	33
Male	43	Vocational courses, managerial studies	Manager	24
Male	49	Vocational courses, managerial studies	Designer	30
Male	36	Vocational school managerial studies	Designer	18
Male	41	Vocational high school	Designer	15
Male	35	Vocational courses	Designer	16
Male	49	Vocational courses	Designer	27
Male	58	Vocational courses	Designer	39
Male	53	Vocational courses, managerial studies	Manager	30
Female	44	Vocational high school	Designer	27

Fourteen of the group 3 students were male and one was female. Their average age was 46 years (ranging from 35 to 58 years) and on average, they had been employed at their current workplace for 26 years (ranging from 15 to 33 years). At the end of 2011, the company employs around 27 500 professionals, of whom about 6 500 work outside Finland.

Theme interviews were conducted with Ergonetti students and their work colleagues from SMEs that had participated in the Ergonetti learning program in different years, and with Ergonetti students from a single large company. The data collection presented in articles II, III and IV were obtained from these interviews (Table 5).

Table 5. Summary of the data collection from the Ergonetti students.

Data (n)	Studying in the Ergonetti, years	Year of the interview, interviewees (n)	Article
Group 1 (n=7)	2002–2003	2004 students (n=7) + work colleagues (n=18)	Article II
		re-interview 2005 students (n=7)	Article III
Group 2 (n=7)	2004–2006	2006 students (n=7)	Article III
Group 3 (n=15)	2007–2009	2009 students (n=15)	Article IV

A theme interview framework based on the research plan of this study was formed in the researcher group. There was no theme interview structure available that would have been complete and suitable for this particular study.

The author personally recruited the participants to the interviews. Students in Group 1 studied in Ergonetti during the development of its version 2. All students were asked to participate in the interviews and all agreed to take part in them. Due to the small number of interviewees, it was not possible to conduct pilot interviews. However, after initial interviews, the interview framework functioned as expected.

The author recruited students to Group 2. All group members were also asked to participate in interviews and all agreed to do so. All students in Group 3 were also asked to take part in interviews. One of them could not be reached, and was therefore left out. During the study, no one cancelled their participation or denied the use of their interviews for research purposes.

A key research objective was to study the quality of the phenomenon rather than its quantity, and so fewer participants were involved than would have been required in a quantitative study (e.g., Draper, 2004). The interviewees had a high knowledge of the Ergonetti learning program and this improved the relevance of the data (e.g., Endacott 2008).

The themes of the interviews were given to the interviewees beforehand (Appendix 2: Individual interview themes/Group 1, Appendix 3: Group interview themes/Group 1, Appendix 4: Individual interview themes/Group 1 and 2, and Appendix 5: Individual interview themes/Group 3) and were carried out following the same pattern; the participants were asked to start with the first theme and after that continue freely.

The interviews discussed in articles II and III were performed under undisturbed conditions at the workplaces of the Ergonetti students or in the researcher's (author of this thesis) office, while the interviews of article IV were carried out by mobile phone; the interviewees were asked to ensure they were in a quiet location at their workplace when participating. All interviews were conducted by an author and according to the same pattern: the interviewees were asked to start with the first theme and after that continue freely. The interviews were recorded; Article II: tape-recorded and videotaped, Article III: tape-recorded and Article IV: digital recorded, and transcribed verbatim by the author in order to maintain the accuracy and authenticity of the data. The participants were provided with copies of the initial transcripts and given the opportunity to make changes to the text if they so desired.

4.2.3 Ethical considerations

During the research plan stage of the study, the Faculty of Health Sciences of the University of Kuopio, Finland granted a research permission for this study with a reference that a hearing by the ethical committee will not be necessary, as the study does not contain ethical matters connected to individuals or companies. The university did not have its own ethical committee at the time, but the ethical process occurred in the ethical commission of the Kuopio University Hospital, Finland. Back then the hospital processed and decided on medical research projects that connected to questions of patient safety. The University of Eastern Finland founded its own ethical committee in 2010, and currently all research permit applications such as the one presented here are dealt with there.

Arrangements for the interviews were made by phone. At the same time, the interviewees were informed about the purpose of the interviews, their voluntary and confidential nature, how they would proceed, that they would be recorded, how the material would be used, and the roles of the student, their work colleagues, and the researcher. Interview themes were mailed to the interviewees in advance, together with further information on the purpose of the study and the interview.

Interviewees were asked to give written consent (Appendix 6) to the use of the interviews for research purposes before the interviews were carried out. The consent form also included the information that the interviewees were able to prohibit the use of their interview for research purposes at any stage of the process.

In the beginning of the interviews, the students and their work colleagues were, once again, briefly informed of the interview's purpose. The author of this thesis personally collected the interview data, and also transcribed it. The interviewees were offered the opportunity to read the transcripts of their interviews and had the chance to make changes to them if they so wished.

The anonymity of the participants and their enterprises was guaranteed by deleting identification information before analyzing and documenting the data. Ethical principles concerning the handling of the data were also taken into consideration and the original data were only available to one researcher (e.g., Huberman and Miles 1994).

Interviews from 2004-2006 were recorded on video and on audiotape. The interviewees were only filmed in group interview situations, as it was important to ensure that it was possible in the transcription stage to recognise which one of the participants had spoken. In individual interview situations, filming only functioned as a precautionary measure for the taping, and the camera was turned away from the interviewee. The original filmed and taped interview data are kept in the Finnish Institute of Occupational Health, Kuopio, Finland. The data have been archived and the directives and provisions of the institute will be adhered to in the preservation of the material. The data must be stored for 10 years, after which they will be destroyed.

The interviews of 2009 were conducted as phone interviews, and thus there is no visual data of the participants. The author keeps original digital interview data recorded on CDs. The data are kept in a locked cupboard in the author's office. There is no separate agreement on destroying the data, but this will take place at the latest when the study based on the data has been published.

