

Can school nurses improve the school environment in Norwegian primary schools?

A protocol for a randomized controlled trial

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ABSTRACT

This protocol describes a randomized controlled trial where additional school nurse resources are assigned to work systemically with schools to improve the school environment and reduce bullying among and absence of 5th–7th grade students. Approximately 9,000 students will have participated each year from 2018–2020 from 107 schools located in 12 Norwegian municipalities. Academic performance is studied as a secondary outcome.

Keywords: RCT, School health service, Nurse, Learning environment, Systemic collaboration

1. Introduction

Having a positive school environment without bullying is important for students' well-being, health, and academic performance, both while in school and later in life (Mega, Ronconi, & De Beni, 2014; Ttofi, Farrington, Lösel, & Loeber, 2011). In Norway, strengthening the school health service is at the core of the government's strategy for a better psychosocial school environment (The Norwegian Ministry of Health, 2016), alongside ambitions for closer collaboration among professions working in schools (The Norwegian Directorate of Education and Training, 2017; The Norwegian Directorate of Health, 2017a). Nevertheless, the evidence on whether and how school nurses can contribute to desired student outcomes—such as improved well-being, reduced bullying, and less absence, all of which could improve academic performance—remains scarce, both internationally (Maughan, 2016) and in Norway (Borg, Drange, Fossetøl, & Jarning, 2014). This protocol describes a randomized, controlled trial that investigates how an increased school nurse resource placed at randomly selected schools, working in systemic and structured collaboration with the schools over a period of two years, affects 5th–7th grade students in 12 Norwegian municipalities. These students are 10–12 years old and on the threshold of adolescence where they gradually must take greater responsibility for their own lives and choices. In this phase of identity development, experiences and perceptions at school may be decisive for a vast number of outcomes and for prospects and choices later in life.

According to Maughan (2016), there is a dearth of research on the impact of school nurses, and measuring the benefits of having school nurses is complex, *inter alia*, because nurses form part of a larger team. However, available studies indicate that healthcare workers in schools may positively affect student absence, risk behavior, and teachers' time devoted to teaching. For instance, a systematic review of Maughan (2003) revealed a positive association

between school nurse presence and student absence. Furthermore, prolonged absence has been found to result in a significant risk of reduced school performance (Credé, Roch, & Kieszczyńska, 2010). In terms of avoiding risk behaviors, school nurses have been found to help students on a broad spectrum of issues, including to stop smoking, lose weight, avoid pregnancy, and improve their mental health (Maughan, 2003).

Two studies have investigated gains to teachers from being assisted by school nurses. A study by Baisch, Lundeen, and Murphy (2011) concluded that healthcare workers relieved teachers of work, thus increasing their time devoted to teaching. The conclusion, however, was based on teachers' *ex post* descriptions of the situation before and after an increase in the school nurse resource—and the intervention was not randomized. Cappella, Jackson, Bilal, Hamre, and Soulé (2011) studied the interaction between teachers and students with and without learning problems, concluding that school healthcare personnel may be important for students' development when the health workers support and guide the teachers about such interactions. The authors stated that strengthening the interaction between the teacher and student is a primary mechanism of development and learning for both children with behavioral problems and their fellow students.

All these factors suggest that nurses may influence student learning (Borg et al., 2014; Maughan, 2003, 2016). This may occur through reduced absence and empowering students to believe that they themselves can master challenges in everyday life. Strengthening the school health service in Norway has been described as having great potential compared with other interventions since having a school health service is mandatory for all municipalities, there is a political interest in Norway for upgrading the school health program, and there is a relatively clear understanding of tasks, responsibilities, and roles for the service (Borg, Christensen, Fossetøl, & Pålshaugen, 2015). However, further research that specifically

investigates causal relations between school nurse interventions and student perceptions of the school environment and academic outcomes is called for.

Thus, the present study aims to contribute to the knowledge base in this area by investigating possible effects of an increased school nurse resource on the psychosocial aspects of the learning environment. Specifically, we will study student emotional well-being, school belonging, bullying, and student attendance as primary outcomes, as well as other learning-related outcomes, such as motivation, academic self-concept, achievement, and performance on academic tests as secondary outcomes.

