Training teacher communication in the classroom. Voice use, body communication and well-being in relation to classroom acoustics.

Karjalainen, Suvi

2021

Document Version:
Publisher's PDF, also known as Version of record

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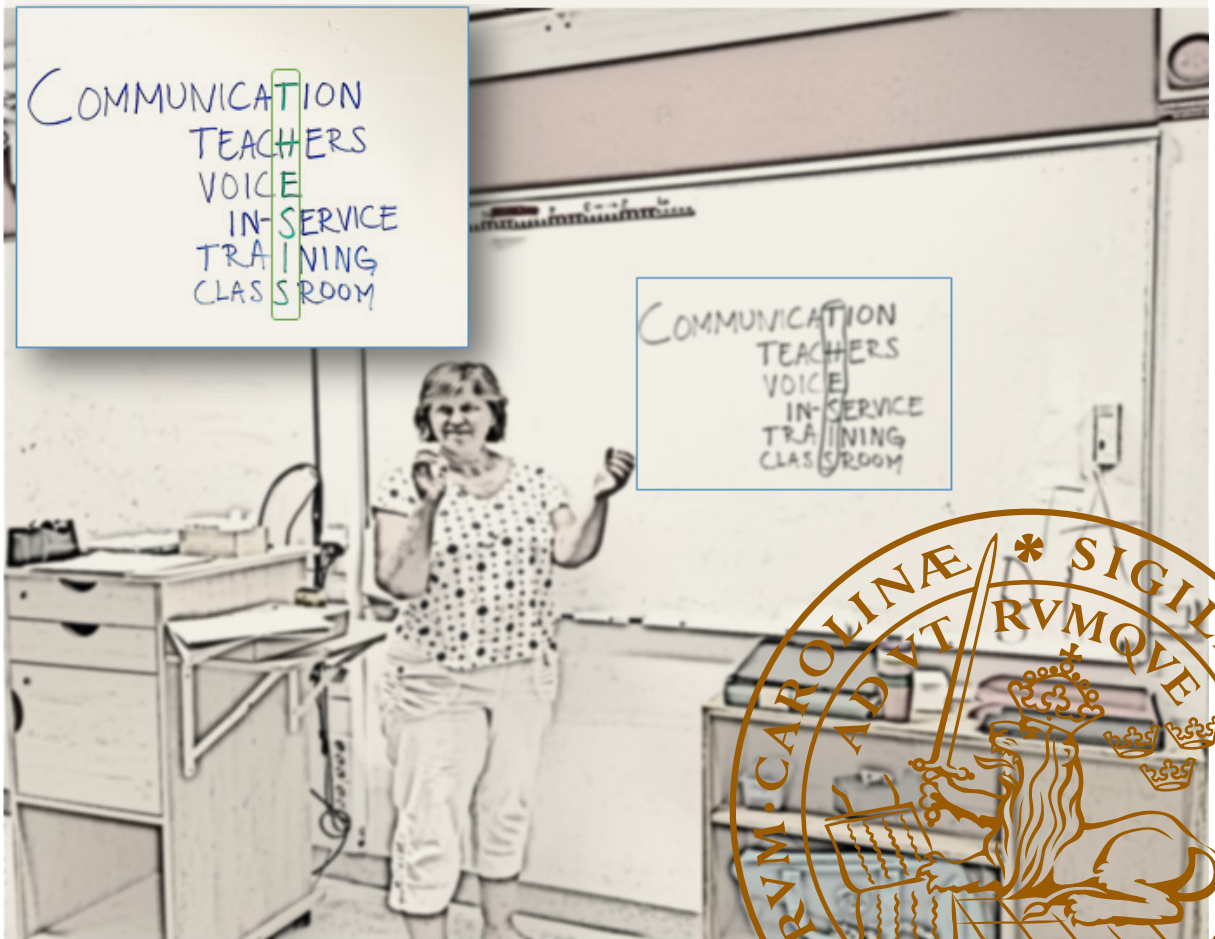
CLINICAL SCIENCES, LOGOPEDICS, PHONIATRICS AND AUDIOLOGY | LUND UNIVERSITY



Training teacher communication in the classroom

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Voice use, body communication and well-being in relation to classroom acoustics

Suvi Karjalainen

LUND
UNIVERSITY

DOCTORAL DISSERTATION

by due permission of the Faculty of Medicine, Lund University, Sweden.
To be defended at Belfragesalen, BMC, D. September 16th, 2021, 13:15.

Faculty opponent
Associate Professor Ingrid Verduyckt, Université de Montréal

Organization LUND UNIVERSITY Faculty of Medicine, Clinical Sciences, Logopedics, Phoniatrics and Audiology	**Document name** DOCTORAL DISSERTATION **Date of issue** September 16th 2021
Author SUVI KARJALAINEN	Sponsoring organization Marcus and Amalia Wallenberg Foundation

Title and subtitle
Training teacher communication in the classroom
Voice use, body communication and well-being in relation to classroom acoustics

Abstract
Teachers' classroom communication is important in creating relationships and supporting students' learning. Research has shown that evidence-based language learning interactions are less frequently observed than is desirable. Teachers' communication is important both in terms of the impact their communication has on students, as well as for their own well-being and ability to work. Little support seems to be offered for teachers in developing and mastering their communication skills. Therefore, this thesis has an in-service training as its core, a program aiming to train teachers' communication, theoretically and in practice. In the present thesis, classroom communication is defined as how teachers speak and use aspects of body communication in their interactions with their students comprising voice quality, vocal intensity, speech rate and speech intelligibility; use of gaze, mimics, gestures, positions and movements in the classroom.

The overarching aim was to investigate internal (vocal health and well-being) and external (acoustical characteristics in the classroom) factors influencing teachers' communication in the classroom and, to investigate the effects of in-service training in teachers' classroom communication.

First, the relationship between teachers' well-being and acoustical properties of their classrooms were investigated by non-parametric correlations. Thereafter, the in-service training was given during 5 weeks, 1.5 hours/week, to 25 teachers, teaching in grades 3-6. The effects of the in-service training on teachers' vocal health and well-being was assessed directly after training and at follow-ups after five weeks and 3-months. Linear mixed effects regression-models were used for the statistical analysis. Lastly, six months after the in-service training the teachers gave their own descriptions of their classroom communication in focus groups. Thematic analysis and was used for the analysis.

The main results showed that in classrooms with higher ventilation noise teachers reported higher degree of burnout and more voice symptoms. There were significant improvements on vocal health and well-being (stress, burnout and self-efficacy). Three overarching themes in the teachers' descriptions were yielded from the thematic analyses: *awareness of voice use, the use of body communication* and *setting the stage for learning.* The teachers gave examples of implementing their increased awareness into new practices and reflected on reflected on prerequisites for classroom communication.

In conclusion, the training gave positive results. Similar programs can with advantage be carried out by speech language pathologists. Furthermore, the results indicate that ventilation noise in classrooms must be reduced.

Key words vocal health; well-being; sound environment; classroom communication; CPD

Classification system and/or index terms (if any)

Supplementary bibliographical information Lund University, Faculty of Medicine Doctoral Dissertation Series 2021:85	**Language** English
ISSN and key title 1652-8220 Training teacher communication in the classroom	**ISBN** 978-91-8021-092-8
Recipient's notes	**Number of pages** 93 Price
	Security classification

Signature  Date 2021-07-25

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Coverphoto by Suvi Karjalainen, Back cover photograph by Peter Hällman

Faculty of Medicine
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Lund University, Faculty of Medicine Doctoral Dissertation Series 2021:85

ISBN 978-91-8021-092-8
ISSN 1652-8220

Printed in Sweden by Media-Tryck, Lund University
Lund 2021

“Listen with your eyes as well as your ears”

Graham Speechley

Table of Contents

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List of papers

Study I

Karjalainen, S., Brännström, J., Christensson, J., Sahlén, B., & Lyberg-Åhlander, V. (2020). A Pilot Study on the Relationship between Primary-School Teachers' Well-Being and the Acoustics of their Classrooms. *International Journal of Environmental Research and Public Health*, 17(6). https://doi.org/10.3390/ijerph17062083

Study II

Karjalainen, S., Sahlén, B., Falck, A., Brännström, J., & Lyberg-Åhlander, V. (2019). Implementation and evaluation of a teacher intervention program on classroom communication. *Logopedics, Phoniatrics, Vocology,* 45(3), 110-122. https://doi.org/10.1080/14015439.2019.1595131

Study III

Karjalainen, S., Lyberg-Åhlander, V., Sahlén, B., & Houmann, A. (2021) *Teachers' descriptions of classroom communication after an SLP-led in-service training.* [Manuscript under review].

Abbreviations and definitions

C_{50}	A measure for clarity of speech, which shows the ratio between early and late sound reflections that arrives with a listener during the first 50 milliseconds
CBI	Copenhagen Burnout Inventory
CPD	Continuing Professional Development
CSCOT	Communication Supporting Classrooms Observation Tool
dB HL	Decibel Hearing Level
dBA	A-weighted decibels, which is the relative loudness of sound as perceived by the human ear
dBC	C-weighted decibels, which captures low-frequency sounds, often found in ventilation noise, but not always perceived by the human ear
DLD	Developmental Language Disorder
ISO	International Organization for Standardization
kHz	kilo Hertz
OECD	Organization of Economic Cooperation and Development
PD	Professional Development
PSQ	Perceived Stress Questionnaire
QPS Nordic 34+	Questionnaire for psychological and social aspects at work
RT	Reverberation Time, the time it takes for the sound level to drop 60 dB after a continuous sound source has been shut off
SLP	Speech-language pathologist
SPL	Sound Pressure Level
TALIS	The Teaching and Learning International Survey
TSES	Teachers' Sense of Efficacy Scale
VHI-11 sum	The Voice Handicap Index with the 11 statements
VHI-11 VAS	The Visual Analogue Scale in VHI-11
VSN	Ventilation System Noise

Studies at a glance

	Study I	**Study II**	**Study III**
Aim	To investigate the relationship between teachers' well-being and classroom acoustics pre in-service training.	To implement an intervention on classroom communcation and explore the effects on teachers' vocal health, self-efficacy, stress and burnout. To explore the effects over time.	To describe teachers own view of their classroom communication 6 months after participating in in-service training targeting classroom communication.
Method	23 teachers' self-assessed anwers from questionnaires on well-being (voice symptoms, stress, burn-out and self-efficacy on classroom management) were compared with the the acoustical measures reverberation time, clarity of speech and ventilation system noise from their respective classrooms.	23 teachers' self-assessed answers from questionnaires on voice symptoms, stress, burn-out, self-efficacy on classroom management and psychological and social aspects at the work-place were compared pre/post-intervention and at follow-ups after 5-weeks and 3-months.	20 teachers were allocated to five focus groups six months post in-service training.
Results	No significant correlations between teachers' well-being and classroom acoustics after corrections for multiple tests. Trends were seen for a relationship between louder ventilation noise and more burnout as well as voice symptoms.	Significant decrease of voice symptoms at 3-month follow-up. Both stress and burnout decreased significantly at 5-weeks follow-up and self-efficacy increased significantly at 5-week follow-up. No significant changes in psychological and social aspects at the work-place.	Three overarcing themes: awareness of voice use, the use of body communication and setting the stage for learning showed that the teachers described an increased awareness and new strategies for the use of voice and body communication after the in-service training. They also reflected on the classroom environment.
Conclusion	Indications that higher degree of burnout in teachers is related to higher ventilation noise in the classroom. Voice symptoms increased with higher ventilation noise. Teachers working in lower grades reported more voice symtoms than those working in higher grades.	Teachers' self-reports on vocal health and self-efficacy increased, while their perception of stress and degree of burnout decreased after the in-service training. The effects are likely due to the in-service traning and not due to temproal effects of the school semester or organizational changes.	The teachers' increased their awareness and implemented new pratices in their classroom communication. They also reflected on prerequisities for classroom communication. In-service training on classroom communication can be recommended.

Preface

My interest in working with voice begun during my speech-language pathology education. What appealed to me was that you use yourself as a tool, make constant adjustments in the moment and the therapeutic part of the profession emerges clearly with voice patients. In 2006, I begun my clinical work and little did I know that I would return 10 years later with useful experience for the research project. I first worked with children with DLD both at the clinic and as a school SLP. With time, I started seeing voice patients and in 2008 I started working as an SLP at the teacher education at Umeå University. Thereafter my work was mainly within voice and split between clinical work and as a lecturer at the University.

In addition to lectures and training student teachers, with focus on voice use, I also taught at the Police Academy where the students got lectures and training on voice but also nonverbal communication. Working at the University awoke the idea of doing a PhD, but only if The right project came along catching my interest. It came close with a project on differences in voice use during work and leisure time, but the time was not right and instead I could be on leave part time and collect data in that research project. This further fuelled my interest for research.

Then in 2016, at the annual meeting for the network on voice ergonomics I first heard about the project. A research team, including both my former teacher in the voice course and supervisor for the master thesis, had received a grant for a project that was about communication in the classroom and included both teachers and students. It was planned as an intervention-based project including a doctoral student. I immediately felt that this was The right project even though it was located in Lund, meaning it was about 1200 km from where I was living with my family. The rest is soon history. It was possible to lead a weekly intervention 1200 km away and collect data from teachers working at seven different schools, because not only could I stay at my mom but also use her car for the many drives to get to the schools for the in-service training and data collection.

It has been a journey in many ways, not just the physical thousands of kilometres travelled. I've made new colleagues and friends, my family and I moved to Skåne for two years, I've presented the research at a number of conferences and met interesting (and interested) people. I've had the opportunity to use both quantitative and qualitative methods in my research. Although I've learnt a lot about the factors influencing teachers communication in the classroom, I have also gained an even deeper understanding of how complex it is. Intervention-based research means making plans build on knowledge from many studies and many hours of work, it also means adjusting to different circumstances. Hence, this thesis focuses on teachers' communication in the classroom and gives some answers to how teachers can be supported in their important everyday practice, educating the children, our future.

Introduction

Communication in the classroom is key in creating relationships and in learning (Hattie, 2009) and a classroom that is supportive of communication has high quality interactions as a core feature (Dockrell et al., 2015).

The act of classroom communication, i.e., how teachers speak and use other aspects of body communication in their interactions with the students, has not been given much attention, at least not in the area of research. In Sweden, classroom communication seems to be somewhat out of sight, since there seem to be no courses offered on communication skills during teacher education or in professional development as in-service training.

In Sweden, as in many other countries today, inclusion of all students is recommended. Teachers in their everyday work enter classrooms with children with a variety of abilities. Especially students with impairments in their cognitive, linguistic and listening capacities, likely benefit from clear classroom communication. However, what is beneficial for students with different impairments is also often beneficial for students without impairments. The school is the largest workplace in Sweden when taking both teachers and students into account (Arbetsmiljöverket, 2017). Hence, considering the vast number of both teachers and their students that are reliant on and affected by communication, this invisibility and scarcity of research is even more surprising.

There are many factors that influence how teachers use their voice and body communication in the classroom. Some of these factors are internal, e.g., teachers' vocal health and well-being and the teacher's knowledge and awareness about voice use and communication. Other factors are external and includes e.g., the response from the students and the acoustical characteristics in the classroom. See Figure 1 for a schematic illustration of the relationship between voice use and body communication and influencing factors, both internal and external and how they interact. Some of these factors have been investigated within this thesis.

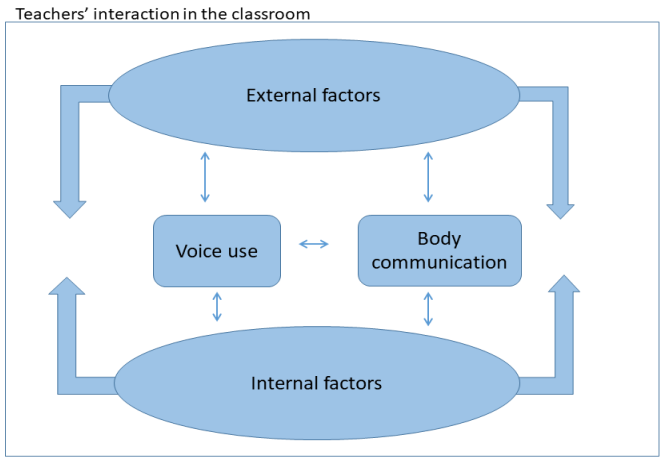


Figure 1. A schematic illustration of how external and internal factors affect and is affected by voise use and body communication.

In this thesis, an underlying assumption is that both teachers and their students will benefit if teachers' are supported in their communication skills, their most important working tool. Teachers are in focus and a central feature is an in-service training program on communication led by a speech language pathologist (SLP). The three studies comprising this thesis investigate: teachers' vocal health and well-being in relation to classroom acoustics (Study I), the effects of the in-service training on the teachers vocal health and well-being (Study II) and lastly the effects of the in-service training on classroom communication, as described by the teachers themselves (Study III).