5 Results

5.1 LEARNING CHARACTERISTICS FOR PROMOTING SUSTAINABLE WELL-BEING AT WORK (ARTICLE I)

The systematic literature search produced 848 references. In the first stage, 629 references were rejected because 'well-being at work' or 'job satisfaction' were not mentioned in their titles. In the second stage, 157 articles were rejected based on their abstracts: six were duplicates, the full articles could not be found in five cases, and selection criteria 1-5 were not satisfied in 146 cases. In the final stage, 46 complete papers were rejected because they did not satisfy the selection criteria. Finally, sixteen articles that related to the hypothetical model and satisfied the selection criteria were selected for analysis.

The results of the analysis were consistent with the hypothetical model. The main focus of the articles was on promoting different aspects of SD and on different dimensions of well-being at work. The learning characteristics that promoted sustainable well-being at work had three dimensions: worker's capabilities and competence; work organization and environment; and leadership. The output variables of the model were the productivity of work and quality of life. The external contexts and networks relating to working life that affect and regulate this model were the family, the community, and global society (Figure 3).

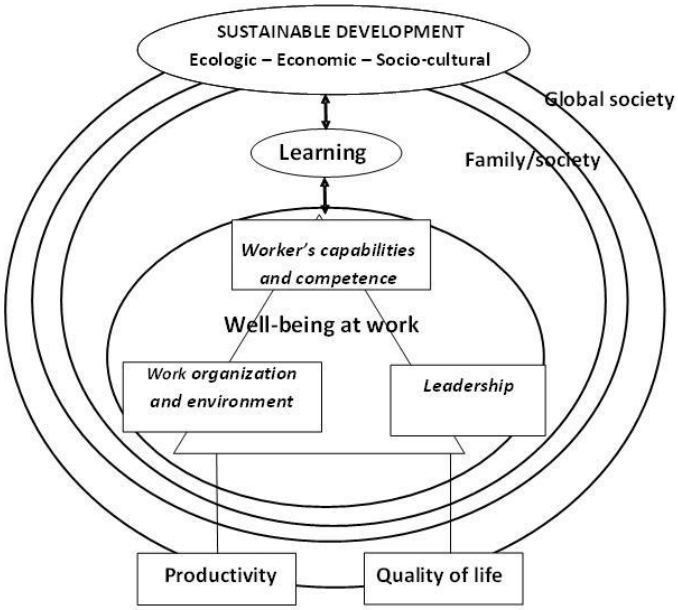

Figure 3. Model for promoting sustainable well-being at work.

The common message of all the articles was that organizations need to develop practices at work that promote sustainability or change their habitual ways of operating. The socio-cultural aspect of SD was also apparent in the articles, as reflected by the different types of learning processes discussed. In addition to the socio-cultural aspect, economic and

ecological aspects emerged. For example, one article discussed the development of sustainable local farming systems not just from the farmers' perspective but also in terms of how it related to the farming system as a whole and could reduce agricultural firms' consumption of water and acid.

Collaboration with work colleagues and managers was consistently described as being important for developing sustainable work practices and well-being at work. Participatory processes allow workers and managers to share their experiences, and collectively create knowledge regarding SD in a way that lets all participants contribute to an equal degree. Effective participatory processes were reported to require education, training, and taking action in actual work situations. Training on sustainable working practices in conjunction with a participatory approach was more effective than lecture-type training without interaction. In meetings of the former type, open and confidential discussions with an equal distribution of responsibility and mutual respect for all participants strengthened the cohesion among workers and helped to create sustainable working practices.

New knowledge on SD and theories of well-being at work and learning, together with active reflection, reportedly led to technical and organizational changes as well as increased awareness of sustainability issues among workers. The success and sustainability of the learning process required the workers' free and willing participation. A supportive managerial approach was also important in promoting the voluntary learning process. Workers were more likely to engage effectively in the learning process and provide valuable input when their participation was voluntary than when it was compulsory.

The SD projects discussed in the articles were usually implemented with the assistance of researchers. The role of the researchers was to guide the learning process and to evaluate the discussions that occurred and the process as a whole. The researchers also concluded the learning projects. With their help, organizations noticed that it was more effective to solve problems using slow and stepwise implementation of changes whose purpose was understood and accepted by all involved parties than by simply trying to address issues immediately.

The promotion of SD and well-being at work required active partners and changes in the goals and values of the organizations. The most effective methods for changing these goals required the investment of time and resources to create double-loop learning processes.

In some cases, outsiders (stakeholders, customers, suppliers, etc.) participated in the developmental processes via meetings arranged by the researchers. The external participants were willing participants in the developmental meetings since both they and the firm benefited from open discussions and participating in collaborative developmental work, which allowed all participants to better understand their partners' requirements. The outcomes of successful learning processes were implemented in practice, generating economic benefits such as cost reductions.

Increased awareness of the importance of regulations initiated a need for common goals and values. The implementation of standards relating to areas such as human rights (SA8000® :2008), quality management systems (ISO 9001:2000), and environmental management systems (ISO 14001:1996) seemed to facilitate the process of change.

Managerial commitments to leadership, teamwork, and collaboration with the workers facilitated the implementation of changes aimed at sustainability and structural changes in the organization. The creation of regulations (manuals of instructions and rules) with input from all parties helped both managers and workers to complete their duties. The implementation of different aspects of SD required changes in the values and culture of organizations, and it was essential for all personnel, both workers and managers, to embrace the changes. Effective action also required that the values and goals of the organization be clear and understood by all parties.

5.2 BENEFITS AND DISADVANTAGES OF THE WEB-BASED LEARNING PROGRAM OF ERGONOMICS (ARTICLE II)

The students of the Ergonetti program implemented program to develop and increase occupational well-being in their workplaces. The benefits of the Ergonetti program were linked to the operations of the enterprise, to the Ergonetti program itself, and to the students as individual.

The enterprises benefited from the increased collaboration between workers and positive changes in the attitudes of managers and workers towards the developmental activities. The development projects worked out well and were conducted in a way that reflected the Ergonetti development cycle model. The positive attitudes of non-student workers and management led to increased support for the students' participation in the Ergonetti program during working hours. Open conversations also provided opportunities for all parties to discuss various problematic issues as they arose.

The Ergonetti learning program was considered good in terms of the instructions, guidelines, and materials provided, the suggested measurements, the tuition of tutors, the support provided by other students, and the flexibility of the studies. The Ergonetti program was also considered to be a straightforward web-based distance learning system.