The study also seeks to contribute to increasing knowledge on how collaboration among different professions at schools may be improved. A challenge that has been identified in the Norwegian public management structure is that school nurses are not administratively part of the school and are not always an integrated part of the school's response to student needs (Borg et al., 2015). In this trial, school nurses, school administrators, and teachers have therefore engaged in a systemic and structured collaboration. *Systemic collaboration* means that school nurses are involved in the school's management with overseeing the health and well-being of the students, including initiating and implementing universal and preventive measures targeting psychosocial aspects of the learning environment. *Structured collaboration* means that schools and school nurses organize their collaboration by regular meetings/contacts in contrast to collaboration based only on irregular and arbitrary contacts between schools and the school health services.

In the next section, we present a theoretical model of hypothesized relations guiding the study. As previous studies on the effects of school nurse interventions and student outcomes are scarce, we partly use theoretical frameworks from education research to inform our theoretical rationale and expectations.

1.1 Objectives and theoretical model

The overall objective is to study the effect of an increased school nurse resource in a systemic and structured collaboration on primary school students' psychosocial environment, and secondarily, their broader learning environment and academic outcomes. Fig. 1 illustrates how the intervention is hypothesized to affect outcomes on three different levels: the student level, the teacher level, and the school level. It also shows which sources of data that will inform the effect evaluation and the implementation and process evaluation, respectively.

Fig. 1 about here

The primary outcome is students' psychosocial environment, measured as their sense of emotional well-being in school, school belonging, bullying, and registered absence. Students' sense of well-being in school in the form of positive academic emotions has been found to be related to better motivation and academic results (Mega et al., 2014). Other research has indicated that school belonging and positive teacher-student relations are predictive of student engagement and achievement (e.g., Cornelius-White, 2007; Danielsen, Samdal, Hetland, & Wold, 2009; Federici & Skaalvik, 2014; Roorda, Koomen, Spilt, & Oort, 2011; Wang & Holcombe, 2010). Thus, if the school nurse could reduce the time that the teacher spends on health issues among students (Baisch et al., 2011), this could allow the teacher to focus more on creating learning-enhancing relationships with the students and teaching. Moreover, the school nurse may help identify students who find social relationships at school difficult and, thus, cooperate with the educational staff to promote the social inclusion of students. Involvement in the prevention of bullying and rehabilitation of students who have been exposed to bullying has been suggested to be a particularly important role for school nurses (Tharaldsen, Slåtten, Hancock, Bru, & Breivik, 2017). Research has suggested that exposure to bullying could seriously impede academic achievement (Bru & Hancock,

2017). Therefore, if the school nurse could help the school become more effective in preventing bullying and alleviating the negative consequences of being bullied, this could improve well-being and academic achievement among students. Finally, a previous Norwegian study found that school absence, even to a limited extent, can be traced to somatic illness (Havik, Bru, & Ertesvåg, 2015). Also, absence from school is a risk factor for lower academic achievement (Credé et al., 2010). The school nurse could help identify students with worrisome absence and help them increase their attendance, and in this way, contribute to enhancing academic achievement among students (Weismuller, Grasska, Alexander, White, & Kramer, 2007)

To understand how the intervention affects the students, it is also important to understand whether the increased school nurse resource is used in a systemic and structured way. The collaboration will be assessed both from the school nurses, the teachers, and the school administration's points of view. Moreover, we hypothesize that the quality of implementation is decisive for the degree to which an increased school nurse resource affects the students' learning environment and academic outcomes. Thus, one important aspect of the implementation and process evaluation consists of teachers' perceptions of school nurse availability and support in tasks related to students' health and psychosocial environment. As indicated in Fig. 1, we will also study to what degree teachers perceive that more time may be devoted to teaching during the intervention and to what extent the students at the treatment schools perceive increased availability of the school nurse.