The concept of communication

Communication occurs in the moment and is in constant change depending on the listeners' response. The momentary nature of communication may well be one of the reasons why it has not received the much needed and deserved attention in educational settings despite its central and significant role.

This thesis deals with face-to-face interpersonal communication. More specifically aspects of teachers' communication in the classroom. Verbal and nonverbal communication are in focus. In this thesis, *verbal communication* refers to spoken words. The voice is the signal that carries the words spoken by the speaker and the meaning of the words can either be reinforced or weakened by the nonverbal communication (Furu, 2017). *Nonverbal communication and body communication* are often used interchangeably. Body communication is the term used in the studies comprising this thesis and the following aspects are included: gestures, gaze,

mimics, and positions in the room. Furthermore, speech intelligibility, speech rate, vocal intensity and voice quality are included.

In social interaction, the speaker ideally notices if and how the meaning gets through, by reading the partners' verbal or nonverbal reactions. Depending on this feed-back (that can be verbal and/or nonverbal) from the listener, the speaker makes adjustments accordingly.

The importance of communication in the classroom

Classroom communication has been described as the interactions and communications taking place in the classroom to support learning and it differs from other types of interaction and communication in its purpose and in the differences in hierarchy between the participants (Farrell, 2018; Kogut & Silver, 2009; Yusof & Halim, 2014).

For this thesis, the definition of classroom communication is more specific: it focuses on how teachers speak and use aspects of body communication in their interactions with the students. This includes voice quality, vocal intensity, speech rate and speech intelligibility as well as the use of gaze, mimics, gestures, positions and movements in the classroom. The definition stems from our lab-based research on how aspects of communication affect listening in children. Several of our studies indicate that the speaker's speech has impact on the listening child, that for example speech rate and voice quality affect children's performance on language comprehension tasks and listening effort (Evitts et al., 2016; Haake et al., 2014; Lyberg Åhlander et al., 2015; Sahlén et al., 2018; von Lochow et al., 2018). However, the interaction between teacher and student is bidirectional, meaning that the students' response affects the teacher's communication.

The aim of classroom communication

The starting point of this thesis is that communication is the key to learning and that clear communication better supports learning. While much of the act of classroom communication relies on the teacher, high quality classroom communication is co-created by teachers and students. However, the teacher is responsible for the management of the classroom; therefore, this thesis focus is primarily on teachers' communicative skills.

Classroom communication differs from other interactions since the main focus is to inform and instruct (Farrell, 2018; Yusof & Halim, 2014). The school has a variety of intended learning outcomes, which the students are expected to reach. Teachers need to communicate to students what knowledge and competence they are expected

to achieve at school (Jensen, 2012). Communication taking place within classrooms is thus affected by the differences in hierarchy, meaning that the teacher often sets the topic, decides who talks and when, and provides feedback (Farrell, 2018; Kogut & Silver, 2009). Listening and speaking are prerequisites for reading and writing and the teacher is a role model regarding communication (Furu, 2017). Internationally, the importance of teachers' communication, both verbal and nonverbal, has been addressed in the research by e.g., Carter 2015, Dockrell and colleagues (2012), Hattie (2009) and Starling and colleagues (2012). However, there is a lack of research in a Swedish school context.

According to Hattie (2009) the two most important aspects in how teachers support students learning are 1) the quality of the teachers' practice, i.e., what they do and the effects these practices have on students, and 2) positive teacher-student relationships. O'Hair and Wright (1990) emphasized teacher communication skills as necessary for improving student learning. Such skills are used not only to organize learning activities, but also to create relationships in the classroom (Kogut & Silver, 2009).

The current curriculum in Sweden presents high demands on language understanding and use across all subjects in both oral and written form (Skolverket, 2018). This brings the teacher-student interaction into focus. In a classroom, supportive of communication, high quality language learning interactions are at the core (Dockrell et al., 2015). However, such language learning interactions occur less often than is desirable (Dockrell et al., 2015). Dockrell and colleagues (2012) performed a review of research on key features of evidence-based language and factors supporting communication and used this to develop a Communication Supporting Classrooms Observation Tool (CSCOT). Three main areas were identified and were included as dimensions in the CSCOT. "*Language Learning Environment* – the physical environment and learning context. *Language Learning Opportunities* – the structured opportunities to support children's language development. *Language Learning Interactions* – the ways in which adults in the setting talk with children." (Dockrell et al, 2012, p. 5). For this thesis, these areas inspired the design of the in-service training. The CSCOT was also used as a training-tool.

Nonverbal communication

Nonverbal communication is important for teachers, both in terms of reading their students' nonverbal signals in the classroom as well as being able to control their own nonverbal communication (Farrell, 2018). If the verbal and nonverbal signals are incongruent, then the message becomes difficult to understand and creates insecurity in the listener, who will tend to favor an interpretation of the nonverbal aspects of the message (Furu, 2017). By having knowledge of and gaining control over nonverbal communication to complement verbal communication and thus

become more congruent and reach greater clarity, teachers can provide an optimal learning environment for their students (Farrell, 2018). However, teachers presumably have a busy and active workday. Teachers have 20-30 students to deal with at the same time and at a pace that moves forward so fast that many teachers can feel overwhelmed with all they have to attend to. Hence, it is not difficult to understand that teachers have a tendency not to consider their nonverbal communication (Farrell, 2018). Further, teachers who proposed changes to their classroom practice, after making observations with the CSCOT, proposed least changes regarding language learning interactions (Law et al., 2019).

In the thesis by York (2013) the relationship between nonverbal communication and student learning was investigated. Two teachers gave a lecture with the same content, one used effective nonverbal communication (good eye contact, arm movement, facial expression, voice fluctuation and position in the classroom) while the other teacher purposely used poor nonverbal communication (poor use of the five aspects listed above). Data was gathered from the students by tests on the subject content, surveys and focus groups. It was found that teachers' use of effective nonverbal communication had a positive effect on students' perceptions of their learning and perceptions of the teacher's credibility, which York found to be consistent with earlier research. Nonverbal communication also had a positive effect on students' knowledge retention measured by changes in test scores between pre/posttest (York, 2013). This is an important contribution, since past research has not been in agreement on whether nonverbal communication had a positive effect on standardized measurements of learning or not (York, 2013). The following four steps mentioned below are based on a literature review and recommended by York (2013) in order to successfully acquire effective nonverbal communication skills.

Training needs to

1) be more than 3 hours, however further research is needed to conclude the length of the optimal training
2) focus on learning effective hand and arm gesturing (easiest to learn)
3) focus on learning effective facial expression fluctuation (most important to learn)
4) focus on learning effective vocal variation (most difficult to learn)

The work by York (2013) sheds important light on the relationship between teachers' nonverbal communication and elements related to student learning. However, one should keep in mind that the research was performed in the setting of higher education and examined teachers giving a lecture using either poor or effective nonverbal immediacy. Consequently, York's research findings cannot be generalized to primary-school which is the setting for this present thesis.

The role of voice in communication

The voice is an important part of communication and carries much information. The voice is the signal that carries the words that are spoken. Together with other, nonverbal aspects of communication, it can determine or underline the meaning of the spoken words. Usually vocal aspects and/or facial expressions have greater effect than the words on how a message is understood (Beebe et al., 2009).

There are different aspects of the voice that affect how the message is perceived. *Pitch* varies depending on the emotional state of the speaker. Listeners become more interested, convinced and attentive when pitch is varied and used to stress parts of the content (Burgoon et al., 1996). Also, the speaker adjusts pitch in relation to who the listener is. For example, the speaker commonly raises to a higher pitch when speaking to children, since children have a higher pitch than adults (Furu, 2017). The *intensity* of the voice or sound pressure level (SPL) varies depending on emotional state, the distance to the listeners and the sound environment where the communication takes place. If the speaker uses a high SPL she/he can be experienced as dominant or aggressive (Jensen, 2012). An experienced speaker uses a varied SPL to get the listeners engaged in what is being said (Beebe, et al., 2009). A raised SPL can be compensated with clear articulation which increases speech intelligibility, making it easier for the listener to perceive what is being said (Furu, 2017). A comfortable *speech rate*, meaning that it is not too fast nor too slow, also facilitates understanding (Jensen, 2012; Haake et al., 2014) as does *voice quality* (Lyberg Åhlander et al., 2015; Morton & Watson, 2001; Rogerson & Dodd, 2005).

The voice also gives information about the speaker her/himself. By just listening to a voice it is possible to determine the speakers' sex, approximate age, cultural or social background (Lindblad, 1992). Further, emotional and health state is often mirrored in speakers' voice use (Lindblad, 1992). The different voice aspects are often affected by the speaker's emotional state. For example, a person experiencing joy speaks with a higher, varied pitch, elevated SPL and somewhat faster speech rate (Lindblad, 1992).

Through voice use, a teacher can convey different aspects of teacher competence, one of them being communication competence (Furu, 2017). The ability to show dedication, presence, warmth, concern, respect or authority by the means of voice use can affect aspects of status, power, distance or closeness between a teacher and the students (Furu, 2017).

Teachers' voice use

One of the starting points of this thesis is that the voice is one of teachers' most important working tools. According to Furu (2017) teachers' voice use reflects both their vocational competence and identity. Teachers' competences are important in creating prerequisites for students' motivation and learning and, voice use plays a crucial role in these competences (Furu, 2017). The voice is a tool that is used throughout the working day and in an environment where it may be necessary to speak with a raised voice for periods of time due to noise and without suitable breaks. However, as long as the voice functions properly, many teachers are unaware of their voice use and the role of their voice in their occupation. In literature, teachers' voice problems are well known (e.g., Barbosa et al., 2021; Leao et al., 2015; Lyberg Åhlander, 2011; Roy et al., 2004; Smith et al., 1998). Voice problems are more common in women due to anatomical differences and women often work within sectors that require a great amount of speaking, such as health care, sales and education. The number of compulsory schoolteachers in Sweden is now higher than ever, with 104 000 working in compulsory schools and the percentage of female teacher is 75% (SCB, 2020).

Voice problems in teachers

Teachers with vocal symptoms reported that they had experienced vocal symptoms already during their teacher education program, however student teachers were more unaware of the potential risks of their future profession on their voice (Thomas et al., 2006). In a longitudinal study, it was found that out of those who did not experience voice problems from the beginning of their education, 14% had developed voice problems by the end of it (Ohlsson et al., 2016). Moreover, it is common that student teachers experience voice problems (16.7%) right from the beginning of their teacher education (Ohlsson et al., 2021).

Despite the vast number of studies on the prevalence of teachers' voice problems, it is difficult to draw any definite conclusions due to the variations in the definition of voice problems, the measurement methods and results (Lyberg Åhlander, 2011; Mattiske et al., 1998). However, Vilkman (2000) concluded that a majority of the teachers had experienced voice problems during their career, 10% had experienced severe problems and 5% had severe and recurring voice problems, which had led to questionable working ability. The review by Cantor-Cutiva et al. (2013) used voice disorder as an umbrella term for the terms used in the studies reviewed, which were voice symptoms, voice complaints, voice problems and voice disorders. The review found the point prevalence of voice disorders to vary from 9% to 37% and the prevalence for voice disorders during the preceeding 12 months ranged from 15% to 80%. Three studies had clinically verified the point

prevalence of voice disorders, which ranged from 17% to 57% (Cantor-Cutiva et al., 2013).

There are many studies showing that teachers suffer voice problems more often than representatives of other occupations, (e.g., Behlau et al., 2012; Fritzell, 1996; Martins et al., 2014; Roy et al., 2004; Smith et al., 1998; van Houtte et al., 2012). The largest epidemiological study to include a question for voice problems was performed in Stockholm, Sweden by Lyberg-Åhlander et al., (2018) on a cohort of 74 351 persons. The question included was "Does your voice tire, strain or get hoarse when you talk? Disregard symptoms that depend on current cold or upper-airway infection. The voice symptoms may vary but try to estimate an average". The prevalence of voice disorders in teaching staff varied between 19.3% and 21.9%. There are also indications that voice problems among teaching staff are on the increase. Simberg et al., (2005) reported an increase of voice problems in teachers between 1988 and 2001.

A study from Ireland including n = 304 teachers concluded that there are barriers in the workplace that hinder vocal health, since voice problems were related to overstretched work demands and large class sizes (Munier & Farrell, 2016). The authors conclude that in order to achieve working conditions that facilitate vocal health there is a need for change on the part of education and health policy makers. If teachers do not have an enduring, well-functioning voice then professional duties and interactions with students are seriously impaired (Rogerson & Dodd, 2004).

Teachers' reports on the effects of their voice problems

Teachers perceive that their voice problems affect their current job performance and their future career options (Alva et al., 2017; Smith et al., 1997). Among teachers who reported voice problems, it was common that voice limited their work and certain tasks were avoided and further, 25% of the teachers reported that their students had trouble hearing them (Lyberg Åhlander et al., 2011). Teachers with voice problems were, not surprisingly, more often absent from work than those without voice problems (35% vs 9%) (Lyberg Åhlander, et al., 2011). In a recent study, a majority of the teachers reported that they had been absent from work within the past year due to their voice and many had needed to change their teaching methods in varying degrees from a little to a great deal (Barbosa et al., 2021). Voice problems also pose a risk to decreased general well-being (Vanhoudt et al., 2008).

Teachers' well-being

Voice problems have shown consequences for teachers' well-being (Alva et al., 2017; Barbosa et al., 2021; Chen et al., 2010; Nusseck et al., 2020; Vanhoudt et al., 2008). Teachers reported that their voice problems adversely affected their ability to teach effectively and that their voice was a source of chronic stress or frustration (Sapir et al., 1993). In the study by Chen et al. (2010) teachers with voice problems experienced stress, anxiety and multiple diseases more often than teachers without voice problems. In addition, teachers with voice problems ran a significantly higher risk of experiencing reduction in communicative ability and in social activity, while their life quality detoriated (Chen et al., 2010). Similar findings were made in the study by Alva et al. (2017), in which teachers with self-reported voice problems were significantly more likely to reduce their overall communication and social activities, and more likely to have a lower quality of life compared to the teachers without voice problems (Alva et al., 2017).

Stress and burnout

In the educational setting, there are several factors capable of leading to chronic stress and thereby leading to burnout among teachers (García-Carmona et al., 2018). Some of these factors are increasing accountability, tightening budgets, larger and increasingly diverse classes in the US (Bottiani et al., 2019). In Sweden, the work environment has changed due to school reforms, new legislation and extensive privatization, which has led to a competitive and unpredictable situation (Arvidsson et al., 2016).

There is no universal definition of stress. Frankenhaeuser and Ödman (1987) wrote that stress emerges from the imbalance between the individual's resources and load contra the demands and needs of the environment. If nothing is done to remedy this imbalance, the individual ends in negative stress, which is harmful to health (Frankenhaeuser & Ödman, 1987).

The Organization of Economic Cooperation and Development (OECD) organizes The Teaching and Learning International Survey (TALIS), a recurring large-scale international survey. The most recent was conducted in 2018 and Sweden was one of the 48 participating countries. The Swedish National Agency for Education has compiled two sub-reports (Skolverket, 2019b; Skolverket, 2020) from the TALIS report by OECD. The second report shows that 45% of Swedish teachers experience stress. The results are in line with both a report from The Swedish National Agency for Education (Skolverket, 2019a) and with a survey from the teachers' union (Lärarförbundet, 2018). The stress levels for Swedish teachers are a couple of percentage points lower than for the whole OECD result, hence stress in teachers is common internationally as well (Skolverket, 2020).

The definition of burnout in this thesis is fatigue and exhaustion in relation to three spheres, namely personal-related, work-related and client-related where client is a broad term that can be exchanged in accordance with whom the person meets in their work, e.g., students, children or patients.

In a recent study 81.6% of Swedish compulsory school teachers reported good general health, but 47.9% experienced stress and high levels of exhaustion were also reported (Boström et al, 2019). In another study on Swedish teachers, 15% were classified as having a high degree of burnout in at least two out of three dimensions: exhaustion, cynicism, and professional efficacy (Arvidsson et al., 2016). In the review study by Brown (2012) all the studies had a negative relationship between self-efficacy and burnout. Brown's review hence, indicates that a good self-efficacy might prevent feelings of burnout.

Self-efficacy in teachers

Perceived self-efficacy was originally coined by Bandura in social cognitive theory and has been defined as "belief in one's capabilities to organize and execute the courses and actions required to produce given attainments" (Bandura, 1997, p.3). In other words, self-efficacy is a persons' belief in their ability to succeed with a task in a particular situation. Self-efficacy in teachers has gained an important role due to its implications for teaching effectiveness, instructional practices and students' academic achievement (Klassen & Tze, 2014). Teacher self-efficacy has been found to be related to both teacher burnout and job satisfaction (Skaalvik & Skaalvik, 2010). As stated in the section above, higher levels of self-efficacy are related to lower degree of burnout and also serve as a protective factor against job-related stress (Schwarzer & Hallum, 2008).