Following the Ergonetti program enhanced the students' personal growth, professional competence, and personal identity in a way that was independent of fixed timetables. The status of the participants increased in the workplace, which contributed to the developmental process.

Some disadvantages of the Ergonetti learning program were encountered during the development of occupational well-being programs in the students' workplaces. These related primarily to implementation of the Ergonetti learning program, inadequate support from the tutors, and individual problems due to changes in the students' personal situations. The worker participants did not report any disadvantages.

The student participants had difficulties in adapting to changes in the learning environment. There were also difficulties at the beginning of each new Ergonetti module and in converting theoretical knowledge from the program into practical measures in the workplace. The counseling of the tutors and the support of other students were often considered poor, student groups disintegrated, and their studies were perceived as being somewhat uncontrolled. There were also individual problems such as having insufficient time, mental problems, loneliness, and feelings of isolation stemming from distance learning.

5.3 SUSTAINABLE WELL-BEING AT WORK CHARACTERISTICS OF THE WEB-BASED LEARNING PROGRAM OF ERGONOMICS IN SMALL- AND MEDIUM-SIZED ENTERPRISES (ARTICLE III)

The Ergonetti students reported that by investing time and resources into the maintenance of mental and physical well-being, it was possible to increase the health and well-being of the workers. Moreover, the number of sick leave days taken by workers decreased. The students felt that both they and other employees learned how to perform development work. Furthermore, workers' attitudes became more positive, and their work competence increased. These positive outcomes and improvements thus validated the implementation of the programs. The competence of the participants increased, as did their understanding and acceptance of ergonomics in the workplace. Ergonetti students also applied their knowledge of ergonomics in their homes and hobbies.

Various successful campaigns were arranged and permanent actions were developed to improve the workers' physical fitness via activities performed within the workplace or in collaboration with occupational health services. Training and education were arranged according to the workers' needs. The workers and managers worked together to select

topics of education. In some workplaces, workers needed, and were offered, career development discussions in addition to (or instead of) education. For example, in some cases, it was necessary to clarify the distribution of work tasks.

Within the work community, the Ergonetti learning program promoted collaboration and interaction among workers. The workers and managers discussed and developed various measures to improve the organization of their work and the working environment. For example, the physical and mental strain on workers was decreased by ensuring that appropriate breaks were taken during the workday and by organizing efficient job rotations. The strains on new employees were also addressed by mentoring and supervising. The principles and prerequisites of individual work tasks were also clarified and developed collaboratively within the different workplaces. Ergonetti students familiarized one-another with the different discussion areas of the Ergonetti learning program and utilized one-another's skills to develop their own work.

The Ergonetti students in managerial positions received valuable information on various developmental actions and also realized that collaboration with the people they managed, for example by motivating, supporting, and giving responsibility to workers, was a more effective way of establishing successful developmental processes than working alone. For example, managerial support proved to be essential for workers developing information methods in the workplace. The skills of the managers also increased when they learned about factors that are important in developing leadership ability.

5.4 DESCRIPTION OF SUSTAINABLE WELL-BEING AT WORK VIA THE WEB-BASED LEARNING PROGRAM OF ERGONOMICS IN A LARGE COMPANY (ARTICLE IV)

Participation in the Ergonetti learning program increased the students' knowledge, credibility and proficiency (i.e. expertise) regarding ergonomics. Students generally felt that they would be able to continue using their knowledge of ergonomics in the future, and that their studies had beneficial effects on their lives. For example, some reported that the program had prompted them to think about ways of doing housework that would cause less strain than their current methods. Some students also stated that the number of sick leave days taken by employees had declined following the implementation of changes in their working practices to reduce their physical workloads.

By developing the tools and working conditions of employees, it was possible to create safer working conditions. The solutions that were implemented were both functional and sustainable. Moreover, continuous organizational development activities were established or were becoming so, and were reported to have positive effects on productivity at work. However, the students generally felt that it would only be possible to accurately evaluate the impact of development activities over a longer period of time.

Getting managers to commit themselves to development work was considered important. Ergonetti students felt that some of the managers were actively involved in and committed to development work. However, others were less engaged, making it more difficult to proceed with the work.

Students who had completed the Ergonetti studies were more likely to think about the requirements and process of development. For example, participants considered the Ergonetti studies to be a good example of how one should think about development and cause-and-effect relationships before starting work on development activities. Moreover, the students' extensive work experience helped them in establishing new activities and validating expenses.

The students noted that learning at work occurred in stages, according to the Ergonetti development cycle model. The students used material from the Ergonetti library to familiarize themselves with the demands of development activities, and only after having done this did they consider how development activities might be implemented. The

students also reported that they had received support for their studies from various sources, including fellow students and their employer, and that this helped them in advancing their studies. They also acknowledged that ergonomic development must be done over extended periods of time and that quartile thinking is not applicable to ergonomics.

Learning also occurred when students were able to make management and other workers engaged in, committed to, and responsible for, development work. Active confidential discussions among employees concerning ergonomic issues also helped to promote learning. It was possible to involve employees in development work by discussing even difficult topics openly and honestly, and by taking the workers' varied viewpoints into account.

5.5 SUMMARY OF THE RESULTS

Learning in an organization is a pivotal, overarching factor that links sustainable development and occupational well-being or work ability. The Ergonetti studies promote occupational well-being in a way that supports sustainable development. The process-like learning of the Ergonetti learning program, which involves developmental cycles and practical development work proved to be functional and useful. Moreover, it was shown that in practice, the Ergonetti development cycle model is transferable to different work tasks and development subjects.

The development of ergonomic programs in workplaces requires the investment of time, the commitment of all involved parties, and managerial support. With the help of shared discussions, it was possible to obtain input from all affected parties and to utilize the tacit knowledge present in the workplace. Overall, students felt that the developmental solutions implemented while following the Ergonetti learning program were sustainable and beneficial.

6 Discussion

6.1 METHODOLOGICAL CONSIDERATIONS AND LIMITATIONS

6.1.1 Evaluation of the systematic literature review (Article I)

The data gathered from the sixteen articles selected for investigation in the systematic literature review were evaluated using inductive content analysis, which is known to be useful for the analysis of articles and other written material (Denscombe 2010a). Every piece of information within the articles that related to the promotion of sustainable well-being at work by learning was highlighted and considered.