The outcomes at the school level are all related to the implementation and process evaluation. We will ask nurses and school leaders at the treatment and control schools to what degree the school nurses are included in planning and decision-making related to student health and the psychosocial learning environment. In addition, important goals of the

implementation and process evaluation are to explore concepts such as fidelity and dosage, that is, the extent to which the school nurses adhere to the intervention and to what degree the additional resource is used at the treatment schools. Finally, qualitative interviews will be conducted with school leaders, school health nurses, heads of education and health departments at the municipal level, as well as group interviews with 5th–7th grade teachers and the Parents Working Committees at selected intervention and control schools. One aim will be to explore aspects of implementation, for instance, whether planning and decision-making in schools take health promoting aspects into account and if the schools perceive that the extra resource alleviates tasks from other staff members, thus freeing up time which can be used for promoting academic performance. A summary of the trial's inputs, activities, outputs, and impacts is shown in Table A1 (Appendix 1).

2. Description of context

The municipalities in Norway are obliged to provide health station services and school health services to children and youth aged 0–20 years. The main purpose of these services is to promote a good environment for children's physical and psychosocial development with easy access (The Norwegian Ministry of Health, 2003). The school health service is obligated to cooperate with the schools and other health services to identify and solve health challenges among the school's students (The Norwegian Directorate of Health, 2017a). School nurses make up about 78% of all full-time equivalent positions of the school health services in primary schools and are the main providers of these services (The Norwegian Directorate of Health, 2016). Females are highly overrepresented among school nurses, as only 0.3% are males (Sykepleierforbundet, 2018). School nurses are certified nurses and need a specialization in preventive and health promoting work to hold permanent positions. The activities of the school nurse consist mainly of preventive work or health promotion work,

such as providing vaccinations, providing information on health issues, and offering counselling to individuals or groups, as well as referring children to other health services when necessary (The Norwegian Directorate of Health, 2017a).

The Norwegian school health service is organized at the municipal level, and the school nurses usually work on the school's premises. School nurses may work at several schools and may combine her/his position with activities at the health station and at schools. There is a set national norm of a minimum of one nurse per 300 students in primary schools, but the norm is not binding, and only 2.5% of primary schools in Norway adhered to the norm in 2015 (Waldum-Grevbo & Haugland, 2015).

The extra resource provided by this project is deployed during a period of rapid expansion of the school health service in Norway, which led to a 25% increase in school health positions in the 2010–2015 period (author's calculations based on data from Statistics Norway). Continued expansion thereafter initially came as budget support to municipalities and in 2016, through targeted funding from the central government (The Norwegian Ministry of Health, 2016). In 2017 and 2018, an incentive issued by the central government for having allocated budget support to the school health service and community health stations provided further expansions in compliant municipalities (The Norwegian Directorate of Health, 2017b). Thus, municipalities have great discretion in choosing the level and distribution of school nurse coverage in their primary schools and are likely to increase their nurse coverage during the project period.

3. Trial design

This project is a cluster-randomized controlled trial in which four schools in 12 municipalities, respectively, are randomly selected to receive a 12.5% position increased school nurse resource from January 2018 to December 2019. The school nurse should work in

a structured and systemic collaboration with the school, and the resource should target 5th–7th grade students. The primary hypothesis is that an increased nurse-to-student ratio will improve students' self-reported measures related to psychosocial aspects of the learning environment and reduce student absence.

3.1 Participants

The participants in the present study are comprised of approximately 9,000 5th–7th grade students each year from 12 not randomly selected municipalities. To be invited, the municipality had to have at least eight primary schools with at least 20 students in grades 5 to 7 (we used the primary and lower secondary school information database (GSI) [www.gsi.udir.no] to obtain these data). Municipalities engaged in other large Nordic Institute for Studies in Innovation, Research and Education (NIFU) projects¹ at the time or who participated in the other “Team around the Student” project (“Improving Inter-Professional Collaboration in Norwegian Primary Schools,” conducted by the Work Research Institute²) were excluded to avoid contamination. A total of 31 municipalities were invited based on the predefined inclusion/exclusion criteria (see flow diagram in Chapter 4), and ultimately a total of 12 municipalities agreed to participate. Random assignment was conducted after the agreement of collaboration was signed by the participating municipalities.

Table 1 shows the number of schools and students participating within each municipality based on the municipalities' own estimates for the 2017–2018 school year. The surveyed student population is made up of repeated cross-sections of the students in the target group at each point in time. Note that schools within each municipality with fewer than 20 students were not invited and, thus, are not included in the table. Moreover, although some of

¹ For instance, the “Small Group Instruction in Mathematics for Pupils Level 1-4.” See <http://1pluss1prosjektet.no/frontpage>

² Protocol available at <https://clinicaltrials.gov/ct2/show/study/NCT03248245?term=54470&rank=1#contacts>

the participating schools are private, they use the same school health services as the public schools. However, private schools are not subordinates of the municipal authority, so we contacted the headmaster/head of administration at each school and invited him or her to participate in the project. Only one private school declined.