Studies have recommended that intervention programs should aim at increasing the sense of self-efficacy in classroom management to decrease and prevent burnout (Dicke, 2014; Schwarzer & Hallum, 2008). Teachers' self-efficacy was investigated in the first sub-report of TALIS 2018 and the four questions asked on self-efficacy in relation to classroom management are the same as are used in Study I and Study II, but an additional four questions on self-efficacy were used in studies I and II. Between 80 and 90% of the Swedish teachers considered that they succeed to a great or relatively great extent in controlling disruptive behavior, clarify expectations on student behavior, have the students follow the rules and calm students who are disruptive or are making noise (Skolverket, 2019b). Compared to the OECD average the Swedish teachers had a somewhat lower self-efficacy regarding self-efficacy in classroom management (Skolverket, 2019b), meaning that Swedish teachers had a slightly lower sense of managing the classroom.

Factors influencing teachers' voice use and communication

As previously mentioned there are several factors influencing teachers' voice use and communication. The influence of some of these factors has not been extensively investigated in earlier research, e.g., well-being, and hence well-being was described separately in the section above. Other factors have been extensively investigated before, e.g., the effects of noise on voice use while other factors have received little attention, e.g., the influence of students' response. The interplay of the speaker's voice and factors influencing voice use and communication is complicated, since some of these factors influence not only voice use and communication, but also some of the other factors.

Effects of noise on voice use and well-being

Teachers' exposure to noise does not only affect the voice in terms of more vocal symptoms and increased SPL, but increased SPL also correlated with more cognitive fatigue at the end of the workday (Kristiansen et al., 2014). There are other factors in the classroom that also affect the teachers' voice use. In a study by Ilomäki et al. (2009) apart from background noise, teachers reported unsatisfactory air quality and stressful work conditions as most harmful for their voices. Stress is a well-known contributor in many illnesses. Stress symptoms also have a significant association with vocal symptoms (Holmqvist et al., 2013). For teachers, stress was found to be the most significant explanatory variable for voice problems in the study by Vertanen-Greis et al. (2020) and the result is in line with earlier studies (Gassull et al., 2010; Kooijman et al., 2006).

The effects of acoustical characteristics in the classroom

Teachers report that they feel disturbed by noise and poor room acoustics (Lyberg Åhlander et al., 2011; Kristiansen et al., 2016). Many school buildings are old, and the room acoustics are in many cases not up to date with the pedagogical activities taking place in today's classrooms. Poor sound conditions likely contribute to an increased activity noise level in classrooms, combined with the use of active learning methods, where students are more active in discussions and in talking to their peers. The proportion of teachers who experience sound levels in the classroom as disturbing has increased since the year 2015 (Skolverket, 2019a). Noise obliges teachers to speak with an increased SPL for prolonged periods of time which leads to vocal fatigue and hoarseness (Lyberg Åhlander et al., 2011; Kob et al., 2008; Kristiansen et al., 2014; Sala et al., 2009; Sapir et al., 1993). The Lombard effect describes how the surrounding noise influences the speakers' voice (Lane & Tranel,

1971). An increase in noise levels causes the speaker to instinctively raise the SPL and changes are made to the spectral contents of the voice signal in order to enhance audibility (Lane & Tranel, 1971). The listener is affected, not only by noise, but also by the changes the noise induces on the speakers' voice.

The teacher and their students share the classroom as their mutual work environment, however they might have different preferences in terms of room acoustics depending on their main roles of speaker or listener. Studies have shown that longer reverberation time (RT) has a positive effect on vocal health (Rantala & Sala, 2015) and teachers with voice problems preferred classrooms with longer RT (Pelegrín-García & Brunskog, 2012). However, longer RTs can mask speech and are hence not preferable for pupils' perception of speech (Knecht et al., 2002). In face-to-face interactions, speaking and listening are entwined meaning that both the speaker and listener need to be considered in environments where communication is taking place, even more so when learning is the purpose of the interactions. The concept of "Speakers' Comfort" considers both speaker and listener and is defined as "the subjective impression that talkers have when they feel that their vocal message reaches the listener effectively with no or low vocal effort" (Brunskog, et al., 2011). Speakers' Comfort describes the teachers' auditory and sensory perception of their own voice and how it is reflected dependent on the room acoustics, and while it also considers how the teacher perceives the students' perception of the teachers' vocal message. This consideration of the students' response to the teachers' voice, and nonverbal communication is acknowledged in the section below.

Feedback from students

Verbal or nonverbal feedback from the listener is an important factor, yet it seems to be left out in at least parts of the literature. This important reciprocal interaction is however addressed by the teachers in the study by (Leite et al., 2020). The teachers put forward the need to analyze their students' verbal and nonverbal feedback and to use this feedback to adjust their own behavior. The teachers also recognized that it is important to be aware of their own verbal and body language in their interactions with the students. Moreover, how the students perceive the teacher can be influenced by the students' cultural background and perceptive ability. Based on teachers' reports, it seems that children with sensitive perception ability do not prefer louder voice or bigger gestures, which could potentially be perceived as overwhelming. More research in this area is warranted.

Factors influencing students

Teachers' voice quality affects students' understanding and attitudes. Children have shown poorer test performance in language comprehension when listening to a dysphonic voice (Lyberg Åhlander et al., 2015; Morton & Watson, 2001; Rogerson & Dodd, 2005). This suggests that children listening to a dysphonic voice need to allocate more resources to processing the voice signal at the expense of comprehension (Lyberg Åhlander et al., 2015; Morton & Watson, 2001; Rogerson & Dodd, 2005). In addition, attitudes toward the teacher were affected by the dysphonic voice and children perceived the dysphonic voice as unpleasant and felt they had to work harder at listening (Brännström et al., 2015; Morton & Watson, 2001). Other studies have shown that perceived listening effort increases when listening to a dysphonic voice even if test performance is not affected (Brännström et al., 2020; Evitts et al., 2016; Sahlén et al., 2018; von Lochow et al., 2018).

Results from lab-based research show that children's performance in language comprehension tasks benefits from listening to slower rather than faster speech rate (Haake et al., 2014) and from listening to a typical voice rather than a dysphonic voice (Lyberg-Åhlander et al., 2015).

In-service training of teachers

Even though teachers' communication skills are of utmost importance in building relationships with the students and in supporting their learning, very little support seems to be offered to teachers in developing and mastering their communication skills. To the best of my knowledge, such training seems to be lacking at least in Sweden.

Voice use plays an important role in communication and is undeniably an important working tool. The study by Munier and Farrell (2016) states that there is no module for voice training for teachers nor student teachers in Ireland and highlight the need for a voice care program to prevent voice problems. The need for voice training during teacher education has been highlighted in many studies (e.g., (Chen et al., 2010; Kooijman et al., 2006; Lyberg Åhlander et al., 2015; Morton & Watson, 2001; Nusseck et al., 2020; Ohlsson et al., 2021; Rogerson & Dodd, 2005). In the Nordic setting, there is variability regarding how voice training is offered. There is a lack of systematic training of the teacher voice in Danish, Norwegian and Swedish teacher education. However, that is not the case in Finnish teacher education (Schøien & Østern, 2019). It has been known for quite some years that training of the teacher voice has an effect whether it is advice on vocal hygiene (Chan, 1994), knowledge of the voice and voice training (e.g., Nusseck et al., 2021; Sapir et al.,

1993). Despite 1) the importance of the teacher voice, 2) the well-known fact that teachers suffer voice problems more often than other professionals and 3) research showing that voice training does have an effect, still little voice training is offered either to student teachers or to teachers. This is a mystery for many in the voice field. The first TALIS 2018 report states that competence development for teachers is insufficient (Skolverket, 2019b). Teachers reported that the reasons why they were unable to attend in-service training were due to scheduling conflicts or the high cost of in-service training. The three areas in which most teachers expressed a need for competence development were 1) using information- and communication technology (ICT) as a tool in teaching, 2) teaching students with special needs and 3) teaching in a multicultural or multilingual environment. Considering the second and third of these areas it is not unreasonable to assume that training in evidence-based techniques for verbal and nonverbal classroom communication could be of help to fill those needs.

There are certain structures of in-service training for teachers, so called continuing professional development (CPD), that have been found to facilitate change, namely if the training program is developed and initiated by an external party, if the instructor takes responsibility for the design and teaching of the training sessions (Wade, 1985) and if collaborative learning is applied (Girardet, 2018). As for instructional methods the following have been found to be effective: classroom observation, video feedback and practice (Wade, 1985). Moreover, to facilitate change it has been found effective to reflect on one's own practice by analyzing videos of one's class or having group discussions (Girardet, 2018). Further, Dunst et al. (2015) conducted a meta-synthesis of 15 research reviews, which comprised 550 studies aiming to identify common, and core features associated with changes and improvements in educator and student outcomes. The 15 reviews included were on studies aiming to improve or change teacher content knowledge and practice and student/child knowledge and behavior. The results of the meta-synthesis showed that in-service PD was most effective when it included: "Trainer introduction, demonstration, explanation of the benefits of mastering content knowledge or practice, active and authentic teacher learning experiences, opportunities for teachers to reflect on their learning experiences, coach or mentor support and feedback during in-service training, extended follow-up support to reinforce in-service learning, and in-service training and follow-up support of sufficient duration and intensity to have discernible teacher and student effects". The reviews included, applied, explicitly or implicitly, to a framework for designing and researching in-service PD. The framework is shown in Figure 2 and is an adaptation of figure 1 in Dunst et al. (2015).

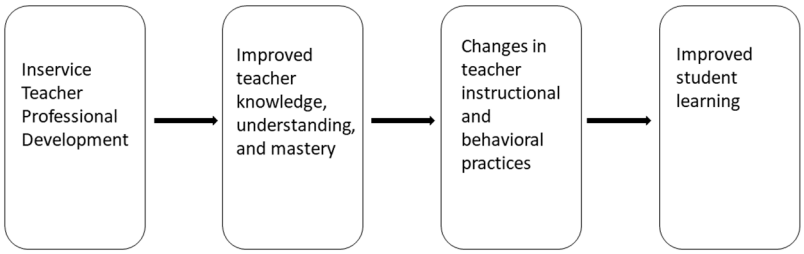


Figure 2. Adaptation of the framework in Dunst et al (2015) for associating in-service PD with improved teacher knowledge, leading to changes in teacher instructional and behavioral practices, in turn resulting in improved student learning.

The framework in Figure 2 shows that in-service PD comprising core features and key characteristics is thought to improve teacher knowledge, skills and teaching practices and ensuing improved student outcomes. This framework is close to reflecting the beliefs of the author of this thesis, but with the addition of students' impact on the teacher, see Figure 3.

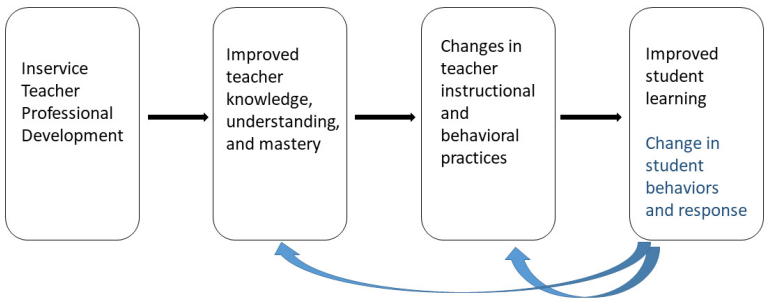


Figure 3. Adaptation of the framework in Dunst et al. (2015) for associating in-service PD with improved teacher knowledge, leading to changes in teacher instructional and behavioral practices, in turn resulting in improved student learning, but here with additions. The addition of the students' impact on the teacher is shown in blue arrows in the figure and in blue text is the addition of the plausible aspect that changes in teacher practices, also lead to change in student behaviors and response.

However, the meta-synthesis by Dunst et al. (2015) could not determine the relationships between a) changes in teachers' knowledge, practices or attitudes and beliefs and b) students changed or improved academic performance, because either the primary studies did not investigate this or the reviews did not determine the relationship between teacher and student outcomes. According to Hattie (2009) a difficulty with reviews of PD is that the outcomes more often are about changes in teachers, and not about what impact PD poses on students' outcomes.

In this thesis, an intervention program on classroom communication was delivered as an in-service training program for teachers and is considered as CPD. The term

in-service training will be used for the training program and *intervention* refers to both training program and data collection. Many of the abovementioned factors regarding effective in-service training were present. First of all, the in-service training program was developed and initiated by an external party (our research team), the instructor (the author) took responsibility for the design and training sessions and collaborative learning was used. The content of the in-service training program and instructional methods used will be described in the Methods section.

Impact of the in-service training on the teachers was assessed. The planned assessments of the students' academic performance could unfortunately not be used, due to difficulties in retrieving the assessments from the schools. A questionnaire evaluating students' experiences of their physical classroom environment, activities and interactions with their teacher was developed for the project and filled out by the participating teachers' students. However, this questionnaire and the results are not included in the papers that form this thesis.

Summary of the introduction

How teachers communicate in the classroom, i.e., how teachers speak and use other aspects of body communication in interaction with students, is important in supporting students learning and in building trust and relationships. Despite this, evidence-based strategies for high quality interaction seems to be applied less often than is desirable. Furthermore, classroom communication is a complex phenomenon with many factors influencing the teachers' voice use and body communication. The factors are both internal (vocal health and well-being) and external (acoustical characteristics of the classroom). There is a gap in research into the influence of some of these factors, e.g., of how well-being affects teachers' communication specifically. In contrast, extensive research has been conducted regarding teacher voice and it has been concluded that teachers present with more voice problems than representatives of other occupations do. Also, teachers' voice problems have been established as a factor that affects teachers' capacity to work. Voice problems have also been shown to affect teachers overall communication. The effects of classroom acoustics and background noise have been studied and research shows that both might negatively affect teachers' voice use and well-being. Despite the importance teachers' communication skills have for the students', little support seems to be offered to teachers in developing and mastering their communication skills. The purpose of this thesis was therefore to explore the effects of an in-service training program aiming to train teachers' communication, theoretically and in practice.

Aims

The overarching aim in this thesis was to investigate internal (vocal health and well-being) and external (acoustical characteristics in the classroom) factors influencing teachers' communication in the classroom and to investigate the effects of in-service training in teachers' classroom communication.

Specific aims for the studies in this thesis

Study I

To investigate the relationship between the teachers' perceived well-being and acoustic characteristics in their classrooms.

Study II

To investigate the effects of in-service training in classroom communication on the teachers' vocal health and well-being directly after training and at follow-ups five weeks and three months after training.

Study III

To describe how the teachers experience and understand classroom communication, six months after they participated in the in-service training in classroom communication.

Methods and material

The central feature in this thesis is a teacher in-service program aiming at improving classroom communication. The first study is before in-service training and investigates the relationship between teachers' well-being and the acoustic characteristics of their classrooms. The second study gives a brief description of the intervention and investigates the teachers' vocal health, stress, burnout, self-efficacy and psychosocial work environment pre/post intervention and at follow-ups at 5-weeks and 3-months post intervention. Finally, the third study reports on how teachers in focus groups describe their communication in the classroom 6 months post intervention. This present section starts with an overview of the methods and assessments in the three studies. Then the participants and the schools are described. Thereafter the in-service training is more fully presented. Then follows a presentation of the different assessments and measures in the studies, data analysis and ethical considerations.

Overview of methods and assessments used in the different studies

Table 1. Overview of the participants, design, data collection, methods and analyses throughout the three papers in the thesis. Note that VHI-11 is one questionnaire but presented with both subscales used. CBI is also one questionnaire, but is also presented in the table with the sub-scales used in the studies. For the abbreviations in the table, see the Abbreviations section at the beginning of the thesis.

	Study I	**Study II**	**Study III**
Participants	23	23	20
Design	Explorative Design	Longitudinal Design	Descriptive Design
Data collection	Pre-intervention	Pre-intervention, post-intervention, follow-ups at 5 weeks and 3-monts post intervention	6-months post intervention
Hearing screening	x	x	
Acoustical measurements from 23 classrooms	x		
C_{50}	x		
RT 125 Hz + 250-4000 Hz	x		
VSN dBA + dBC	x		
Questionnaires	x	x	
VHI-11 sum	x	x	
VHI-11 VAS	x	x	
PSQ	x	x	
CBI total score	x	x	
CBI subscale personal related		x	
CBI subscale work related		x	
CBI subscale student related		x	
TSES	x	x	
QPS Nordic 34+		x	
Focus groups			x
Analyses	Descriptive statistics, Mann-Whitney U-test, bivariate correlations, Benjamini and Hochberg's false discovery rate, partial correlations	Descriptive statistics, t-test, linear-mixed effects regression with maximal random effects for short term training effects and long term traning effects	Descriptive statistics. Thematic analyses

Participants

Collaboration with the research team was initiated from the school authority in a municipality in Southern Sweden, which had had an ongoing refurbishment of lighting and acoustics. The collaboration had two purposes, of which one is treated in this thesis, namely to study whether in-service training in classroom communication affected teachers vocal health, well-being and self-efficacy. The

school management assisted in choosing the schools to enable an even distribution of teachers working in acoustically refurbished and non-refurbished classrooms. The headmasters at seven schools approved their schools participation in the project and were then contacted by the author. The headmasters thereafter informed the teachers working in grades 3-5 and then passed on the names of thirty-two teachers who were willing to participate. Grades 3-5 were chosen to ensure that their students (aged 9-11) were able to comprehend a student-questionnaire (not reported in the thesis). The teachers were given oral and written information by the author. Four teachers declined to participate after receiving information. The reason given was sick leave amongst colleagues, which added to their work load. Three teachers were not included since they were working in grade 2. Two teachers were working in grade 6, but were included, since their students would be able to comprehend the student-questionnaire. In the end, 25 teachers (23 F/2M) participated in the in-service training.