The planning of the search for the systematic literature review was time-consuming and challenging, but also important and necessary for the empirical studies. The search strategy to be used and its implementation were discussed extensively with research supervisors and information specialists.

The validity of this review might be impaired by the fact that every step of the review process was not described in detail. Inclusion and exclusion criteria should have been explained in more detail. The inclusion criteria were reduced during the review rounds of the article. Initially, the included articles were meant to be in English or Swedish, and electronic or full paper articles available in Finland. These criteria were followed, but were no longer mentioned in the actual study.

Research types could also have been made clearer by explaining that studies were allowed to be qualitative or quantitative. Moreover, based on the headline chapter and the abstract chapter, all articles were included where sustainable development, learning, or job satisfaction was mentioned.

In databases, the search was only limited by the year of publication. Only publications that had come up in 1990 or later were included. Due to this, the search results included e.g. books, proceedings, reports, and public articles in addition to scientific articles. Therefore, the majority of publications were discarded at the "rejected at title" phase.

The validity of this review might be also weakened by the facts that in some cases, it was not possible to locate the articles corresponding to abstracts that satisfied the search criteria. Moreover, some of the articles that were included were more than five years old, and only one researcher analyzed the data. The result might have been more reliable if the usual protocol of having two researchers analyze the data had been used.

However, the trustworthiness of the review was increased by having experienced research supervisors carefully and repeatedly audits the author's work (e.g., Polit and Beck 2012). Information specialists from the university also guided the development of the search strategy, and their expertise was essential in identifying suitable keywords. Data were obtained from peer-reviewed scientific articles that satisfied pre-defined selection criteria. All of the chosen studies clearly described the circumstances under which they were conducted and the learning processes they examined. Moreover, the sixteen chosen articles described studies conducted in a wide range of working contexts. The data were obtained from 16 articles and, therefore the inductive content analysis was chosen as a method instead of deductive in this study.

The results of the systematic literature review revealed some clear gaps in our understanding of the development of sustainable well-being at work by learning.

6.1.2 Evaluation of the students' interviews of the web-based learning program of ergonomics (Articles II, III and IV)

Trustworthiness

In qualitative research, the trustworthiness of data is normally evaluated based on its credibility, dependability, conformability, transferability, and authenticity (Polit and Beck 2012). The criteria used to evaluate the interview data gathered in this work were credibility, dependability, and transferability.

Credibility

Credibility refers to the credibility of research and it results, and to the demonstration of said credibility. As indicated by the systematic literature review, there were some clear gaps in our understanding of how learning affects the development of sustainable well-being at work, which prompted the initiation of the research described herein. Moreover, there was a general lack of research data on the promotion of sustainable well-being at work. Therefore, the first objective of the study was to develop a model that describes the promotion of sustainable occupational well-being. The relevance of this model was then studied in the context of OL and the promotion of occupational well-being by interviewing Ergonetti students and their co-workers in SMEs, and Ergonetti students in a large company. This made it possible to gather new information on the research topic.

The Ergonetti program has been accessible to students since the year 2000. This work aside, the only researcher to have studied the experiences of Ergonetti students and their satisfaction with the program was Ropponen (2009), who performed a questionnaire-based investigation. The aim of this study was to interview Ergonetti students and thereby gather information on the benefits and disadvantages of the Ergonetti studies in promoting occupational well-being in workplaces, perspectives on the impact of the studies, and to understand how the program promoted understanding of sustainable well-being at work.

Learning is rooted in change, either change that has already occurred or a situation that creates a need for change (e.g., Alexander et al. 2009). Motivations for change can be either external or internal (see e.g., Ruohotie 1998). The participants in these studies participated in the Ergonetti program on a voluntary basis: they were interested in studying ergonomics and motivated to do so. Therefore, they had a good foundation for learning. Two groups of students were recruited from SMEs, and in addition, the management of a large company asked its employees about their interest in studying the Ergonetti learning program. All participants were aware that the program was aimed at promoting occupational well-being and that it would involve addressing real-world issues that had emerged in their workplaces. The credibility of the study was boosted by the fact that, by the time they were interviewed, the students had completed their Ergonetti studies and therefore had a thorough understanding of the phenomena under investigation.

The decision to use theme interviews to gather data was motivated by a need to examine more of the students' opinions, views, experiences, and emotions regarding their Ergonetti studies than would have been possible with a structured interview or a questionnaire. Moreover, group interviews made it possible to simultaneously obtain insights from several perspectives on the topic at hand rather than getting just one point of view (e.g., Denscombe 2010a). The open themes of the interviews were derived from the aims of the study.

The interviewees discussed their experiences and ideas relating to the studies freely and openly according to the structure of the theme interviews. The author interrupted the interview if the interviewee started to discuss topics unrelated to the themes, and redirected the discussion back to the topics of the themes. In group interview situations, the author intervened in the conversation and moderated the discussion when it appeared that the same participants were talking incessantly. This was done to ensure that everyone had an opportunity to present their views on the Ergonetti studies.

The natural progress of the interviews was also aided by the fact that the author and the interviewees had become acquainted with one another before they took place. The author met the students of group 1 in shared meetings and in different interview rounds during the development of version 2 of the Ergonetti program. She personally recruited the participants of group 2 to the Ergonetti studies either by telephone or by meeting them in their places of work. The author also met them personally during interview rounds and functioned as a tutor for student group 2. The author did not meet the students in group 3 personally, as the interviews were conducted by phone. However, the author had contacted the interviewees by e-mail and by telephone before the interviews took place. Moreover, the author had gained a lot of experience in interviewing the Ergonetti students, and was thus able to obtain useful research data from the interviews with group 3.

In total, 433 pages of interview data were gathered. This body of data included responses that addressed all of the topics of interest and was thus sufficient to cover all of the study's aims. Inductive content analysis (Denscombe 2010b, Krippendorff 2004, Patton 2002) was used to evaluate the interview data. This approach is suitable for the analysis of both scientific articles (Denscombe 2010b) and interviews (Huberman and Miles 1994, Krippendorff 2004, Patton 2002).