Table 1 about here

Regardless of the total number of participating schools within each municipal authority, four schools were randomly assigned to the treatment group with the rest of the schools were assigned to the control group (for details see Chapter 3, Randomization).

3.2 *Intervention*

The *dosage* in the project comprises a 50% position increase in each participating municipality's school health service. More specifically, the additional resource is to be used to increase the presence of the school health service at the four schools in the treatment group. This comprises a 12.5% position additional availability of the school nurse at each school—targeting the students in 5th, 6th, and 7th grades.

The additional school nurse resource should provide services in accordance with the guidelines for the school health service (The Norwegian Directorate for Health, 2017a). These guidelines highlight that the school health service should work in systemic collaboration with the staff at schools. The school nurse should collaborate with the schools in getting an overview of the student population's health and well-being and identifying possible areas where the school nurse could contribute to positive measures regarding health-related issues and illness prevention, as well as measures for all students or groups of students in the 5th–7th grades with an emphasis on improving the students' psychosocial environment. Thus,

systemic here means working in a universal and preventive manner with the psychosocial aspects of the learning environment.

In addition to collaborating with the school staff in a systemic way and in accordance with the guidelines, the intervention is also structured by a set of criteria. That is, the municipal authority should have a plan for how to organize the additional resource, and the schools should have plans for how frequently the meetings will take place, what will be discussed at them, and how measures will be followed up. Although the municipal authority, the schools, and the school health service are given local autonomy, some structure is a prerequisite for being able to work systemically, for collaboration to occur, and for not having to rely solely on individual arrangements. The criteria (principles), inputs, and other activities will be presented in the following sections.

3.2.1 Principles for the additional resource

The municipalities, and thus the school health service and the treatment schools, agreed to the following guidelines governing the use of the additional school nurse resource:

- 1) The treatment schools must receive at least 3.25 additional hours each per week with an actively present school nurse targeting the students. In addition, 3.25 more hours per week should be devoted to administrative tasks in each municipality (out-of-school meetings, courses, etc.). If administrative time is not needed, the time should be used at the treatment schools.
- 2) The increased school nurse resource must be organized in a way that avoids excessive splitting up of the service to multiple nurses within each school. One school nurse can cover a maximum of two treatment schools.

- 3) The increased school nurse resource must be organized in a way that enables the school nurse to work systemically and in a structured way. Plans and measures must be aimed at students in the 5th–7th grades and should not result in increased segregation of students.
- 4) The increased school nurse resource must work in accordance with the guidelines for the school health service. As previously mentioned, the guidelines underscore that the school health service should work systemically and in structured collaboration with the schools. Moreover, they consist of descriptions of various tasks and themes that the school nurse should be involved in. The intervention should focus on themes and tasks related to the student psychosocial environment.
- 5) The increased school nurse resource should identify specific health promoting and preventive measures that will improve the students' psychosocial environment at each treatment school. Also, at the initial meeting between the school and the additional school nurse, a fact sheet consisting of data from the Norwegian Pupil Survey (concerning the students' learning environment) and a synthesis of the guidelines for the school health service will be provided.

3.2.2 Workshop, initial meeting, and meeting series

The school health service, the school nurses, headmasters at the treatment schools, and the municipal authority were invited to a two-day workshop at the beginning of the project (January 2018). The workshop was comprised of introductions, presentations, group tasks, and discussions. The researchers also presented a guide that included state-of-the-art research findings about various aspects of student learning environments. The guide was produced by the research consortium and provides tips and ideas regarding how to work in a systemic and structured manner within the student psychosocial environment. Note that the workshop did not include any courses or presentations that could be regarded as formal education.