Table 2. Distribution of the 25 participating teachers' as per teaching grade, teaching experience, number of certified teachers (teachers that completed their education) and age.

	Teachers teaching in grade 3	Teachers teaching in grade 4	Teachers teaching in grade 5	Teachers teaching in grade 6
N	11	10	2	2
Years of teaching				
0-5	2	2		
6-19	5	5	2	2
>20	4	3		
Certified	10	9	2	2
Age, mean (range)	43.5 (34-63)	44.6 (27-57)	44.0 (41-47)	41.5 (36-47)

Participants in the studies

Two teachers were excluded from the data analysis, due to too much missing data yielding 23 participants in both Study I and II. The 23 teachers (21F/2M) had a mean age of 44 (27-63) years and their mean teaching experience was 14.5 (0-31) years. Five teachers were unable to participate in the focus groups, yielding 20 teachers participating in Study III. The 20 teachers (18F/2M) had a mean age of 42 (27-63) years and their mean teaching experience was 13 (1-26 years) years. Hence, the teacher demographics were similar between Studies I-II and Study III.

Description of the participating schools

The teachers worked at seven different public mainstream schools, which were situated in a city or in small towns. There was a variation between the schools regarding the proportion of students with a foreign background (defined as born in a country other than Sweden or with two parents born in a country other than

Sweden) varying from 12% to 92%, as compared to the national average of 24% (Skolverket). The proportion of parents with tertiary education varied between 22% and 69%, and the national average was 55%. The class sizes varied from 17 to 37 students with a median of 22 students. At the point of data collection, school year 2016/2017, the median class size in Sweden for grades 3-6 was 20 students (Skolverket).

The on-going refurbishment of the schools meant that 10 out of 23 classrooms were acoustically refurbished. The acoustical refurbishment usually meant that additional acoustic panels had been put in the ceiling and on the rear wall. However, individual adjustments for the classrooms were made depending on the design of the classroom, e.g., location of windows.

The in-service training

The in-service training was administered and led by the author in group sessions to four groups with 4-8 participants during fall 2016 and spring 2017. The sessions consisted of five modules and took place at two of the schools after class. They lasted 90 minutes and were given for five consecutive weeks. The in-service training aimed at strengthening teachers' knowledge and practical skills in classroom communication. The in-service training was based on evidence-based techniques for language learning interactions and voice training aimed to support classroom communication.

The point of departure for forming the in-service training was the lab-based research from the research group showing the importance of the speakers' speech rate and voice quality on children's understanding (Haake et al., 2014; Lyberg-Åhlander et al, 2015; Brännström et al., 2015). The content of the in-service training was based on a) the previous studies mentioned above, b) The Communication Supporting Classrooms Observation Tool (CSCOT) which contains evidence-based techniques for interactions (Dockrell et al., 2012) and c) proven experience from clinical work and teaching. The main content of the five modules was drawn up in the research group and based on literature, and earlier research mentioned above. Two focus groups were held prior to the intervention with teachers from the participating municipality. The focus groups discussed what strategies the teachers had and what they wished they knew about the classroom environment, communication, voice and language stimulation. This input was the point of departure for the final design of the modules made by the author. Apart from the five modules the in-service training also included an introduction to and presentation of the main content of the training program. It was made clear that the training to a large extent was to be driven by the participants' needs and wishes. Following this the introduction dealt with expectations of the training and the participants' prior knowledge of the content.

Throughout the in-service training different measures were taken to keep the training close to practice, such as using video recordings and peer observations from real classroom situations. A collaborative learning approach was used under guidance of the author. Collaborative reflections on the teachers' experiences were used to support learning how to develop one's own communicative strategies and language interactions used in the classroom. The teachers were also asked to make personal reflections which alternated between stating them in the group or writing them down for themselves. To enhance transfer to everyday practice, the participants were urged to include in their reflections what aspects/practice/tools they took with them from the group sessions and how to make use of these in their everyday teaching. When two sessions remained the teachers were asked to write down and hand to the instructor "What have I learned so far?" and "What do I need?". This was done in order to meet the teachers' expressed needs.

The content of the in-service training

Using healthy voice technique

This module sought to optimize the teachers' voice use. It started with reflection on whether the participants had any voice problems and what they wanted to learn. A mini-lecture was given on voice function and advice on vocal hygiene and was then mixed with practical exercises for optimal voice use, including abdominal breathing, posture and voice exercises. This module continued through most of the sessions, to enable a gradual prolongation of the exercises, continued reflection on voice use, posture, breathing, relaxation and voice. Voice exercises up to the length of sentences were conducted in the group sessions. Voice use was integrated in the practical exercises with body communication. The purpose of the voice exercises as well as of the practical exercises was to increase the teachers' knowledge and skills in interacting with the students; the teachers practiced in interaction with each other and with the author.

Voice ergonomics

The aim of this module was to increase the teachers' knowledge on how voice use is affected by the environment in which the communication takes place and by different demands on the voice, in relation to the students' needs, as well as the possibility of voice rest. A mini-lecture was held on the topic of voice ergonomics. Different postures were demonstrated, both those beneficial for speaking in the classroom as well as postures that might lead to tense muscles and strained voice. Reflections were made upon different aspects of the teachers' work environment such as noise and air quality. Discussions were held on the importance of acknowledging risk factors in the environment and different means to avoid straining the voice. The voice ergonomic assessment protocol developed by Sala

and colleagues (Sala et al., 2012) was presented and handed out to the teachers so that they might identify potential risk factors in their own work environment.

Room acoustics

This module sought to increase knowledge about both the effects of sound environments and also how to affect the sound environment. An acoustician, specialized in educational facilities, gave a presentation about those acoustical measures which are important in the perception of the sound environment and about how sound is perceived by humans. The presentation emphasized acoustic conditions preferable to enhance speech intelligibility and sound environment in schools. It also included practical advice for the classroom environment, e.g., that the acoustic panels can be used to hold posters and that open shelves are preferable from an acoustic viewpoint to bookcases. This was followed up by the author in another group session with reflections on the sound environment in the teachers' classrooms. Further, the teachers were advised on how they themselves with the help of an app, developed by the Swedish Work Environment Authority to measure noise, can make an estimate of the noise level. Discussions were held on whom to contact if they considered the sound environment to be poor.

Strategies supporting language

The aim was to expand knowledge and increase the number of evidence-based strategies for high quality interaction in the classroom. The CSCOT developed by Dockrell et al. (2012) and translated into Swedish by Waldmann et al. (2015) (Waldmann et al.) was used twice during the intervention to raise the teachers' awareness of activities which support oral language development and of the extent to which teacher-student interactions take place in their classroom. Each teacher was observed by a colleague and made an observation of a colleague between sessions one and two, and then again between sessions four and five. The latter observation included only one of the three dimensions, namely the dimension with language learning interactions. After both observations, the teachers were to discuss the outcome of the observation and after the second observation they were encouraged to reflect on any differences between the two observations. A mini-lecture was held on supporting students with weak language abilities. The teachers shared their good practices with each other, in how they work to support language learning interactions in their classrooms.

Body communication

The aim of this module was to enhance speech clarity and to amplify body communication. A mini-lecture was given on different factors supporting speech clarity, such as speech rate, pausing, stress, intonation and vocal intensity, the lecture alternating with modelling these factors. The impact of body communication, including gestures, gaze and mimics, when delivering a message

was addressed and then implemented through different practical exercises. Video recordings of real classroom situations were encouraged, but not compulsory. If a teacher had not been recorded in class, they were recorded during the training session. Then the recordings were watched within the groups, and the teacher recorded received feedback both from colleagues and the SLP on voice use and body communication.

Assessments and measures

Hearing screening

Before the in-service training, all teachers underwent pure tone hearing screening according to ISO 8253-1 at 20 dB HL for frequencies 0.25, 0.5, 1, 2, 4, 6 and 8 kHz. The equipment used was a GSI 16 (Grason Stadler, Eden Prairie, MN, USA) with SA 201 m Sennheiser earphones (Sennheiser, Wedemark, Germany). Three teachers did not pass and were recommended to seek audiological expertise. The slight hearing impairment of the three teachers was judged to be minor and was not expected to have a negative effect on the outcome of the in-service training.

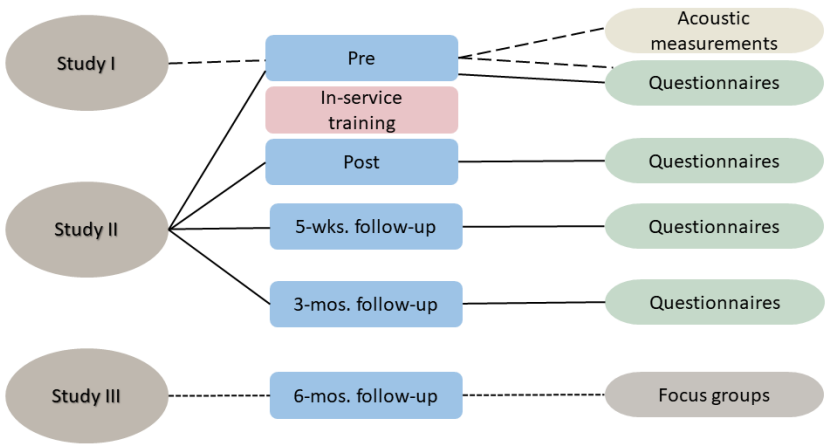


Figure 4. An overview of the three studies and when data was collected in relation to the in-service training.

Acoustical measurements

Acoustical measurements were made for all classrooms by an acoustician specialized in educational settings. The classrooms were measured for RT (T_{20}), clarity (C_{50}) and ventilation system noise (VSN). All measurements were made in unoccupied classrooms, which is according to the standards. RT (T_{20}) was measured

in accordance with ISO 3382-2 and analyzed in octave bands 125 Hz and 250-4000 Hz. C_{50} was measured according to ISO 3382-1. The equipment used were ElectroVoice 120 + Dodekaeder loudspeakers, a Room Capture system with a Roland UA-55 Quad-Capture sound card, a Crown XLS 1500 amplifier and a BSWA MP281 microphone connected to a Gras amplifier. Two different loudspeaker positions were used, one to the left and one to the right, with the centre of the loudspeaker measured 1.5 meter above the floor and the six recording microphones were positioned in the two last rows of the classrooms with a distance > 5 meters from the loudspeakers. Twelve measurements were made in each classroom. The measurements of VSN were performed in accordance with ISO 10052, meaning that equivalent sound levels are given in both dBA ($L_{A, eq}$) and dBC ($L_{C, eq}$) filters and recorded for 30 seconds using a Brüel and Kjaer 2250 sound level meter. The reason both dBA and dBC filters are used is that the former resembles the sensitivity of human hearing and the latter allows for low frequencies, which are common in VSN. The low frequencies, although not always audible to the human ear, are known to affect humans (Persson Waye et al., 1997).

Questionnaires

Questionnaires were chosen to be able to make repeated measures of the wide spread of factors regarding teachers' vocal health, well-being and aspects of the workplace. The selection of the current questionnaires was also based on the research questions of the project, official statistics and previous research reporting on the risk of voice problems, stress and burnout in teachers (e.g., Arbetsmiljöverket, 2014; Arvidsson et al., 2016; Fritzell, 1996; Kooijman et al., 2006; Lyberg Åhlander, 2011). There is a well-known relationship between burnout and self-efficacy in teachers (e.g., Brown, 2012; Skaalvik & Skaalvik, 2010) and hence a questionnaire on self-efficacy was included. The questionnaires needed to be in Swedish and there are not many questionnaires in Swedish on self-efficacy. Teachers' Sense of Efficacy Scale: Classroom Management Subscale (TSES) was found and it had been translated into Swedish and additionally, had already been used together with questionnaires for stress and burnout (Wedholm & Wideklint, 2015). All the questionnaires are translated from English to Swedish and have previously been validated in their original language. The Voice Handicap Index (VHI-11) and QPS Nordic + are also validated in Swedish. The questionnaires were filled out using paper and pen. Scorings and calculations were made in accordance with the test manuals. Table 3 shows the questionnaires used in both Study I and II from the measure point pre-intervention and the values from the validation studies of the questionnaires are presented.

Table 3. Overview of the questionnaires that were used in both Study I and Study II with respective range, direction of scores, number of responding participants (n), mean (M) and standard deviation (SD). Reference values from previous validation studies are shown with mean (M) and standard devation (SD). Some of the validation studies are based on clinical populations.

Measure	Range and Direction of scores	n	M, (SD)	M, SD *validation studies*
VHI-11-sum	0-44 Lower = Better	23	1.17, (1.72)	Patients: 12.96, (9.70) Controls: 2.11, (2.52) *Nyman & Åradsson, 2008.*
VHI11–VAS	0–10 *Lower* = better	21	1.04, (1.30)	Patients: 4.38, (3.12) Controls: 1.43, (1.98) *Lyberg-Åhlander, et al., 2011.*
PSQ index	0–1 *Lower* = better	23	0.28, (0.13)	Low stress: ≤ 0.34 Moderate stress: > 0.34 – ≤0.46 High stress: > 0.46 *Bergdahl & Bergdahl, 2002.*
CBI total score	0–100 *Lower* = better	22	28.11, (12.60)	33.3, (17.3) High degree of burnout > 50 *Borritz & Kristensen, 2004*
TSES: subscale classroom management	1–9 *Higher* = better	23	7.76, (0.70)	Range of mean from five different countries: M = 6.59 – 7.65 *Klassen et al., 2009.*

The Voice Handicap Index (VHI-11)

VHI-short version (Rosen et al., 2004), Swedish version (Nyman, 2008) was used for investigating vocal health. VHI-11 has 11 statements on self-perceived voice symptoms that are estimated on a five-point, frequency-based scale (0 = never - 4 = always). A higher score indicates a higher degree of subjective voice problems. The questionnaire has a 12th item, a 100-mm visual analogue scale (VAS), to rate perception of the current voice status, with 0 = no voice disorders 100 = maximum voice disorders.

Perceived Stress Questionnaire (PSQ)

PSQ (Levenstein et al., 1993), Swedish version (Wedholm & Wideklint, 2015) covers 30 statements to assess cognitive perceptions of stress rather than capturing stressful life events or emotional states. Statements are answered on a 4-point frequency-based scale from 1 (almost never) to 4 (almost always). The total sum for all statement is used to calculate a PSQ-index ranging from 0 (no stress) to 1 (maximum stress). The scale is general or time limited (previous month) and the time limited scale was used in this study.

Copenhagen Burnout Inventory (CBI)

CBI (Kristensen et al., 2005), Swedish version (Arneson, 2006) consist of 19 items assessing burnout defined as fatigue and exhaustion in relation to specific domains. The form is divided into three subscales addressing personal (6 items), work related (7 items) and client related (6 items) fatigue (the word client was exchanged for student in the 6 items, in accordance with the recommendation of Kristensen et al. (2005) to use the appropriate term). Responses are given on a 5-point scale and depending on the item the response is either to what extent one agrees from 1 (to a very high degree) to 5 (a very low degree) or frequency-based from 1 (always) to 5 (never/almost never). The answers are scored as 1 = 100, 2 = 75, 3 = 50, 4 = 25, 5 = 0. Mean score ranges between 0 and 100 and is calculated both for all the items together and for the three subscales separately, a higher score indicating a higher degree of burnout. In Study I total score was reported, however in Study II both total score and scores for the three subscales separately were reported.

Teachers' Sense of Efficacy Scale: Long form: Subscale Classroom Management (TSES)

TSES (Tschannen-Moran & Hoy, 2001), Swedish version (Wedholm & Wideklint, 2015) covers 8 items intended to target teachers' sense of their ability to manage the classroom and create pedagogical prerequisites despite distracting events. Responses are given on a 9-point scale from 1 (nothing) to 9 (a great deal). A mean for all items is calculated and a higher score indicates a greater sense of ability in managing the classroom.