The main strength of content analysis is that it provides a method for quantifying the contents of a text, and it does so in a way that is clear and, in principle, repeatable by other researchers. A further benefit of content analysis is that it can be used to unearth topics that are hidden in written text (Denscombe 2010b). With the help of content analysis, it was possible to uncover all of the possible words, ideas, and sentences relating to the studied phenomenon. Moreover, the number of times each of these words, ideas, and sentences appeared in the text was counted; the resulting frequencies were listed in result tables. Content analysis also helped to reveal the positive and negative viewpoints towards the phenomenon contained within the text, and was used to identify related topics after careful consideration.

The data were imported into the atlas.ti qualitative analysis software package (atlas.ti 2012), which proved to be suitable for this study. The program made it easy to establish the initial groupings from the data. However, an ordinary word processor was used for subsequent analyses. The coding rules employed were always applied equally, and groupings were made only when they appeared naturally.

The main limitation of content analysis is that it has an in-built tendency to separate the units and their meaning from the context in which they were made, and to even out the intentions of the writer (Denscombe 2010b). There was an attempt to avoid this, in that the only part of the analysis done by the author alone was the construction of the simplified expressions and sub-categories of the data. These analyses were presented to a group of research supervisors during the analysis in order to obtain feedback and to minimize the likelihood of inadvertent distortion of the data. The entire research group (author and supervisors) worked on the grouping and naming of the upper and main categories. This increased the reliability of the coding, since it was done in a way that incorporated the expertise and viewpoints of all involved.

Credibility suffers if a researcher is not aware of the context of their research. The author of this thesis has a good understanding of the history and development of the Ergonetti learning program, having worked as an Ergonetti tutor since 2000 and participated in developing version 2 of Ergonetti. Moreover, she has later contributed to the updating of different phases of Ergonetti.

Dependability

The dependability of a study is affected by the research process as a whole, and requires that the research process be recorded in a way that is easily followed by other researchers. Here, the entire data were transcribed word for word and then carefully interpreted and reported. Dependability was increased by describing the data using authentic expressions, drawing a figure (Article II), and compiling the results in tables (Article III and IV).

Study results should be founded on data rather than a researcher's ideas regarding the topic at hand. This was ensured by using an inductive approach to data analysis. Naturally, the author had knowledge of the studied phenomenon and on actions taking to promote occupational well-being, but the inductive approach also made it possible to uncover different viewpoints and report on them. A deductive analysis would have been based on a ready-made analysis structure, and this might have caused the author's viewpoints to have a greater impact than was intended, resulting in more extensive data reduction than would have been the case in an inductive analysis.

The dependability of the research was accounted for by data triangulation. The interviewees worked in different workplaces and had different duties. They included men and women of different ages with different educational backgrounds. The students from the large company performed similar work tasks, but worked in different locations throughout Finland, so there was variance in their working conditions and methods.

It is possible that another researcher would come up with a different interpretation of the data considered. However, in qualitative research, this does not mean that there is a problem of dependability, as different interpretations increase understanding of the phenomenon that is being studied (e.g., Malterud 2001).

Transferability

The author carefully described the interviewees, and also provided information on the environments (workplaces) that they represented so that readers can evaluate transferability of results. The aim was to provide readers with enough information on the data gathered to form their own conclusions regarding the usefulness of the results.

Moreover, there were questions regarding the transferability of the Ergonetti development cycle model in the interview themes (connected to theme two of individual interviews and to theme four of group interviews). Some of the students had already applied the cycle model to other work tasks or their personal life, and almost all of them believed that the Ergonetti development cycle model could be applied in other fields where problem solving based on personal experiences and on-the-job-learning would be useful.

6.1.3 Limitations

Despite the richness of the data, the study had some notable limitations. The amount of research information available from peer-reviewed studies was low, and so conceptual papers and previous literature reviews were included, some of which may not have been through the peer review process. These materials were only used after careful consideration, and only to illuminate particularly important issues relating to the subject at hand.

It may be difficult or impossible to generalize the results obtained from this work and any attempt at generalization should be done with great care due to the small number of participants from both the SMEs and the large company. The results may be applicable to other settings, but not statistically generalizable (Connelly and Yoder 2000). The main problem of qualitative content analysis relates to achieving adequate data-reduction during the analytical process (e.g., Denscombe 2010a). However, the data set gathered in this work is large enough (433 pages) to minimize this problem. Furthermore, the use of low inference descriptors in field notes and multiple careful audits by other members of the research group increased the qualitative power of the analysis. In addition, by using an inductive

rather than a deductive approach, all relevant expressions were included in the analyses (Huberman and Miles 1994).

Nearly half of the Ergonetti students in the SMEs were in a managerial position and may therefore have experienced more positive results in their developmental activities than would have been the case for less senior company employees. In addition, all of the participants from the large company had similar work tasks. However, they worked in offices in different parts of Finland and would thus have been exposed to slightly different styles of working and work conditions. Different results may have been obtained if there had been participants from other large companies and they had represented different lines of business.

The effects of the development activities were primarily positive. This positive perception may be due to the fact that the data set primarily reflected the perspectives of the Ergonetti students. The study presented in article II was the only one that included the perspectives of the students' work colleagues; articles III and IV were based exclusively on interviews with students. It is possible that these studies would have yielded different results if workers involved in the developmental work had been interviewed.

The author conducted the initial analysis (simplification and constructing subcategories) of the data alone. However, the input of supervisors was sought at multiple stages of this process, and they were directly involved in the later stages of the analysis (identifying and naming the upper and main categories).

Students usually participate in the Ergonetti studies in their own time. Nearly all of the participants of this study also had the opportunity to devote some of their working hours to their studies, and this might have had a positive impact on their perception of the process.

The evaluated section of the Ergonetti program typically lasts for 1.5-2 years. In this study, the participants' studies took place over approximately 2 years. Over such a long period of time, it is possible that unexpected changes in personnel or other aspects of the workplace may have either facilitated or hindered development activities in a way that might not have been reflected in the interviews.

6.2 DISCUSSION OF THE RESULTS

The primary focus of Ergonetti is not on sustainable development. However, the Ergonetti program does contain elements that deal with the establishment of sustainable well-being at work through learning.