The participants were also presented with guidelines for the initial meeting and further meetings between the school nurse and staff at the treatment schools (e.g., headmasters, 5th–7th grade teachers, students, and other socio-pedagogical professionals). The headmaster at each treatment school is responsible for initiating the first meeting. The purpose was to get an overview and establish a common understanding of the 5th–7th grade students' well-being and identify factors contributing to or preventing the development of a positive psychosocial environment. Furthermore, key measures to improve the students' learning environment to which the school nurse would contribute had to be formulated and reported to the researchers. A plan for further meetings was decided upon by the participants, and meetings are to be carried out at least three times each semester. At these meetings, the participants should follow up proposed measures, discuss the need for changes in measures, or develop and implement new measures.

To summarize, the school nurse and the staff at the treatment schools have extensive autonomy to decide on how to use the additional resource, as long the measures are systemic, the collaboration is structured, and the resource is used in line with the principles and guidelines presented above.

3.3 Implementation and process evaluation

The study of effect is accompanied by a thorough implementation and process evaluation (IPE). An IPE refers to the generation and analysis of data to examine how an intervention is put into practice, how it operates to achieve its intended outcomes, and the factors that influence these processes (Humphrey et al., 2015). In the present study, the IPE is informed by both quantitative and qualitative data.

To investigate whether the nurses have spent the right amount of time in each school, we apply a time registration survey to all nurses working in primary schools within each

participating municipality. The survey is distributed to all school nurses once every four weeks, and they are asked to report time use and activities for the following week. In addition, surveys are distributed twice a year during the project period to the headmasters, teachers, and school nurses. The aims of these surveys are twofold: first, they explore to what degree the involved actors perceive that they work in a systemic and structured manner. Second, they explore to what degree the guidelines are being followed and whether the school nurses are included in planning and decision-making at the schools. To complement these surveys, all treatment schools must provide the researchers with a report from both the initial meeting and the subsequent meetings. Finally, qualitative interviews are conducted with representatives from the school, municipal authority, school health service, teachers, and Parents Working Committees at both the intervention and control schools.

3.4 Study of effect outcomes

The primary and secondary outcomes of the effect study are comprised of both subjective and objective measures. The subjective measures are students' perceptions of psychological and social dimensions related to the psychosocial aspects of the learning environment, whereas the objective measures are student attendance and student achievement—the latter measured as results on the Norwegian National Tests.

Our categorization of the outcomes is inspired by the framework used in the Programme for International Student Assessment (PISA) for measuring student well-being (for details, see Organisation for Economic Co-operation and Development [OECD], 2017). The OECD (2017) defines well-being as a multi-dimensional construct comprised of psychological, social, cognitive, and physical dimensions, which together are indicative of students' functioning and well-being (Borgonovi & Pál, 2016). These dimensions are all influenced by students' proximal context, such as the school learning environment. In their report, the

psychological dimension of students' well-being is described as students' sense of purpose in life, self-awareness, affective states, and emotional strength. These perceptions are, in turn, supported by self-esteem and motivation and hindered by anxiety and stress. The social dimension refers to students' social lives and includes aspects such as relationships with family, peers, and teachers, as well as exposure to bullying. The cognitive dimension of students' well-being refers to the cognitive foundation students need to participate fully in society. In the PISA of 2015, this dimension was measured as students' achievement across the PISA domains. Finally, the physical dimension refers to students' health. PISA does not measure students' health directly, but provides self-reports on physical activity and eating habits (OECD, 2017).

As with conceptualizations of student well-being, definitions of the school learning environment (and school climate) often indicate a multidimensional structure of the construct. For instance, Cohen, McCabe, Michelli, and Pickeral (2009) define a learning environment as “the quality and character of school life. School climate is based on patterns of people’s experiences of school life and reflects norms, goals, values, interpersonal relationships, teaching and learning practices, and organizational structures” (pp. 182). Such a definition indicates that students’ perceptions of the learning environment should be captured by several indicators covering different domains. Thus, we adopt a similar categorization as the OECD framework for measuring subjective and objective aspects of students’ self-perceptions related to the learning environment at school. Combined, these measures cover various aspects of the students’ learning environment.

3.4.1 Measuring the outcomes

The subjective measures of learning environment are measured by the Norwegian Pupil Survey. This survey is administrated by the Norwegian Directorate for Education and

Training (see <https://www.udir.no/in-english/>) and given twice each school year (autumn and spring). It is compulsory in the autumn for 7th, 10th, and 11th grades. However, all schools with students from 5th–13th grade are encouraged to include all grades in the survey, and the decision whether or not to participate is usually taken at the municipal or school level.