QPS Nordic 34 + (QPS)

QPS (Dallner, 2000) is composed of 37 items targeting self-assessment of psychological and social aspects of the workplace. Each item has five response options and depending on the item the response is either on an intensity/amount scale from 1 (very little or not at all) to 5 (very much) or a frequency scale 1 (very seldom or never) to 5 (very often or always). A mean score is calculated for the 37 items and a lower score indicates a more favorable perception of the psychological, social and organizational aspects of the workplace.

Focus groups

To be able to investigate how the teachers themselves described their classroom communication, a qualitative method with focus groups was chosen. The focus groups were held 6 months post in-service training. A focus group approach was chosen since it enables individual answers, but still enables an expansion or

modification after hearing the perspectives of others in the focus group (Bryman, 2018). It also better allows the participants to raise what is important to them, since some of the control is handed over from the focus group leader to the participants (Bryman, 2018). According to Halkier (2010) focus groups can be chosen with the intention to derive more complex data, rather than studying the group interactions and this was another reason for choosing focus groups. The interviews focused on whether the teachers experienced that they had made any changes in their teaching practices related to the in-service training. Five focus groups were held six months post in-service training and they lasted between 17 to 33 minutes and were audio recorded with a digital Zoom Handy Recorder H2 (Zoom Corporation, Tokyo, Japan).

Data analysis

All data from the questionnaires were first entered into Excel and ten percent of the data entries were checked by another project member with 100% agreement. The descriptive statistics on the participants' age (mean and range), teaching experience (mean and range), what grades they taught and the median number of students per class were done in Excel. The descriptive statistics on the acoustical measures with mean and range for RT 125 Hz, RT 250-4000 Hz, C_{50} and VSN dBA and dBC were also extracted from Excel.

For studies I and II frequency histograms were used to visually inspect if the data was approximately normally distributed. The alpha level for all statistical analyses was set to $p \leq 0.05$.

Study I

All statistical analyses in the first study were made using IBM SPSS Statistics for Windows, version 25. Non-parametric statistics were used since the majority of the questionnaires were measured on ordinal scale, the data on VHI-11 was skewed and the sample size was small. Mann-Whitney U-test was used to determine if the refurbished and non-refurbished classrooms posed any differences on teachers' well-being and classroom acoustics. Bivariate correlations with Spearman's rho were computed to determine the relationship between teachers' well-being and classroom acoustics. The possible relationship between teachers' demographics and well-being was analyzed with bivariate analysis. Thereafter partial correlations were computed for the relationship between teachers' well-being and classroom acoustics with corrections for teacher demographics. Multiple tests for correlations come with a risk of finding falsely positive significant relationships, therefor Benjamini-Hochbergs false discovery rate was applied to calculate a corrected alpha level in

the analysis where significant correlations were found (Benjamini & Hochberg, 1995).

Study II

All statistical analyses were performed using the statistical software R. Linear mixed-effects regression was chosen to assess changes in the teachers' well-being over time, since this method has superior power and retains more data while still handling within-subject variance, compared to a regular ANOVA. Maximal random effects were as far as possible retained in all models, in accordance with the recommendations from Barr and colleagues (2013). Teachers' reported vocal health well-being was assessed pre and post intervention and with follow-ups at 5-weeks and 3-months. The data on VHI-11 was skewed and to mitigate some of the scewness, all analyses were performed on the logarithms of VHI-11. Firstly, a comparison was made over the first two measure points, meaning that for the early training group this coincided with pre/post intervention, but for the late training group this coincided with 5-weeks pre-intervention and pre-intervention measure points, see Figure 5 for the different measure points for the training groups. Thereafter the early and late training groups were combined and linear mixed-effects regressions over all measure points were conducted.

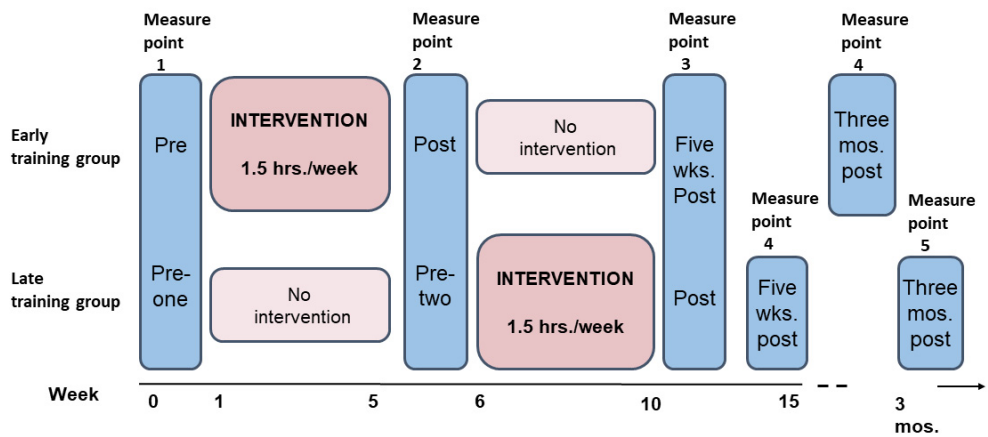


Figure 5. Overview of the measurepoints by traning group and in relation to the intervention.

Study III

Thematic analyses were used to analyze the focus groups as it is a method to identify, analyze and reports patterns, also known as themes, from data (Braun & Clarke, 2006). The thematic analysis was done according to the model described by Braun and Clarke (2006) and the recommendations by Castleberry and Nolen (2018) for conducting a thorough thematic analysis were regarded. An inductive approach allows the identification of themes based on the data and was used as this study focuses on the teachers' experiences.

The focus groups were transcribed verbatim and the software program NVivo® (QSR International Pty Ltd. NVivo, Version 12 Plus, 2018) was used for coding the data. Two focus group recordings were first transcribed and read through and thereafter the coding process started. The codes were formed from verbatim phrases from the teachers. There were preliminary, but flexible, themes after the two first focus groups had been coded. When a new theme was identified, the previous transcripts were read through again to ensure that the theme was not present, otherwise re-coding was done when needed.

Ethical considerations

The project was approved by the Regional Ethical Review Board in Lund (Dnr 2016/567). Each participant was informed orally and in writing. When receiving the oral information the participants also had the opportunity to ask questions. They were also informed about their right to decline to participate or to withdraw from participation at any point without stating any reason and that it would not bring any negative consequences for their employment or in any other way. Further, they were informed that the SLP leading the group sessions was bound by professional secrecy and that nothing of what was said would be passed on. Informed, written consent was obtained from each participant.

At the first group session, it was emphasized that what was said and discussed during the group sessions would stay within the group and that this applied to everyone in the group.

Results

The main results are presented in this section. Detailed results are found in the respective papers.

Study I

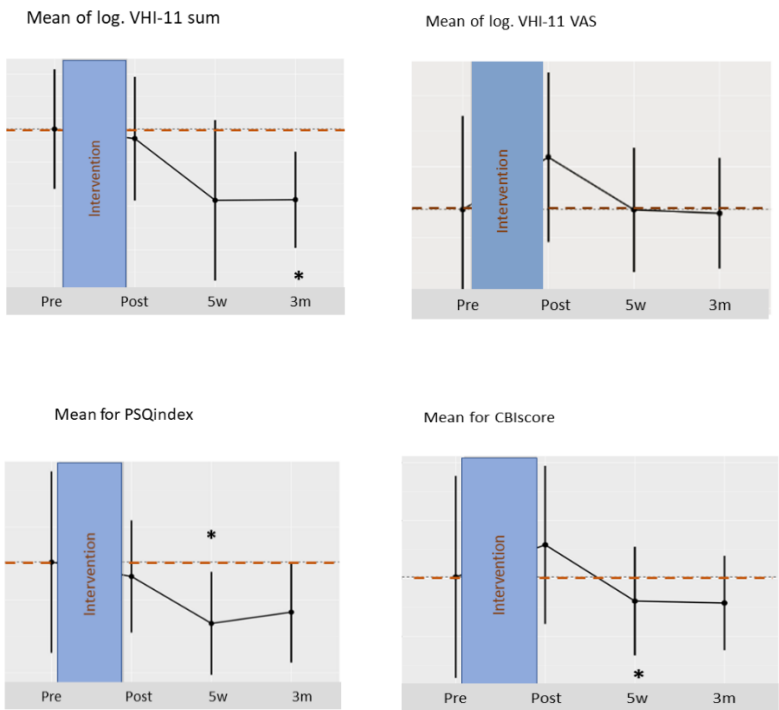
The primary objective of this study was to explore the relationship between teachers' well-being and the acoustic characteristics in the classrooms they were working in, either refurbished or non-refurbished. The only significant differences regarding both teachers' well-being and classroom acoustics due to refurbishment were on two acoustical measures, namely RT 250-4000 Hz and C_{50}. RT 250-4000 Hz was significantly shorter in the refurbished classrooms and C_{50} was significantly higher in the refurbished classrooms, meaning the differences were in favor for of the refurbished classrooms. Since RT 250-4000 Hz and C_{50} were the only measures that differed significantly between refurbished and non-refurbished classrooms, the correlations were made on the pooled data of all classrooms in order to retain more statistical power.

There was a low significant positive correlation between higher degree of burnout and higher ventilation system noise (VSN) dBA. Voice symptoms had a moderate positive correlation with higher VSN dBA. After corrections for multiple testing were made, no previously significant correlations remained significant. Teachers working in lower grades reported more voice symptoms than those working in higher grades.

Study II

The aim of this study was to investigate the effects of the in-service training on teachers' vocal health, self-efficacy and well-being. The first analyses showed that for the early training group there was a significant increase in voice problems assessed with the VAS-scale (VHI-VAS) directly post-intervention. No other effects were found for the early training group and no effects were found for the late training group.

When investigating all training groups combined and over all measure points for the different scales, six linear mixed-effects regressions were conducted. The plots (mean values and regression confidence intervals) for the regression are shown in Figure 6. There was no longer a significant increase in voice problems assessed with VHI-VAS directly after intervention. Perceived voice problems had returned to baseline at 3-month follow-up. As for voice problems reported with VHI-sum there was a decrease post-intervention and the decrease was significant at 3-month follow-up. Also PSQ index had decreased post-intervention, with a significant decrease at 5-week follow-up. For CBI there was also a significant decrease at 5-week follow-up, and although the result was similar at 3-month follow-up it was not significant. Analyses of the three separate subscales for CBI showed that for the student-related subscale the degree of burnout had decreased significantly at both 5-week follow-up and 3-month follow-up. The other two subscales had only small and non-significant decreases below baseline. The estimates of teachers sense of self-efficacy increased post-intervention, significantly so at 5 weeks. For QPS only small and non-significant changes were seen.



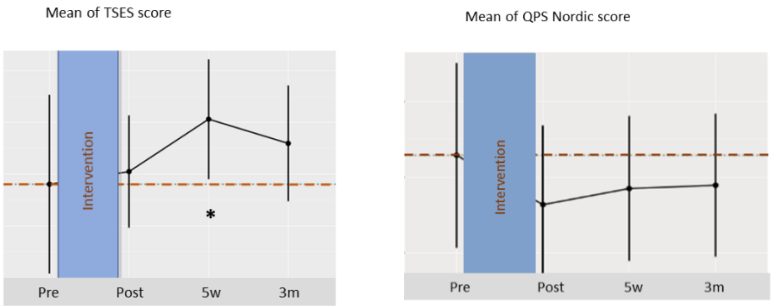


Figure 6. Data from all teachers participating in Study II with mean values and regression confidence intervals.The dotted line through the first measure point (Pre-training) indicates the baseline so that changes at the other points are more clearly visible. Note that confidence intervals overlap the baseline for some effects that are nevertheless significant. This is due to small differences between predicted values and calculated means, as the model included covariates. $p < 0.05$*

Study III

The overall objective of this qualitative study was to explore the teachers' experience and understanding of classroom communication after the 5-week in-service training. Three overarching themes were yielded from the thematic analyses, namely *awareness of voice use, the use of body communication* and *setting the stage for learning.* The teachers talked about *voice use* from different perspectives, ranging from voice use in relation to being heard to vocal health. The teachers gave examples of trying out new kinds of voice use in order to put less strain on the voice. They also mentioned thinking about posture and abdominal breathing while speaking. There was also a more explicit awareness of the importance of the voice as a working tool. The following example describes how a teacher talks about the importance of voice in teaching and that a loss of voice would make it impossible to keep working as a teacher:

> But what you think about more, probably, is that the voice is an incredibly good, important instrument. It's mostly that [which] all teaching is based on – that you can speak. Lose your voice and that's it really. If you get so hoarse that you can't speak, you can't do anything here, that's just the way it is. (Participant 4)

As for *the use of body communication*, there were examples of moving around more in the classroom while teaching. This is exemplified in one teachers description of moving around more and fully using the room from different angles:

> I move more in the classroom and stop and talk from different angles, not just from the front. I might stand towards the back of the room. Or in the corner or by the window. Yes, I move about much more. (Participant 7)

This teacher's description of how she stops and talks shows she is also using positioning in the classroom. Further, teachers reported using more body communication than before and that body communication sometimes can be used instead of words. However, the teachers also mentioned standing still in front of class and silently waiting to gain the students attention, and that this had gotten the students' attention. Silently awaiting the students, as opposed to raising the voice also constitutes an ease on the voice, and is one of the approaches brought up in the in-service training. Articulation was brought up by some teachers inasmuch as they were more aware after the in-service training of the need to talk more slowly and articulate more deliberately.

Setting the stage for learning relates to the classroom environment. The teachers talked about sound and that they were more aware of the impact of the sound environment after the in-service training and were more focused on noise and sounds in the classroom. One teacher reflected on her awareness of sounds and how to control them and she talked about the impact of high noise levels and how her awareness of the environment had changed.

> Yes, I would say more focus on sound, things that make noises, all those small things. You think more about where they come from. How they start and it doesn't take much to stop them so they don't get to be too much, you stop it in time so you can keep the noise level down. And it's not just we teachers who suffer from the noise, it's the students too of course. It's their working environment as well as ours. (Participant 13)

The teachers also expressed that they were more active in checking that the students could hear them across the room. It was mentioned that classes vary in this context, which in turn affected what was brought to attention in the classroom. For example in a more noisy class the teacher needs to make the students aware of the sound levels they are generating. The teachers also reported thinking more about the physical, acoustic environment regarding furniture, especially bookshelves.

General discussion

The core of the thesis was in-service training of teachers. The separate studies revolved around this core. The first aim in this thesis was to investigate the relationship between teachers' well-being and the acoustic characteristics of the classroom before the in-service training. Thereafter, an in-service training program in classroom communication was administered. The second aim was to investigate the effects of the training on the teachers' vocal health and well-being. This was assessed directly after training and/or at follow-up evaluations occurring five weeks after training and three months after training. The final evaluation was conducted six months after the in-service training and surveyed the teachers' own descriptions of their classroom communication skills. The third aim was to describe the teachers' experience and understanding of classroom communication, six months after participating in the in-service training.

What can be gained from in-service training of teachers' classroom communication and providing optimal room acoustics?

Following the in-service training the teachers reported increased awareness of their communication practices and increased mastery of their own classroom communication skills (Study III). Results indicated that the increased awareness and mastery of communication skills improved their vocal health and well-being, including reduces stress, less burnout and greater self-efficacy (Study II). These findings show that in-service training, even as short as the one presented in this thesis, can support many teachers, prevent them from developing voice problems and impact positively on their well-being. These results corroborate the findings by Nusseck et al. (2019), where voice training had a positive impact on voice quality, awareness of voice use and mental health.

Communication in the classroom is vitally important for learning and for building relationships (Hattie, 2009; Kogut & Silver, 2009). High quality interactions are a central element in classroom environments that support communication (Dockrell et al., 2015). In this context, room acoustics are an external factor that can either support or hinder communication. In the best of scenarios, optimal classroom

acoustics with appropriate reverberation and favorable sound conditions help teachers to reach out with their message with ease and without undue effort. It is the author's belief that internal and external factors (i.e., teachers' well-being and their working environment) affect the way teachers work and communicate. Freed from such negative consequences of poor classroom acoustics as vocal health problems, emotional exhaustion and noise annoyance, teachers would have more opportunities to engage in high quality interaction with their students in order to support their understanding, and learning would increase. Hopefully, this will in turn create trustful relationships and lessen unruly behavior in the classroom.

The effects of external factors on teachers' well-being (Study I)

Traditionally the acoustic design of classrooms has focused on listening conditions for the students and not on the speaking conditions for the teacher. In addition, the majority of research on classroom sound environment has examined the listeners' perspective; only a small number of studies (e.g., Lyberg Åhlander et al., 2011; Kristiansen et al., 2016; Kristiansen et al., 2014; Pelegrin-Garcia, 2012; Rantala & Sala, 2015) have included the speakers' perspective, despite the fact that speakers and listeners share the same sound environment.