The topic of lean thinking was not on focus of these studies (e.g., Reijula and Tommelein 2012). However, the Ergonetti development cycle model is close to the continuous improvement cycle of lean thinking.

6.2.1 Evaluation of the learning characteristics for promoting sustainable well-being at work (Article I)

Learning was shown to be an important component in the promotion of sustainable well-being at work. The 'well-being at work' aspect of the hypothetical model and the results of this study supported the earlier models of Ilmarinen and Rantanen (1999) and Ilmarinen (2006). The learning characteristics that were identified as promoting sustainable well-being at work had three dimensions: (1) workers' capabilities and competence, (2) work organization and environment, and (3) leadership (see Figure 3).

Workers' awareness of sustainable well-being at work is increased by their active participation in, and reflection on, learning processes. Voluntary participation in the learning process increases workers' commitment and motivation, and produces more positive results than would be achieved if the participants were reduced to taking a passive role (e.g., Kira and Ejnatten 2009).

Successful outcomes (in terms of SD) are achieved when a high priority is assigned to the project and there are well-defined organizational learning goals. The processes and

outcomes of developmental projects are satisfying when they are assigned a high priority and their aim is to reduce daily costs through practical measures.

Developmental work requires innovative thinking and approaches from the organization. Single-loop learning can be useful for solving daily problems, but double-loop learning is needed to achieve sustainable changes based on organizational goals (e.g., Argyris and Schön 1996).

Researchers can play essential roles in guiding, monitoring, and evaluating sustainable learning processes. However, outside support is not used in the Ergonetti learning program as such. The learning environment includes guidelines on development activities, and a tutor guides the studies. The tutor comments on the tasks at the different stages of the cycle, but the students themselves establish and perform the actual development activities in collaboration with their work colleagues and managers. Indeed, Ergonetti is a good example of how workplaces have the power to address internal flaws and promote occupational well-being within the organization.

The development of sustainable solutions and well-being at work requires time, guidance, awareness, and reflection on experiences. Therefore, organizations must go through an entire learning process under real leadership to attain a sustainable orientation (Crutz et al. 2006, Docherty et al. 2009). The investment required in the early stages of the project may be large, but will eventually be rewarded by increased productivity and improved quality of life for the workers (e.g., Velazquetz et al 2011).

The promotion of sustainable well-being at work requires a lot of voluntary collaborative processes in the workplaces and managerial support. Additionally, transparent and shared goals that are understood and accepted by all partners are essential (e.g. Molnar and Mulvihill 2003). Documented goals, rules and procedures support developmental work (e.g. Veleva et al. 2001, Hjort and Bagheri 2006). On the other hand, real and sustainable changes in organizations, especially in areas relating to the health and safety of workers, seem to occur only through discussions of invisible issues, such as emotions, beliefs, mental models, and perceptions. These issues are very individual and are based on each worker's knowledge and experiences (e.g. Nonaka and Takeuchi 1995).

6.2.2 Evaluation of the learning program of ergonomics as a method for developing sustainable well-being at work (Articles II, III and IV)

Evaluation of the benefits and disadvantages of the web-based learning program of ergonomics (Article II)

Participation in the Ergonetti program had more advantages than disadvanteges. The identification of these aspects is valuable for the program's further development. Practical implementation of the Ergonetti tasks promoted the discussion of difficult problems and collaboration between all parties within the workplace partners. This ultimately led to improvements in working conditions. The developmental process based on the Ergonetti development cycle requires a participatory approach. The ideas of learning through experience (Kolb 1984) and on-the-job learning (Pohjonen 2002) worked out well among the student participants.

According to Cheng et al. (2012), managerial and organizational support promotes learning in workplaces. The Ergonetti students were well motivated and their work colleagues and managers were also committed to, and participated in, the development of their projects and supported learning and the implementation of the Ergonetti program.

The results showed that the web-based courses were convenient, and offered flexibility for most of the adult students. A lack of spare time at work and free time at home decreased the students' motivation to continue with the Ergonetti program. Similar problems have been reported previously by van Gog et al. (2010).

The web-based studies are intended to encourage independent learning. However, some students clearly required more individual guidance and instruction than the tutors of the Ergonetti could offer.

Evaluation of the sustainable well-being at work characteristics of the web-based learning program of ergonomics in small- and medium-sized enterprises (Article III)

All levels of OL were well actualized within the Ergonetti program. The students who participated in the study learned about OL on an individual level, and their learning was mainly explicit (e.g., Bucic et al. 2010, Nonaka and Takeuchi 1995). The benefits achieved through this learning were an increased know-how regarding ergonomics and the ability to apply this knowledge. The Ergonetti students spread information on ergonomics in their workplaces, and, through shared discussions, their managers and co-workers were able to share their experiences and knowledge of sustainable well-being at work. At the team and organizational levels, OL was initially achieved through mutual discussions, and increased as the developmental work was executed (e.g., Bucic et al. 2010, Lifvergren et al. 2009, Nonaka and Takeuchi 1995). On the other hand, the cyclic model of the Ergonetti learning program as a means for supporting developmental work requires close cooperation in the workplace (e.g., Ropponen 2009).

Awareness of tacit knowledge increased in the workplaces when the developmental principles for developing work environment and work community were clarified during discussions (e.g., Lifvergren et al. 2009, Lozano 2008). In these discussions, tacit knowledge was utilized when problems involving well-being at work were identified and everyone could produce different solutions that could be applied to the problem areas. Tacit knowledge was also utilized with new workers, who were properly familiarized with their work tasks and were assigned mentors to guide their work (e.g., Saru 2007). Moreover, the development of methods and tools that would decrease work strain and increase work safety was seen as an important factor contributing to sustainable well-being at work.

Other employees and managers were actively involved in the discussion of developmental procedures and agreed on the methods that were to be used. Managers encouraged workers to commit to the process, motivated them, and gave them more opportunities to participate in the developmental work. These results were similar to those previously reported by Molnar and Mulvihill (2003) and Velazquez et al. (2011), whose view was that sustainable education programs demand the commitment of all employees and management.