The survey consists of both compulsory questions that vary among the levels (e.g., upper primary level, lower secondary level, and upper secondary level) and optional questions. In the present study, we use compulsory measures, optional questions, and additional questions. The compulsory measures have been utilized since the last revision of the Norwegian Pupil Survey in 2012 and have been subjected to both exploratory and partly confirmatory factor analysis (CFA) (Federici, Caspersen, & Wendelborg, 2016; Federici & Wendelborg, 2013; Wendelborg, Røe, & Federici, 2014). Regarding the additional questions, we use previously validated measures and single items specifically developed for the study. The scales and items are presented in Tables 2 and 3. Note that the survey is administrated in Norwegian (bokmål or nynorsk); thus, the listed items represent translations into English.

3.4.2 Primary outcomes

The four primary outcomes measure a psychological dimension of well-being, a social dimension, and student absence. The social dimension is comprised of two subdimensions. Each dimension is connected to several secondary outcomes as well (see section 3.4.3).

The *psychological dimension* comprises students' perceived *emotional well-being* at school and focuses on affective states and emotional responses in class during the previous week. The measures were inspired by the *core affect scale* developed by Russell (2003); however, we use a short version consisting of five items to ascertain both positive and negative affect. A similar short version has been employed in previous studies such as in the Children's Worlds, the International Survey of Children's Well-Being (Rees & Main, 2015)

and has successfully been administered to Norwegian 5th–7th graders in the Ungdata Junior project (Løvgren & Overå, 2017). In the present study, responses are given on a five-point Likert scale ranging from (1) “never” to (5) “always.” In our analyses, the scale will be used as a composite measure indicative of students’ emotional well-being. Note that the measure has been subjected to quantitative and qualitative piloting with students in 5th and 6th grade. Moreover, the initial analyses will include confirmatory factor analyses to ensure scale reliability and validity. Items that do not reach statistical significance and other measures of goodness of fit statistics, such as comparative fit index (CFI), incremental fit index (IFI), Tucker Lewis index (TLI), root mean square error of approximation (RMSEA) (Hoyle, 2012; Kline, 2011; Tabachnick & Fidell, 2007) in baseline data will be excluded. For the CFI, IFI, and TLI indices, values above .90 are typically considered as acceptable, whereas values greater than .95 indicate a good fit (Hoyle, 2012; Hu & Bentler, 1999; Kline, 2011). For well-specified models, an RMSEA of .06 or less reflects a good fit (Byrne, 2010; Tabachnick & Fidell, 2007).

The *social dimension* comprises school belonging (or relatedness) and bullying. The OECD defines a sense of belonging as a feeling of acceptance and being liked by the rest of the group, feeling connected to others, and feeling like a member of a community (Baumeister & Leary, 1995; OECD, 2017). School belonging is measured using six trend items previously used in PISA 2012 and PISA 2015. Responses are given on a five-point Likert scale ranging from (1) “strongly disagree” to (5) “strongly agree.” In the PISA of 2015, the reliability of the scale (the Norwegian questions) was .86. Note that the answering format in the PISA is a four-point Likert scale with the answers of “strongly agree,” “agree,” “disagree,” and “strongly disagree.” We chose to include a “neutral” option to increase reliability—a five-point Likert scale is the standard response format in the Norwegian Pupil Survey.

Bullying is measured by one item, and the question is compulsory in the Norwegian Pupil Survey. The students are asked whether they have been bullied by other students at school during the past few months. The response choices are “not at all,” “rarely,” “2 or 3 times a month,” “about once a week,” and “several times a week.” In the literature, there is a lack of consensus regarding the frequency of bullying that should occur to be defined as bullied. For instance, Olweus (2013) suggests two or three times a month, while Roland (1999) proposes once or up to several times a week. In research reports analyzing the Norwegian Pupil Survey data, a student is defined as bullied if he or she experiences bullying two or three times a month or more (Wendelborg, 2017). Moreover, the research reports provide information regarding the criteria for excluding unreliable/unserious responses. Respondents who state that they experience bullying from others, from teachers, and cyberbullying several times a week, and state on the same questions that they bully others, are excluded from the analysis. In the Norwegian Pupil Survey for 2016, this amounted to 0.1% (623 students) of the respondents (Wendelborg, 2017).