Study I in this thesis investigated the relationship between teachers' well-being and acoustic properties of the participating teachers' classrooms. The teachers' self-reported well-being was above average compared to the questionnaire's validation studies: that is, they had fewer vocal symptoms, a lower degree of stress and burnout and a higher a degree of self-efficacy compared to the validation studies. Also, most of the classrooms complied with current acoustical standards for school buildings. However, an important finding concerned the adverse effect of classroom ventilation noise. Only two out of 23 classrooms met the acoustic standards for classroom ventilation noise (SS 25268). The teachers' voice symptoms increased with higher ventilation noise (dBA) levels and furthermore, a higher degree of burnout was associated with higher levels of ventilation noise (dBA). Moreover, teachers working with younger students reported more vocal symptoms than those working with older students. The fact that ventilation noise did not meet the acoustic standard could explain why teachers reported both a higher degree of burnout and more voice symptoms when working in classrooms with higher levels of ventilation noise. These findings indicate the importance of inspections to ensure that classroom ventilation complies with noise level standards; judging from the current findings, such a robust inspection regime is not in place.

As briefly mentioned in the methods section, the particpating municipality was carrying out a large-scale acoustical refurbishment at the time this research was

conducted. This might have affected the teachers' assessments of their well-being, based on perceptions of enhanced support from the employer.

Effects of background noise

The results from Study I indicate a relationship between work-related noise levels and burnout. This finding is in line with the study by Santana et al. (2012) which showed that the higher the noise levels were in the classroom, the greater was the emotional exhaustion among teachers. While that study did not state which type of noise was measured, the reported noise levels indicate that they stemmed from activity noise. The noise in Study I was from ventilation. Such noise adds on to the background noise, which affects everyone in the classroom. It is plausible that the activity noise is higher in classrooms with higher background noise. Noise exposure constitutes a risk to public health, and has been shown to induce hearing impairment, hypertension and ischemic heart disease, annoyance, sleep disturbance and decreased school performance (Passchier-Vermeer & Passchier, 2000). The proportion of teachers in Sweden who reported that they were disturbed by loud noise levels during class (i.e., activity noise) has increased (Skolverket, 2019a). A questionnaire study on noise and sensitivity to noise with 43 teachers showed that among the older teachers, 81% found it harder to tolerate high sound levels compared to their tolerance at the beginning of their career, with 68% of the teachers reporting being annoyed by high noise levels regardless of age (Eysel-Gosepath et al., 2012). There were no correlations for teachers' age or teaching experience in Study I. To the best of my knowledge, it is not known whether there is a causal link between work-related noise and well-being outcomes such as burnout, however the results from previous studies and Study I give indications in that direction. It is thus very plausible that exposure to background noise does have a negative impact on teachers well-being, but more studies on the effects of noise exposure on different aspects of teachers' well-being are needed and with larger sample sizes.

Effects of background noise on voice

The teachers in Study I reported more vocal symptoms when the ventilation noise was louder. Noise affects teachers' voices, not least due to the Lombard effect, where noise causes the speaker to instinctively raise the voice, i.e., increased SPL, and make changes to the voice spectrum to enhance audibility (Lane & Tranel, 1971). The many studies reporting on the relationship between higher noise levels and vocal symptoms in teachers have established a relationship between these two parameters (Cantor-Cutiva et al., 2013; Devadas et al., 2017; Rantala et al., 2012; van Houtte et al., 2012).

Effects of reverberation time

Earlier research has shown that teachers reported that their voice tired easily when working in classrooms with shorter reverberation times (Rantala & Sala, 2015) and that teachers with voice problems preferred classrooms with longer reverberation times (Pelegrín-García & Brunskog, 2012). However, it is important to keep in mind that what supports the speakers voice, might affect other aspects negatively and the listener might have different preferences regarding the length of reverberation times. Longer reverberation can mask speech and consequently hamper students' perception of speech (Knecht et al., 2002). Kristiansen and colleagues (2013) found significant associations between long reverberation times in the classrooms and teachers' lack of energy, low job satisfaction and interest in leaving the job. The authors concluded that good classroom acoustics are important for teachers' well-being. The teachers in Study I reported low occurrence of voice symptoms and the reverberation times complied with acoustical standards; this may very well explain the lack of association between vocal health and reverberation times. Another explanation may be the limited sample size.

Noise affects students and students affect teachers

Even though the first study in this thesis showed little evidence for a relationship between teachers´ well-being and classroom acoustics there are other studies showing that the physical properties in classrooms affect teachers and that good classroom acoustics are important for teachers' well-being. Although not in focus in this thesis, the students in the classroom are an important factor to keep in mind. They are also affected by the classroom acoustics. Not only is their well-being affected but also their performance (Klatte et al., 2010; Osman & Sullivan, 2014; Shield & Dockrell, 2008).

In the thesis by Durup (2017), it was found that even though the classroom acoustics (measured in unoccupied classrooms) complied with regulations, the measured activity noise levels during class time were high. It would have been interesting to have measurements of activity noise levels in the classrooms in the present thesis to see if there were also high levels of noise during lessons, even though the room acoustics, apart from ventilation noise, complied with regulations.

Another of in Durup's (2017) findings was similar to findings in the present thesis, namely that teachers working in lower grades reported more voice symptoms. This finding has also been reported in a national survey of New Zealand teachers (Leao et al., 2015). There are a number of factors that are plausible explanations for this finding. Younger students are not yet independent readers and need more verbal information and instructions from the teacher. Furthermore, teachers in younger grades teach most subjects themselves and hence have fewer opportunities for voice

rest between classes. Thus, the students' age and needs affect the teachers' voice use.

Feedback from the students is an important factor in teachers' adjustment of their own communication (Leite et al., 2020). However, the teachers in the present studies did not mention this. Perhaps the adjustment related to the students' feedback is an unconscious action that often occurs naturally in the moment while communicating.

Effects on teachers after training in classroom communication (Study II-III)

Earlier research and surveys have reported on challenges regarding teachers' vocal health and well-being, of which some were reviewed in the introduction to this thesis. The effects of voice training have been investigated and shown positive outcomes (e.g., de Oliveira Bastos & Hermes, 2018; Sapir et al., 1993). Voice training has also been found to improve mental health and increase awareness of voice use (Nusseck et al., 2021). Taken together, these findings suggest there is a lot to be gained regarding teachers' vocal health and well-being by providing them with voice training. However, the effects on teachers' vocal health and well-being of adopting a more holistic approach, addressing general aspects of teachers' classroom communication, their awareness of voice use and the influence of the classroom's acoustics is an area that has not been investigated before to the best of my knowledge.

The teachers' pre-training vocal health and well-being were relatively good in comparison with the validation studies of the questionnaires (Study I). Considering earlier research and surveys, this was somewhat unexpected. Despite the teachers' healthy starting point, there were significant improvements in teachers' vocal health and well-being after training, also as reported by the teachers after training.

Teachers' reporting of effects on awareness after training (Study III)

Awareness of voice use

The teachers described being more aware of their voice use six months after the in-service training. The awareness of voice use was described in a variety of ways and included aspects that were explicitly discussed or trained with practical exercises such as posture, abdominal breathing as well as strategies to avoid vocal strain while speaking, and when reading aloud. Examples were given on how this awareness was used in implementing new practices. The teachers also described aspects that were not explicitly brought up in the in-service training. That is, they had drawn conclusions of their own from the in-service training on aspects such as change in

the use of voice as a working tool, the importance of the voice as a working tool and sharing their own increased awareness with students.

A recent study investigating the long term effects of teachers' voice training found not only long-term positive effects on voice quality, but also significantly increased awareness of voice use and mental health in comparison with the control group (Nusseck et al., 2021).

The use of body communication

In some of the teachers' descriptions, there were combinations of themes, such as awareness of voice use and the use of body communication. The teachers described using positioning in the classroom and just standing still to gain attention at the beginning of a lesson, instead of using the voice; that is, they used positioning in the classroom as a way to avoid vocal strain. There were examples of teachers describing how they used their body to convey messages after the in-service training, by sometimes enhancing movements and gestures. Some of the teachers were more aware of their speech rate after watching the video recordings and some reported slowing their speech rate by articulating more. The teachers also described moving around more in the classroom while teaching.

Body communication with respect to teachers' communication is a subject which does not seem to have received much attention in previous research. Where body communication has been studied in relation to teachers' classroom management. A research collaboration between University West in Sweden and two elementary schools studied how leadership emerges through communication and relationships (Johansson & Halvarsson, 2019). Leadership was created in interaction with and in relation to the students. Some of the teachers in the collaboration study also reported moving around in the classroom. They used moving around and positioning as a way to break down the hierarchic relationship between teacher and student and to make the students more active. Further, some teachers reported how they used the voice to manage the classroom by varying the pitch or being silent and while adopting certain positions in the classroom. The researchers concluded that the body is of course used all the time by teachers to mediate knowledge, but it is through experience that the teacher can use gaze, gestures and moving around in the classroom deliberately when interacting with the students. Further, the researchers stated that there is more to be explored on the importance of nonverbal communication in managing the classroom, as well as a need for professional development in this area (Johansson & Halvarsson, 2019).

Setting the stage for learning

The teachers also described being more aware of the physical environment of the classroom. They mostly reflected on the sound environment with regards to sound and noise in the classroom, noting that the noise levels varied between different classes. Teachers also described being more aware of checking that students could

hear them across the room. The fact that sound environment was a chief focus of teachers' reflections likely mirrors the fact that sound environment was the physical aspect addressed the most during the in-service training. It is likely that the ongoing acoustical refurbishment of the schools in the municipality also increased their awareness of sound environment. Further, studies using the CSCOT for observing classroom practice has shown that the physical environment in the classroom is both the domain observed the most and the domain where teachers proposed most changes to their own classroom (Dockrell et al., 2015; Law et al., 2019; Nordberg, 2019). Hence, the physical environment seems to be an area receiving a high degree of teacher focus.

Besides descriptions of increased awareness of voice use, body communication and the physical environment, examples were also given to illustrate how this increased awareness was put into practice. With a few exceptions, the teachers described changes in their classroom communication, despite the rather brief duration of the in-service training. This in-service training lasted 7.5 hours over 5 weeks, which is a short time in the context of in-service training (Markussen-Brown et al., 2017). The review by Markussen-Brown and colleagues (2017) indicated that rather than focusing on intensity or duration, a high number of components in the training may have greater benefits. Since the in-service training in this thesis focused on classroom communication, it is not tied to a specific content or grade. On the contrary, the knowledge and skills gained are to be used across subjects and grades.

Measured effects on vocal health and well-being after training (Study II)

There were significant improvements in vocal health and well-being (stress, burnout and self-efficacy) measured immediately after and at the follow-up at 5 weeks and/or 3-months after training.

Vocal health (VHI-11)

The ratings on the different parts on VHI differed, but it is not clear why. This inconsistency may reflect the difference between VHI-VAS being one item, assessing current voice problems and thus being more sensitive to immediate change than the 11 statements forming VHI-sum.

There was a trend that voice problems assessed with VAS increased directly after the training, however at the 3-month follow-up the ratings had returned to baseline. The immediate increase and later decrease is in line with clinical experience and can be interpreted as an increased awareness of one's own voice and not an actual increase in voice problems. However, the voice problems assessed with the separate statements of the VHI-11sum did not increase immediately after training as the VHI-VAS did. On the contrary – and somewhat surprisingly due to the already low

assessments of voice problems – there was a decrease in voice problems remaining significant at the 3-month follow-up. It is noteworthy that a decrease in voice problems is interpreted as an improvement in vocal health.

It is important to provide teachers with tools to improve their vocal health, not just for the sake of their voice. Vocal symptoms in teachers have been shown to have commonalities with symptoms of common mental disorders, including symptoms such as irritability, fatigue, anxiety, concentration difficulty, insomnia, forgetfulness and somatic complaints (Barbosa et al., 2021).

Stress (PSQ)

The self-reported perception of stress decreased below baseline after training, and significantly so at the 5-week follow up.

The decrease in voice symptoms was not significant at the 5-week follow-up at the 0.05 alpha level, but at 3-month follow-up. However, the coefficients were the same for both the 5-week and the 3-month follow-up. While there could be an association between the decrease in stress and voice symptoms, it is not possible to determine the direction of this potential relationship. In earlier research, stress has been confirmed as a significant contributor to voice problems (Gassull et al., 2010; Kooijman et al., 2006; Vertanen-Greis et al., 2020).

Burnout (CBI)

In the case of burnout, measured as fatigue and exhaustion, the significant decrease occurred at the 5-week follow-up. While the results looked similar at the 3-month follow-up, they were only significant at 5-weeks for the total scale. However, the effect on the total scale was almost entirely driven by the results on the student-related subscale which showed significant decrease at both 5-week and 3-month follow-up. This indicates that the teachers after training were less fatigued and exhausted by their work with students. This is an interesting finding, since the training aimed to support communication with the students. There are studies showing that student disruptive behavior is one of the sources of burnout (e.g., Bottiani et al., 2019; Hakanen et al., 2006; Skaalvik & Skaalvik, 2017). Further, the study by Hakanen et al. (2006) highlights the need for interventions to support teachers in aspects that can be taxing, e.g., handling the demanding nature of student interaction, reducing high workload and improving the physical environment in schools to mitigate burnout. Skaalvik and Skaalvik (2017) also discuss strategies to support teachers, proposing measures such as developing positive student-teacher relationships. Considering that classroom communication is vital in building relationship between teachers and students it is plausible that optimized classroom communication supports this relationship and thereby lessens student disruptive behavior.

Teachers' sense of self-efficacy (TSES)

Teachers' sense of self-efficacy, in relation to managing the classroom and creating pedagogical prerequisites despite distracting events, increased after training and significantly so at the 5-week follow-up. In line with earlier research, the increase in self-efficacy is related to the decrease in burnout, which both show significant results at the 5-week follow up. However, the direction of the causal relationship between burnout and self-efficacy has not yet been established. While many studies have investigated the relationship between self-efficacy and burnout, not as many have investigated the relationship between self-efficacy and stress. In the current study, the significant results at the 5-week follow up were decrease in both burnout and stress, while self-efficacy increased. The study by Bottiani et al. (2019) also found that both stress and burnout were negatively related to self-efficacy on classroom management. The increase in self-efficacy in the current study is favorable since it seems to act as a protective factor against burnout.

It has been recommended that intervention programs should aim at increasing teachers' sense of self-efficacy in classroom management to decrease and prevent burnout (Dicke et al., 2014; Schwarzer & Hallum, 2008). The in-service training was focused on classroom communication, but it is easy to see that interactions play an important role in classroom management. Granström (2007) stated that professional classroom management is based on knowing what you are doing. Hence, I believe that certainty in communication provides certainty in the classroom, which in turn extends to certainty in classroom management.

In the study by Bottiani et al. (2019), the school context was low-income middle schools in the US, and hence varied from the context of the schools included in the present thesis, but had several interesting findings on stress and burnout. It was found that higher levels of self-reported stress were significantly associated with less demanding teaching practice, meaning less use of instructional dialogue, i.e., less teaching practice requiring higher-order thinking and memory. However, higher levels of emotional exhaustion were associated with more observed teacher sensitivity, e.g., checking in with students and providing individualized support. A possible explanation for the latter finding was that teachers being more responsive to students may become more emotionally exhausted; however due to the cross-sectional design of the study, the direction of this association could not be established (Bottiani et al., 2019). The finding that increased stress was related to lower levels of demanding teaching gives support to my belief that teachers' well-being and their working environment affects the way they work and communicate.

Is communication in the classroom important?

Classroom communication is of great importance and is fundamental to supporting students' learning and to building relationships. The findings from the studies in this thesis show that teachers' vocal health and well-being increase when their communicative skills increase. Teachers with improved well-being and communicative skills can be presumed to have better resources to engage in high quality interactions with their students, thus supporting their learning. Providing teachers with opportunities to improve their communicative skills is therefore important for both the teachers themselves and their students.

The teaching profession employs many people, in Sweden and around the globe, and a huge number of people are affected by teachers' communicative skills and well-being.

Swedish children start school in August the year of their sixth birthday, which is the start of a ten-year compulsory school between the ages 6-15 years. The majority of schools are public mainstream schools (85%), meaning they are run by the municipalities (Skolverket). The teachers in the studies in this thesis were working in public mainstream schools. There has been an increase in the levels of immigration to Sweden with a peak in 2015, which has resulted an increasingly large group of students with poor Swedish language skills when they first enter school. Many countries recommend inclusion of all students; this entails that in many classrooms today there is a variation of abilities between students. These factors may explain why teachers express a wish to develop their competence in teaching students with special needs and teaching in a multicultural or multilingual environment (Skolverket, 2019b). More communication training is needed, to support both children with varying abilities and teachers in their professional development.

Methodological considerations

Classroom communication is complex and multi-dimensional and a number of factors both influence and are influenced by classroom communication. To capture and investigate them all is no easy task, if even possible.