All of the students involved were active, and their employers had positive opinions on the developmental projects conducted. All enterprises, regardless of their size, achieved significant positive outcomes from the developmental tasks. Half of the students were either owners of their own enterprises or in a management position, and this might have had an effect on the quick progress of the developmental work. On the other hand, some of the students held lower-level positions but were nevertheless able to inspire other workers and management to get involved in the developmental work as they themselves gained more competence.

Evaluation of the sustainable well-being at work description via the web-based learning program of ergonomics in a large company (Article IV)

The Ergonetti students actively initiated and implemented developmental projects as their studies proceeded. All participants had worked for the company for long periods of time, and they exploited this and their experience with its operations in their developmental projects. They were voluntary participants in the Ergonetti learning program and were highly motivated to learn about ergonomics and to improve their working conditions. The Ergonetti learning program proved to have great potential for solving problems within the company (e.g., Tynjälä and Häkkinen 2005). A requirement for fruitful e-learning environments is that they must contain theoretical information on the learning topic and

also promote interaction and the sharing of information (Falconer 2006, Tynjälä and Häkkinen 2005). All of these are achieved within the Ergonetti program.

The Ergonetti development cycle model proved to be functional and useful according to students and was even adopted for other tasks within the company. The company's employees discussed and raised awareness of drawbacks to their current ways of working and learned how to mitigate them. It was possible to establish and embed new information into the organization, reinforcing its learning ability. Shared discussions in the workplace also revealed the opinions of all workers affected by development activities, making it possible to access and exploit the workers' tacit knowledge (e.g., Falconer 2006).

Organizational change is required for the promotion of sustainable occupational well-being (Dellve et al. 2007, Heward et al. 2007). Changes were made in the company's operations, and new work techniques and tools were developed. This helped to reduce the physical strain imposed on employees. In turn, these improvements made their work safer and decreased the number of sick leave days taken by employees. Therefore, the Ergonetti development activities had a positive impact on the company's profitability (e.g., Velazquez et al. 2011). Participants noticed that developing occupational well-being at work requires long-term investments of time and commitment from all participants (e.g., Haug and Talwar 2010).

Some of the managers were committed to development work. However, their high workloads proved somewhat problematic, as did the high turnover of management. Some new managers had a little awareness of ergonomic issues and were therefore not committed to development work. As noted by Dellve et al. (2007) and Heward et al. (2007), good leadership is needed for the promotion of sustainable occupational well-being.

According to the Ergonetti students, learning occurred and was achieved in the workplace when students' past experiences and knowledge of their work were utilized in the company, and when students familiarized themselves with the requirements of development activities by acquiring new information from the Ergonetti library (e.g., Haugh and Talwar 2010). Only by doing this could the development projects be usefully completed. Support from managers, the working community, and the broader organization increases workers' motivation to use e-programs (Cheng et al. 2012, Wang et. al. 2010). In addition, the support of peers and the study group was shown to be particularly important.

While some managers did not wholly commit to development activities, almost all of the Ergonetti students felt that they received enough support from their managers. The company also put effort into providing support. Most students were allowed to study during their working hours, and the student group gathered regularly to discuss their development projects despite living and working in different areas of Finland.

7 Conclusions

1. The systematic literature review indicated that learning processes in the workplace are essential for the promotion of sustainable well-being at work and for productive work. The learning characteristics that promote sustainable well-being at work related to the workers' capabilities and competence, the broader work organization and environment, and the organization's leadership.

2. In the SMEs, collaboration increased in workplaces as a result of the Ergonetti studies. Both the Ergonetti students and their work colleagues engaged in more extensive discussions than they had before. This helped to unearth problems relating to the workplace and made it possible to address these issues. On the other hand, students had difficulties in finding time to study in between work and their free time.

3. In the SMEs, managers and workers were committed to the Ergonetti development work. Managers and employees shared their experience and knowledge of well-being at work in joint discussion relating to Ergonetti. The awareness of useful tacit knowledge was increased through shared discussions in which the developmental principles of the Ergonetti projects were clarified. The projects decreased work-related strain in the workplace, and increased work safety, contributing significantly to sustainable well-being at work.

4. In the large company, the Ergonetti studies helped to change and develop the organization's operational methods by making them healthier and safer. The Ergonetti development cycle model turned out to be useful and functional. Moreover, it was transferrable within the company and could be applied in other workplaces where problem solving is based on personal experiences and on-the-job-learning. The Ergonetti development cycle model thus seems to be practical and efficient as a way of promoting sustainable well-being at work. However, its successful implementation requires the investment of time, resources, and commitment, as well as managerial support.

8 Recommendations and needs for further research

Interactive, full-time educational programs such as the Ergonetti studies merit further investigation and analysis. Web-based learning, time-independent learning, and place-independent distance learning are increasingly replacing learning in traditional, school-like settings. The flexibility of these web-based courses is a major advantage, since it allows students to participate even when they are located a long way from the other students and the educators. This in turn allows web-based studies to reach more people, which promotes equality in a way that is consistent with sustainable development.

Promoting sustainable well-being at work requires continuous learning, and should be part of the everyday operations of workplaces. Sustainable well-being at work can be defined as a process that occurs in workplaces "to meet the present needs of workforce capacity and competence as well as work organization and environment, and leadership without reducing the capacity of the future generations and workplaces to meet their needs".

Commitment to the promotion of sustainable well-being at work is useful because healthy and skillful employees are the most important resource that companies have. The costs of development operations will reimburse themselves in the form of improved well-being and quality of life, and also through improved employee productivity.

With the help of the Ergonetti program, workplaces can take responsibility for developing their occupational well-being. Indeed, it would be advantageous for all workplaces, even small ones, to train workers to take responsibility for their occupational well-being.

In the future, more analysis of the development activities conducted in the studied workplaces will be required to determine how sustainable their efforts have been. The Ergonetti program was successful; however, furher research is needed to evaluate long term impact of the program.

This study highlighted the beneficial impact of the Ergonetti program and showed how learning occurred in workplaces in terms of sustainable occupational well-being. In the future, a questionnaire-based survey based on the results of the interviews used in this work could be conducted to gather data from a larger group of Ergonetti students as part of a larger study on the impact of Ergonetti development projects within the workplace. In addition to students, other employees and managers who have participated in development activities could participate in such a study.