The optimal way to study teachers' communication – and possible changes after an intervention – would have been to observe the teachers in the classroom. One major limitation in assessing the effects of the in-service training was the lack of opportunity to observe and film the teachers in the classrooms. This would have provided an opportunity to collect objectively observed data and not, as in these studies, be solely dependent on what the participants express about their classroom

communication. Further, it would have been possible to observe classroom communication happening in the moment and to later analyze and gain knowledge of actions that might be unstated, difficult to put into words or that the participants are unaware of. Observations through filming would have given the opportunity to investigate if what the participants think and say they are doing is consistent with what they really are doing in the classroom, also including the effect of the interactions with the listeners and the physical environment. Unfortunately, in the end, recordings of classroom observations as data collection were not employed due to ethical considerations.

One way to investigate the effects of the in-service training would naturally have been to collect data on the students' academic performance. This was also the original plan. However, as stated in the methods section, it was difficult to retrieve the academic results since the matrices for their school results were difficult to retrieve from the schools. The intention with this planned data collection was to investigate if there was a change in the students' academic outcome after the teachers had participated in the in-service training. Even though teacher-student interaction is fundamental to support learning, it is questionable whether using teachers' assessments of their students is a viable method to investigate short-term changes in interaction. In previous research, it varies whether changes in students are reported at all (Dunst et al., 2015) and to which extent teachers in-service training translates to student outcomes (Markussen-Brown et al., 2017). The study by Starling and colleagues (2012) is one of few exceptions, where change in teachers' increased use of language modification techniques was linked to significant improvements in language abilities of students with DLD. Moreover, a questionnaire that is distributed by the schools annually about well-being, social relations and work environment in school, could have given important information that might have been more sensitive to the possible changes in the teachers' interactions. However, it turned out that the results of the questionnaire could not be retrieved on a class-level but only for the whole school and could therefore not be used. So, with just one of three planned ways to assess the students available, it was decided to put focus on the teachers. However, a questionnaire for the children's assessment of perceptions of interaction with their teacher, well-being and classroom environment was designed for this project. The result of the questionnaire will be published elsewhere.

As for the sample size, 25 teachers partook in in-service training. The data analysis in the quantitative analyses was based on 23 teachers, since two teachers had to be excluded due to too much missing data in the questionnaires. Great efforts were made to recruit more teachers. A subgroup was added and given the intervention during the following semester. Despite this, it was still not possible to recruit more than 25 teachers.

The teachers had better vocal health and well-being, compared to the validation studies of the questionnaires and other research on teachers' vocal health and well-

being (Arvidsson et al., 2016; Bergdahl & Bergdahl, 2002; Boström et al., 2019; Klassen et al., 2009; Kristensen et al., 2005; Lyberg Åhlander et al., 2011; Nyman & Åradsson, 2008). A possible explanation for this could be sample bias. As mentioned in the methods section, the schools were chosen by the school authority to balance the distribution between refurbished and non-refurbished schools. Then the headmasters at the schools gave the names of teachers working with the requested grades. From several schools, the names of the whole teaching team for the grades in question were given to the author, but this was not the case at all schools. Although there were no indications that specific teachers' names were chosen/not chosen to be passed on, it is not something that could be controlled for and there is, at least theoretically, a possibility that the headmasters chose to pass on names of teachers who seemed less burdened.

This thesis used both quantitative and qualitative methods, which is a methodological strength. Further, it enabled us to investigate the effects of the in-service training with a combination of repeated measures with questionnaires pre/post in-service training and at follow-ups and allowed us to retrieve the participants' own descriptions of their classroom communication six months after the in-service training.

The choice of assessments can be discussed. "Testing to the task", i.e., to explicitly test what was trained, would have been to observe the teachers' classroom communication before and after the in-service training and would thereby have been a more direct approach to investigate possible changes in the teachers' communication. Instead, the measurements of presumable outcomes of the in-service training focused on investigating the external (acoustical characteristics) and internal (vocal health and well-being) factors influencing teachers' communication and on how these internal factors were affected by the in-service training.

The external factors were thoroughly investigated with objective measurements and included a measurement for speech clarity (C_{50}) that has not been widely used previously. C_{50} is a very suitable acoustical measure in teaching environments. A high level C_{50} indicates that speech is easily transmitted in the room and thus, enhances the listeners' perception of the message. It also indicates that support is given to the speaker to hear their own voice.

Study I indicated a relationship between background noise levels and burnout. It would therefore have been interesting to have measures of the noise levels in the classrooms, not only from before the in-service training, but also at the same time as the follow-ups, when a significant decrease of burnout occurred. While it would not be expected that the background noise levels would have changed much, it would have been interesting to measure the activity noise levels as well to detect if there was a change.

The internal factors were tested with self-assessments questionnaires at several points. A common limitation of self-reports is the risk of participants

misinterpreting the items, or wanting to give socially desirable or 'correct answers' to please the researcher. These risks were mitigated by using validated questionnaires and also by informing the participants that the questionnaires would be coded by another member of the research team. The latter was especially important to clarify that the author (who led the in-service training and administered the data collection) thereby would not have access to which questionnaire was related to which respondent. The possible risks or disadvantages with self-reports were in this way outweighed by their strengths and advantages. The main strength was the possibility to gain insight into the participant's own perceptions. This is an absolute must when investigating vocal health and well-being, since these are subjective perceptions. For the participant, one advantage was that by answering questionnaires with pencil-and paper, participants could be confident that their answers would not be accessible for anyone outside the research team. Using a paper format also enabled the questionnaires to be filled out at a time and place of the participants own choice, within the time frame of a couple of days. The advantage for the research was that questionnaires were a relatively easy way to collect data for repeated measures. However, there might be a risk that participants recognize the statements in the questionnaires, recall how they answered previously and repeat the same answer. This does not seem to have been the case in the present studies, since the answers varied over time.

The data collection in this research project was extensive in order to try to capture some of the factors influencing and being influenced by the communication in the classroom. Not all of the collected data is reported in this thesis. The extensive nature of the data collection was burdensome to the participants. This can be an explanation as to why there was too much missing data for two participants, leading to the subsequent exclusion of their data from data analysis. In future projects, it would be recommended to investigate the possibility of either scaling down on the breadth of the data collection, or cutting down on the number of measurement points. However, since there are many factors influencing and being influenced by classroom communication and it is of interest to detect if and when changes occur, it might be difficult to scale down the data collection. It might be better instead to repeat information to the participants about the research process and the purpose of repeated measures.

Conclusions on the effects of in-service training

The teachers increased their knowledge and awareness of voice use, body communication as well as the prerequisites for successful classroom communication after the in-service training. In addition, their assessments of their vocal health and well-being increased through their improved mastery of communication skills. These findings indicate that even a relatively short in-service training program

supports teachers' vocal health and well-being. This type of in-service training can be recommended as continuing professional development and can even be considered a preventive measure to reduce the risk of teachers developing voice problems. Prevention is especially important since many teachers have not been prone to seek help for their voice problems and voice problems have been found in student teachers at the beginning of their education (Leao et al., 2014; Morton & Watson, 1998; Ohlsson et al., 2021; Roy et al., 2004).

It would be advantageous to include certain elements of the in-service training presented in this thesis already during teacher education programs. Since student teachers commonly lack the experience of working in the field, they cannot be expected to benefit from the entire in-service training, with its base in professional experience. Therefore, the basics of voice use and body communication, and factors influencing these, as well as the impact of teachers' communication on their students, should be taught and trained during teacher education and later be complemented with in-service training, based on work-life experience.

Research has shown advantages of an external party being responsible for training and for collaborative approaches in training (Wade, 1985; Girardet, 2018). In-service training on classroom communication could preferably be led by an SLP, given the knowledge SLPs have on voice use, communication and children's language development and disorders. It is important for teachers to be well acquainted with language development practices to enable all students to develop from their individual premises; this calls for peer learning and observation among teachers (Tjernberg 2013; Dockrell et al., 2015). It is important for teachers to collaborate, share good practice, raise pedagogical issues and observe each other, in order to find strategies to support students with language developmental vulnerability (Tjernberg, 2013). By doing this in collaboration with another profession, e.g., SLPs, new insights and knowledge can be gained.

Directions from earlier research and suggestions moving forward

A large step for the research conducted within the frames of this thesis was taking the scientific knowledge gained from the lab-based research from the research group and the research of others on speech rate, vocal quality and evidence-based interaction techniques, and boiling it down to an intervention. The intervention was practice-embedded through in-service training at the schools, thereby ensuring ecological validity. Some of the recommendations from earlier research could be followed in this way, e.g., by making objective measurements of classroom acoustics (Cantor-Cutiva et al, 2013) while other recommendations were not possible to fulfill, such as recommendations on observing and recording individual

teachers' use of language modification techniques in the classroom, pre,-post and at follow-up after training (Starling et al., 2012).

Indisputably, future studies on classroom communication should aim for observations of the participants and include both teachers and students. Moreover, future studies would benefit from larger sample sizes. While research and surveys have shown that many teachers' vocal health and well-being is challenged and thereby affects their working ability, it is important to remember that many teachers are in good health. Good health for all teachers is a question that should be prioritized. Therefore, an aspect that should be further explored in future studies is the resources available to teachers, e.g., support from headmasters and colleagues, and the teacher's perception of control, since these factors likely support teachers' well-being.

Intervention studies are time-consuming and conducting research within different professional contexts requires a great deal of consideration. It would be beneficial to have a closer collaboration with participating schools in order to solve some of the logistics involved in scheduling and booking premises. Collaboration with a research partner within the school could also prevent possible misunderstandings emerging from the meeting of two contexts. Information on project design and measure points needs to be explained and repeated frequently during the process of an intervention with repeated measures.

Conclusions

- Teachers' reported a higher degree of burnout and more voice symptoms if working in classrooms with higher noise levels from the ventilation, showing an indication of external factors (acoustical characteristics) affecting internal factors (well-being). In the current sample both teachers' well-being and the acoustical properties of the classrooms were favorable (Study I). In another sample, more associations between teachers' well-being and classroom acoustics can be expected.
- Teachers working in lower grades reported more voice symptoms than those working in higher grades. Voice use is connected to which grade the teacher is working in (Study I).

The teachers participated in in-service training on classroom communication with a holistic approach covering factors that influence communication, e.g., the physical environment and demands on the voice, as well as knowledge of and practice in teachers' use of voice and aspects of body communication to enable high quality interactions with the students. The training program had several effects:

- Teachers' vocal health and well-being improved and long-term effects were inferred (Study II).
- Teachers increased their knowledge and awareness of voice use, body communication as well as the prerequisites for successful classroom communication and implemented these new practices in their classroom communication (Study III).
- The results indicate that the teachers' increased knowledge and mastery of classroom communication improved their vocal health and well-being (Study III-II).
- This type of in-service training is recommended for teachers and could preferably be led by an SLP. It would be an advantage to offer a similar program during teacher education and then have a follow-up when the teacher has gained work-life experience (Study II-III).

Sammanfattning på svenska

Lärarens kommunikation i klassrummet är viktig både när det gäller att skapa relationer och stödja elevers lärande. Forskning har visat att språkstödjande interaktion i klassrummet förekommer mer sällan än önskvärt för att stödja god språkutveckling. I denna avhandling definieras lärares klassrumskommunikation som hur lärare talar och använder andra aspekter av icke-verbal kommunikation i undervisning och interaktion med eleverna. Detta innefattar aspekter som taluppfattbarhet, taltempo, röststyrka, röstkvalité och även lärares användning av blick, gester och placering i klassrummet. Definitionen härrör från forskargruppens laboratoriestudier som visat att lärarens taltempo och röstkvalité påverkar barnens prestationsförmåga och lyssnings ansträngning.

Klassrumskommunikation är komplex. Den både påverkar och påverkas av flera interna och externa faktorer. Interna faktorer handlar exempelvis om vilken kunskap och medvetenhet lärarna har om röstanvändning och kommunikation samt om hur deras rösthälsa och välmående är. Externa faktorer är sådana som exempelvis ljudförhållandena i klassrummet. Man vet idag olika mycket om dessa faktorer. Det har bedrivits omfattande forskning gällande lärares röster och det har kunnat konstateras att lärare drabbas av röstproblem oftare än andra yrkesgrupper och att röstproblem påverkar lärares kommunikation och arbetsförmåga. Det har också visat sig att en hes lärarröst påverkar elevernas förståelse och vad de tycker om läraren. När det gäller rumsakustik i klassrum är det framför allt effekten av buller som har utforskats och det har visat sig att buller påverkar både lärares röster och välmående negativt. En annan extern faktor som påverkar lärares kommunikation är elevernas respons på det läraren har framfört, det har inte forskats mycket om detta. Det finns en kunskapslucka kring hur välmående påverkar samt påverkas av lärares kommunikation.

Trots att lärares kommunikation är viktig både gällande deras eget välmående och arbetsförmåga samt den påverkan som lärarnas kommunikation har på eleverna, tycks det erbjudas föga stöd för lärare att utveckla och hantera sin klassrumskommunikation. Mot bakgrund av detta utvecklades en fortbildning med målet att ge lärare kunskap och praktiska verktyg i att använda evidens-baserad språklig interaktion, d v s på vilket sätt läraren interagerar med eleverna. Fortbildningen syftade till att öka lärarnas medvetenhet kring och stödja utvecklingen av att använda god röstteknik, optimera den icke-verbala kommunikationen och optimera den språkliga miljön. Följande fem moduler ingick

i fortbildningen: använda god röstteknik, röstergonomi, rumsakustik, språkstödjande strategier samt icke-verbal kommunikation. Fortbildningen pågick under fem veckor, 1,5 timme per vecka och gavs till 25 lärare som undervisade i åk 3-6.

Kärnan i denna avhandling var fortbildning för lärare och de tre ingående studierna gjordes före/efter fortbildningen. Den första delstudien undersöker sambandet mellan lärares upplevda välmående och rumsakustiken i deras klassrum. Därefter gavs fortbildningen om klassrumskommunikation. Den andra studien undersöker effekterna av fortbildningen på lärares rösthälsa och välmående direkt efter fortbildningen samt vid uppföljning efter fem veckor och tre månader. Slutligen beskriver den tredje delstudien hur lärarna upplever sin klassrumskommunikation sex månader efter att de deltagit i fortbildningen. I den första och andra studien (Studie I, II) är resultaten baserade på 23 lärare och i den tredje delstudien (Studie III) baseras resultaten på 20 lärare.

De huvudsakliga resultaten var:

- Det fanns sparsamt med samband mellan lärarnas välmående och rumsakustiken. En förklaring till detta kan vara att lärarna i vår studie överlag hade gott välmående och rumsakustiken var generellt i enlighet med rådande rekommendationer. Däremot visade sig ventilationsbullret i de flesta klassrum överstiga de rekommenderade värdena. De resultat som sågs hade samband med just ventilationsbullret, då lärare upplevde både högre grad av utbrändhet samt mer röstsymptom vid högre nivåer av ventilationsbuller (dBA). Utöver det så framkom att lärare som arbetade i lägre årskurser hade mer röstsymptom än de som arbetade i högre årskurser (Studie I).
- Lärarna hade generellt gott välmående före fortbildningen, men trots det förbättrades deras rösthälsa, välmående och självskattade förmåga (self-efficacy) signifikant efter fortbildningen. Det innebar att de skattade lägre grad av röstsymptom, stress och utbrändhet efter fortbildningen samtidigt som de skattade sin förmåga att hantera klassrummet trots störande inslag som förbättrad (Studie II).
- Sex månader efter fortbildningen beskrev lärarna en ökad medvetenhet och viss förändring i användning av röst och icke-verbal kommunikation samt reflekterade kring förutsättningar för klassrumskommunikation. Lärarna beskrev flera aspekter av röstanvändning, såsom att göra sig hörd, olika sätt att minska röstbelastningen samt en medvetenhet om betydelsen av rösten som arbetsverktyg. Gällande icke-verbal kommunikation beskrevs exempel på att röra sig mer runt i klassrummet, använda sig av placering i klassrummet och även att artikulera långsammare togs upp. Lärarnas medvetenhet kring förutsättningar för klassrumskommunikation knöt till stor del an till aspekter av rumsakustik och ökad medvetenhet kring ljud och

buller i klassrummet samt vad som kan göras för att påverka ljudnivån i klassrummet (Studie III).

- Resultaten indikerar att lärarnas ökade medvetenhet och hantering av klassrumskommunikationen förbättrade deras rösthälsa och välmående (Studie III-II).
- Denna typ av fortbildning rekommenderas och kan med fördel ledas av logoped i samverkan med lärare. Dock vore det bra om grunderna gällande klassrumskommunikation kunde ingå redan under lärarutbildningen för att sedan byggas på när lärarna hunnit verka inom yrket under några års tid.

Yhteenveto

Luokkahuoneessa tapahtuva opettajan viestintä on merkityksellistä sekä vuorovaikutusyhteyden muodostamisessa oppilaiden kanssa, että heidän oppimisensa tukemisessa. Tutkimus on osoittanut, että oppilaiden hyvää kielenkehitystä tukevaa suotuisaa kielellistä viestintää esiintyy luokkahuoneessa vähemmän kuin olisi toivottavaa. Opettajan luokkahuoneviestintä määritellään tässä väitöskirjassa tavaksi, jolla opettaja puhuu ja kuinka hän käyttää muita keinoja eli ei-kielellistä viestintää opetuksessaan ja ollessaan vuorovaikutuksessa oppilaiden kanssa. Näitä tekijöitä ovat puheen ymmärrettävyys, puhenopeus, äänen voimakkuus, äänen laatu ja myös se, kuinka opettaja käyttää katsetta ja eleitä, sekä mihin paikkoihin hän sijoittaa itsensä luokkahuoneessa. Määritelmä perustuu tutkimusryhmän laboratoriotutkimuksiin, jotka ovat osoittaneet, että opettajan puhenopeus ja äänen laatu vaikuttavat lasten suorituskykyyn ja siihen, kuinka rasittavaa kuunteleminen heille on.

Luokkahuoneviestintä on monimutkaista. Siihen vaikuttavat monet sisäiset ja ulkoiset tekijät, mutta luokkahuoneviestintä vaikuttaa puolestaan näihin molempiin tekijöihin. Sisäisiä tekijöitä ovat muun muassa opettajien tietoisuus äänenkäytöstä ja viestinnästä sekä taidot niiden käytössä, kuten myös millainen on heidän ääniterveytensä ja hyvinvointinsa. Ulkoisia tekijöitä ovat muun muassa luokkahuoneen ääniolosuhteet. Joistakin näistä tekijöistä tiedetään enemmän kuin toisista. Opettajien äänenkäyttöä on tutkittu paljon ja todettu, että heillä on enemmän ääniongelmia kuin muilla ammattiryhmillä, ja on osoitettu, että ääniongelmat vaikuttavat heidän viestintäänsä ja työkykyynsä. Lisäksi on todettu, että opettajan käheä ääni vaikuttaa siihen, miten oppilaat ymmärtävät hänen puhettaan ja mitä mieltä he ovat opettajasta. Luokkatilojen huoneakustiikkatutkimuksissa on keskitytty ennen kaikkea melun vaikutuksiin ja todettu, että melu vaikuttaa sekä opettajan ääneen, että hänen hyvinvointiinsa kielteisesti. Eräs opettajan viestintään vaikuttava tekijä on se, miten oppilaat reagoivat hänen viestintäänsä. Tätä ei ole tutkittu kovinkaan paljoa. Tarvitaan enemmän tietoa siitä, miten opettajan hyvinvointi vaikuttaa hänen viestintäänsä mutta myös, miten viestintä vaikuttaa hänen hyvinvointiinsa.

Opettajien viestintä on tärkeää sekä heidän omalle hyvinvoinnilleen ja työkyvylleen, että sille, miten se vaikuttaa heidän oppilaisiinsa. Tästä huolimatta opettajille tarjotaan vain vähän tukea luokkahuoneviestinnästä huolehtimiseen ja sen kehittämiseen. Tämän takia kehitettiin täydennyskoulutusjakso, jonka

tavoitteena on tarjota opettajille tietoa ja käytännön työkaluja näyttöön perustuvan kielellisen vuorovaikutuksen käyttöön. Toisin sanoen siihen, miten opettaja on vuorovaikutuksessa oppilaiden kanssa. Täydennyskoulutuksen tavoitteena oli lisätä opettajien tietoisuutta hyvästä äänenkäyttötekniikasta ja kehittää sitä, optimoida ei-kielellisen viestinnän käyttö, sekä optimoida kielellinen ympäristö. Täydennyskoulutus sisälsi seuraavat viisi moduulia: hyvän äänentuottotekniikan käyttäminen, ääniergonomia, huoneakustiikka, kielenkehitystä tukevat strategiat ja ei-kielellinen viestintä. Täydennyskoulutus kesti viisi viikkoa, 1,5 tuntia viikossa, ja siihen osallistui 25 opettajaa, jotka opettivat 3-6 luokilla olevia oppilaita.

Tämän väitöskirjan ydin oli opettajille annettu täydennyskoulutus, ja mukana olevien kolmen tutkimuksen aineisto kerättiin ennen ja jälkeen koulutuksen. Ensimmäisessä osatutkimuksessa tutkitaan, onko opettajien kokemalla hyvinvoinnilla ja heidän luokkahuoneidensa huoneakustiikalla yhteyttä. Sen jälkeen opettajat saivat koulutusta luokkahuoneviestinnästä. Toinen osatutkimus tutkii koulutuksen vaikutusta opettajien ääniterveyteen ja hyvinvointiin välittömästi koulutuksen jälkeen sekä viiden viikon ja kolmen kuukauden seurannassa. Kolmas osatutkimus kuvaa, millaisena opettajat kokevat luokkahuoneviestintänsä, kun kuusi kuukautta täydennyskoulutuksesta on kulunut. Ensimmäisen ja toisen osatutkimuksen (Tutkimukset I, II) tulokset perustuvat 23 opettajan vastauksiin ja kolmannen osatutkimuksen (Tutkimus III) tulokset perustuvat 20 opettajan vastauksiin.

Päätulokset olivat:

- Yhteydet opettajien hyvinvoinnin ja huoneakustiikan välillä olivat vähäiset. Tämä voi selittyä sillä, että opettajat voivat kauttaaltaan hyvin ja huoneakustiikka vastasi pääpiirteittäin voimassaolevia suosituksia. Sen sijaan osoittautui ilmastoinnista aiheutuva melu ylittävän suositusarvot useimmissa luokkahuoneissa. Tuloksissa näkyikin yhteys juuri ilmastointimeluun, sillä opettajat, joiden luokkahuoneissa ilmastointimelu oli voimakkaampaa (dBA), kokivat enemmän uupumista ja äänioireita. Tämän lisäksi kävi ilmi, että alempien vuosiluokkien kanssa työskentelevillä opettajilla oli enemmän äänioireita kuin ylempien vuosikurssien kanssa työskentelevillä opettajilla (Tutkimus I).
- Opettajat voivat pääpiirteittäin hyvin ennen täydennyskoulutusta, mutta siitä huolimatta ääniterveys, itsearvioidut kyvyt (self-efficacy) ja hyvinvointi paranivat merkitsevästi koulutuksen jälkeen. He arvioivat vähemmän äänioireita, stressiä ja uupumusta koulutuksen jälkeen, samalla kun he arvioivat kykynsä (self-efficacy) hoitaa viestintä luokkahuoneessa parantuneeksi häiritsevistä tekijöistä huolimatta (Tutkimus II).

- Kuusi kuukautta täydennyskoulutuksen jälkeen opettajat kuvasivat olevansa tietoisempia äänen ja ei-kielellisen viestinnän käytöstä ja niiden käytön muuttuneen tietyllä tavalla. Lisäksi he pohtivat luokkahuoneviestinnän edellytyksiä. Opettajat kuvasivat äänenkäyttöä eri näkökulmista, kuten esimerkiksi äänen kuuluvuus, erilaisia tapoja vähentää äänirasitusta ja tietoisuus äänestä työkaluna. Ei-kielellisestä viestinnästä annettiin esimerkkeinä aktiivisempi liikkuminen luokkahuoneessa, oma sijoittuminen luokkahuonetilassa ja myös hitaampi artikulointi. Opettajien tietoisuus luokkahuoneviestinnän edellytyksistä liittyivät suurelta osin huoneakustiikkaan ja lisääntyneeseen tietoisuuteen äänistä ja melusta luokkahuoneessa, sekä niihin keinoihin, joilla luokkahuoneen äänitasoon voidaan vaikuttaa (Tutkimus III).
- Tulokset osoittavat, että opettajien lisääntynyt tietoisuus luokkahuoneviestinnästä ja sen käyttö paransi heidän ääniterveyttään ja hyvinvointiaan (Tutkimukset III-II).
- Tällaista täydennyskoulutusta suositellaan opettajille. Olisi hyödyllistä järjestää se puheterapeutin johdolla yhteistyössä opettajien kanssa. Toki olisi hyvä, jos luokkahuoneviestinnän perusteet voisivat sisältyä jo opettajakoulutuksen opetusohjelmaan. Näitä taitoja voidaan sitten syventää opettajien ehdittyä toimia ammatissa joitakin vuosia.

Acknowledgements

Det finns väldigt många personer som jag vill tacka, men att tacka er alla som på något vis stöttat, gett uppmuntran eller visat intresse för arbetet med forskningsprojektet är inte riktigt möjligt, men ni ska veta att jag har uppskattat det. Så, tack till er alla som på något vis gett uppmuntran under dessa år, men inte omnämns med namn här, till exempel intresserade frågor som kommit vid nätverksträffar med röstergonomiska nätverket.

Först, ett stort tack till er 25 lärare som deltog i fortbildningen! Jag är full av beundran för det arbete ni utför varje dag i era klassrum. Tack också till de rektorer som jag haft kontakt med, till er på utbildningsförvaltningen som svarat på frågor och hjälpt till att fixa praktiska saker och för våra möten. Tack även till den skolpersonal som varit behjälplig för att akustikmätningarna skulle kunna göras.

Ett varmt tack till mina fyra handledare! Jag är så glad över att ha haft just er som mina handledare, med era olika kunskapsområden och personligheter som varit en stor hjälp och förgyllt mitt arbete. Min huvudhandledare, Viveka. Tack för att du har varit generös med din tid, kunskap och dessutom svarat snabbt. Du är både klarsynt i ditt kunskapsområde och en väldigt empatisk och inkännande person. Tack för att du redan från början betraktade mig mer som en kollega och gav mig ansvaret för fortbildningen, även om det innebar många samtal (ibland per dag) till en början. Birgitta, tack för all den kunskap du besitter och generöst delar med dig av (det gäller er alla fyra). Tack också för din otroliga skarpsynthet. Du har en sällan skådad energi och effektivitet och det är lätt att skratta med dig. Jonas, du har alltid kommit med uppmuntran och beröm när du läst mina texter, det har jag verkligen uppskattat! Tack för inspiration till att ta sig an skrivandet och för många tips i den processen. Tack också för våra statistik-samtal. Anna, tack för dina perspektiv på arbetet med fortbildningen och för att du tålmodigt lotsat mig gällande kvalitativ metod och låtit mig växa i den processen. Tack också för alla uttryck som du gett mig, att humla, är bara ett av många som varit användbart i tankarna i projektet (och ibland i min egen process när jag varit trött).

Till alla mina doktorandkollegor. Oj, vad mycket roligare detta arbete har varit med ert sällskap. Om vi börjar från början. Sanna W, tack för att du så entusiastiskt tog emot mig när jag började och för kloka råd längs vägen, fira ofta var ett bra råd. Tack för all pepp! Karolina, vi hann inte dela rum så mycket, men desto mer tack för vår fina grannsämja under de åren vi bodde i Skåne där vi blandat in jobbsnack

också. Sebastian, tack för fina samtal och du gör grymt goda praliner. Synd att vi inte kommer ha vår adventskalender längre. Emily och Ida, vi som hunnit dela mest tid på kontoret. Jag är verkligen glad att vi har fått dela stora delar av den här tiden, vilket också inneburit att vi fått följa varandras liv under flera år. Vilken ynnest att vi haft likande forskningsprojekt och kunnat dela erfarenheter och tips med varandra. Till doktoranderna i ”det andra rummet”. Lara och Johanna, tack för trevliga och intressanta samtal i fikarummet. Och Pontus, vad kul att vi hann dela en del av tiden och kunde diskutera kvalitativ metod. Karolina L, senast in i gänget och jag ser framemot att följa ditt projekt. Emma, även om vi inte varit doktorander vid samma avdelning, så har vi delat huvudhandledare och samtal kring kvalitativ analys. Tack för arbetet med databearbetning och för att det fick mig att få syn på sådant jag hunnit bli hemmablind för.

Tack till alla på avdelningen för logopedi, foniatri och audiologi för intressanta och roliga samtal vi haft i fikarummet, det har verkligen sin charm med en liten avdelning. Ketty, tack för frågor om hur det går och för pepp och mat- och bakprat. Cia, tack för intressanta diskussioner inom det kliniska arbetet med röst och för samarbete inom röstkurser. Helena, tack för hjälp med grupper, scheman och annat relaterat till undervisning och även för fina samtal.

Till kollegorna på Logopedmottagningen i Umeå, tack för de samtal vi haft när jag av logistiska skäl suttit och haft en arbetsplats hos er i början av doktorandtiden. Tack för platsen Alexandra. Jag ser framemot att få jobba lite kliniskt och få dela fikarum med er igen.

Till mina närmsta kollegor på Språkstudier. Tack Maria, Elin och Åsa för att ni tålmodigt svarat på alla frågor när jag kom tillbaka i våras och för er förståelse med att mina tankar ibland varit på kappan samt er flexibilitet med tidsplanering, tack!

Jenny och Elisabeth, tack för zoom-fikor och intresserade frågor och pepp!

Tack till Jonas C för all din kunskap inom rumsakustik, för de rumsakustiska mätningarna och för att du tålmodigt svarat på mina frågor och förklarat rumsakustik både för mig och inom fortbildningen. Tack också för trevligt sällskap när vi haft presentationer på samma ställe.

Pirkko, varmt tack för hjälpen med översättningen till den finska sammanfattningen!

Vänner, tack för att ni får mig att tänka på annat än arbete. Särskilt tack till Malin och Martin som här på slutet tagit med våra sommarlovslediga barn på äventyr och därmed gett mig välbehövlig arbetstid. Tack Freddan och Linda för att jag fått låna ert kontor och framöver när vi ses, så ska jag inte ha med mig arbetsdatorn, varken till kräftskivor eller sommarsemester, jag lovar. Melli, tack för de semesterresor vi haft under dessa år, både med och utan våra familjer, som verkligen gett mig ny energi. Tack också för all hjälp med flytt och allt annat som underlättat i livet utanför jobbet.

Ulla, tack för hämtningar på förskola under de första åren när jag reste mycket.

Skåne-familjen. Marko, Camilla, Marielle och Isabelle. Tack för att vi för det mesta pratar om annat än arbete och den välbehövliga paus som det gett. För att ni peppat mig och trott på mig och gett uppmuntran samt roat våra barn. Sami, tack även för arbetsplats och husrum hos dig vid en av mina 'jobbestrar'. Fabian, tack för att du är med och roar våra barn.

Äiti. Ei sanat riitä kiittää kaikesta avusta. Kiitos yösijasta, ruoasta, auton lainasta, lasten hoidosta ja kaikesta muusta! Kiitos myös siitä, että olet aina näyttänyt optimistinen lähestymistapa elämään!

Adela, tack för din diplomatiska sida och ditt lugn i familjen. Mika ja Milla, kiitos että saate minut elämään nykyhetkessä. Olette niin ihania kaiken teidän energian ja uteliaisuuden kanssa. Nyt tämä kirja on valmis ja nyt me tutkitaan ihan muita asioita, yhdessä.

Älskling. Tack för att du fick mig att söka samt tacka ja till doktorandtjänsten som att det var en självklarhet, även om det skulle innebära en flytt på 125 mil. Tack för att du fick mig att börja cykla och för att du servat såväl min cykel som familjen med många goda middagar. Tack också för att du påmint mig om vikten av återhämtning, jag ska bli lite bättre på den biten nu.

Tack till Marcus och Amalia Wallenbergs minnesfond som genom sitt anslag finansierat detta doktorandprojekt!

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Training teacher communication in the classroom

In this thesis, different factors affecting classroom communication are described. The implementation and evaluation of an in-service training program on classroom communication for teachers is presented. Twenty-five teacher participated in the in-service training. Prior to the in-service training the relationship between the teachers' well-being and acoustical properties of their classrooms were investigated. After the in-service training the effects of the training on the teachers' vocal health and well-being was assessed. The final evaluation was conducted six months after the in-service training and surveyed the teachers' own descriptions of their classroom communication skills.

Teachers' vocal health and well-being were favourable already from start. Teachers working in classrooms with higher ventilation noise reported higher degree of burnout and more voice symptoms. After the in-service training, there were significant improvements on vocal health and well-being (stress, burnout and self-efficacy). The teachers gave examples of implementing their increased awareness into new practices and reflected on reflected on prerequisites for classroom communication.

In conclusion, the training gave positive results and this type of in-service training can be recommended for teachers.

Printed by Media-Tryck, Lund 2021 NORDIC SWAN ECOLABEL 3041 0903

LUND UNIVERSITY

FACULTY OF MEDICINE

Clinical Sciences,
Logopedics, Phoniatrics and Audiology

Lund University, Faculty of Medicine
Doctoral Dissertation Series 2021:85
ISBN 978-91-8021-092-8
ISSN 1652-8220