It would also be interesting to compare Ergonetti and its model of occupational well-being to similar web-based training programs used elsewhere in the world.

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Appendix 1

Example of forming the categories

Example based on the Table 2 in Article IV. The Ergonetti students' (n=15) views on the importance of learning to the organization and working environment.

Simplified expression (examples) (+ identifying mark of the interview)	**Subcategories + No. of the interview in which the category was present (=f*)**	**Upper categories**	**Main category**
- a chair was developed for sorting (2) - car equipment ergonomics were improved (1)	Work tools were developed (4)	**Working conditions were developed to be safer** (total =17)	**The profitability of developmental activities in the organization and work environment was improved**
- questionnaire indicated a better atmosphere at work(13) -air conditioning at work was fixed (1)	Working conditions were improved (8)		
- the number of accidents decreased after stair rails were installed (7)	Employees' work safety was improved (5)		
- developed activities must be maintained (6)	Development activities must be maintained (2)	**Constant development was started in the organization** (total =44)	
- results of development activities in working community will show after many years (5)	The impacts of development activities can be seen in the long run (11)		
- expensive development activities must be rethought and carried out differently (13)	The impacts of development activities can be seen in the long run and demand budgeting (2)		
- when planning development projects, ergonomics issues are immediately noted(15)	Development activities became more efficient (5)		
- Ergonetti development measures have been sustainable and were developed further (10)	Development activities became continuous in the working community (3)		
- recycled materials were taken into use (14) - good, functional and effortless solutions are sustainable and are in use (11)	The development solutions have been sustainable (5)		
- productivity was increased when employees were healthier (10)	The productivity of work has improved (4)		
- healthier workers – better work quality – benefits to customers (3)	Customer benefits were better taken into account in the company (12)		
- transferring work methods demands knowing work community and work environment (11)	The transferability of the Ergonetti development cycle model must be thought about within the company (3)	**The Ergonetti development cycle model was utilized in the company** (total =31)	
- the operations model is transferable to different kinds of business activities (2) - applying the operations model makes it possible to transfer it to other organizations, working methods must be taken into account (6)	The Ergonetti development cycle model is transferable to different jobs or other companies either directly or by applying it (14)		
-within the company, the operations model is transferable to production work in particular (14)	Utilizing the Ergonetti delopment cycle model became more frequent (5)		
- has changed their job within their company and has already applied the Ergonetti measurings in the new workplace (10)	The Ergonetti studies had a positive transfer effect within the company (9)		

*f (frequency) = Number of authentic expression from the interviews. The same point might be expressed in different ways, and, therefore, every expression was counted separately.

Appendix 2

Individual interview themes / Group 1

1. Describe your experiences of the Ergonetti studies.

2. Describe the importance of the Ergonetti studies.

- For yourself, to your work (work know-how), for other areas of your life.
- For the company.
- For the employees.
- For the customers.
- For society.

3. Describe which of your individual features were important in the starting point of the developmental actions?

4. Describe which factors promoted / hindered your Ergonetti studies?

5. Is there anything else you would like to tell in terms of feedback?

Appendix 3

Group interview themes / Group 1

1. Describe actualized developmental actions related to the Ergonetti.

2. Describe factors that were involved in the developmental actions of your work?

- Which factors enhanced the realization of developmental actions?
- Which factors hindered the realization of developmental actions?
- Have there been any other changes in the company and are they related to the Ergonetti?

3. Describe the process of the developmental work and its progress.

4. Describe the importance of developmental work.

- For the staff.
- For yourself.
- For the clients.
- For the company.
- For the society.
- Contributed he developmental work other good practices?
- Is the developmental work transferable for other organizations?

5. Describe the progress of you developmental work in the future.

6. Is there anything else you would like to say in terms of feedback?

Appendix 4

Individual interview themes / Group 1 and Group 2

1. Describe the current state of the Ergonetti developmental actions.

2. Describe the factors which have affected the developmental actions at your work site.

- Promoting factors.
- Hindering factors.

3. Describe the importance of the Ergonetti studies.

- For yourself, to your work (work know-how), for other areas of your life.
- For the company.
- For the employees.
- For the customers.
- For society.

4. Describe the importance of developmental work.

5. Describe the future plans related to developmental actions.

6. Is there anything else you would like to say in terms of feedback?

Appendix 5

Individual interview themes / Group 3

1. Describe your experiences of the Ergonetti studies.

2. Describe the importance of the Ergonetti studies.

- For yourself, to your work (work know-how), for other areas of your life.
- For the company.
- For the employees.
- For the customers.
- For society.

3. Describe which of your individual features were important in the starting point of the developmental actions?

4. Describe which factors promoted / hindered your Ergonetti studies and developmental actions at your work site?

5. Is there anything else you would like to tell in terms of feedback?

Appendix 6

Consent form

I have received enough information about the “Kestävä kehitys ja Ergonetti-opinnot työhyvinvointia edistävässä toiminnassa” (Sustainable development and Ergonetti-studies for promoting well-being at work) study and I am willing to participate in the study. I have been made aware that my participation is voluntary and I can abandon my participation at any given time without having to provide a reason.

The information collected by the interview may be utilized in research work.

Yes___ No___

Place_____ Date _____

Signature_____ Date of birth_____

Clarification of the signature_____

Home address_____ Postal code and post office_____

Signature of the receiver _____

Clarification of the signature _____

Marja Randelin

Sustainable Well-being at Work through Ergonomics via the Web-based Learning Program of Ergonetti

This thesis identifies the learning characteristics that promote sustainable well-being at work and evaluates the Ergonetti learning program as a method for developing sustainable well-being at work in different enterprises. The Ergonetti is a practical and efficient way of promoting sustainable well-being at work. The Ergonetti projects decreased work-related strain in the workplace and increased work safety, contributing significantly to sustainable well-being at work. Successful implementation of the Ergonetti requires the investment of time, resources, commitment, and managerial support.

UNIVERSITY OF
EASTERN FINLAND

Publications of the University of Eastern Finland
Dissertations in Health Sciences

ISBN 978-952-61-1121-6