The final primary outcome is student absence. Each semester (spring/autumn), the participating municipalities provide deidentified absence data for all pupils in the target grades for each school to the researchers. The data are structured on the individual level with a unique identification number for the individual student. Note that the researchers do not know the reasons for students’ absence.

3.4.3 Secondary outcomes

As with the primary outcomes, the secondary outcomes comprise a psychological dimension, a social dimension, and a cognitive dimension. Table 3 gives an overview of the secondary outcomes.

The cognitive dimension is assessed on one of the Norwegian National Tests. The national tests were introduced in Norway in 2004 as part of a quality assessment system in education. These tests are administered every autumn for 5th, 8th, and 9th graders and focus on core academic skills, namely, numeracy, literacy, and English. The main purpose of the tests is to provide educational authorities at local and national levels with information on general student competency after the 4th, 7th, and 8th years of compulsory schooling.

We will use two types of tests that are already implemented in schools. The national test in reading, English, and mathematics for 5th grade students will be used to measure pre-intervention levels in students' achievement. These national tests are available for the entire Norwegian student population, with a few exemptions. The cohort born in 2006 took the 5th grade test in the fall of 2016. They will take a national test in the same subjects in 8th grade in the fall of 2019 when students who attended the treatment schools have been exposed to 1.5 years of an extra school nurse resource. We will compare development in test results in 8th grade between the treatment and control schools for this cohort. Depending upon additional funding, we will also conduct a study of the 2007 cohort, who took the 5th grade test in 2017 and will take the 8th grade test in 2020, to measure the impact of the full two years of intervention and studying effects on the two cohorts combined.

We also include a measure related to the implementation and process evaluation in the Norwegian Pupil Survey. The students are asked two questions regarding to what degree they know the school nurse and whether the school nurse is an "adult that is easy to talk with." The main purpose of these questions is to investigate possible differences in perceptions of the school health service between the treatment and control schools.

Tables 2 and 3 about here

3.5 *Sample and effect size*

The sample used in this study consists of approximately 9,000 students in the 5th–7th grades at each point in time, distributed across 12 municipalities and 107 schools. The sample size was determined based on an initial power analysis. With access to more data, we can present an updated power analysis of the detectable effect size in this study. The power analysis concludes that the randomized controlled trial (RCT) can detect a minimal effect size of 0.12 SD with 95% confidence, using standard assumptions in the literature.

For most of the measures that we will use in the study, previous measures are not available. Furthermore, data on learning environment from the Norwegian Pupil's Survey are only available for 7th grade. Therefore, we use a measure that we believe is highly correlated with our main outcomes and which was asked both in 2016 and 2017. We use two questions to make this measure: one question on whether the student likes it at school, and one about whether the student has fellow students to be with during breaks. The responses to the questions are given values of 1–5, where 5 is the most positive response. The statistic is then standardized and, thereafter, averaged across the two items. This average is then standardized again. The intraclass correlation of this variable, which we can call well-being, is 0.02.

To conduct the power analysis, an additional term was added to the well-being statistic of treatment schools to simulate the effect of an intervention. The term was a normally distributed random variable. Terms with means of 0.1 and 0.2 standard deviations (*SDs*) were tested, and 98% of the variation was added as an individual effect and 2% as a shared school effect. This was simulated 400 times, and minimum detectable effect sizes were then calculated.

The effect sizes were calculated in two models, one which included the school mean score of 7th grade responses in 2016, with sex, grade, and strata as controls, and one with only

strata as control variables. The correlation rate of the 2016 school mean with the 2017 individual scores was only 0.05. Furthermore, the predictive value of the previous score was not significant.

In the simulation, we used data from 8,529 students in 107 schools in the first model and 8,232 students in 102 schools in the extended model with baseline controls. Table 4 shows the results of the simulations after correcting the significance levels for multiple hypotheses testing using the false discovery rate method (see Chapter 4 for details). We found that all models had at least one significant result. However, when testing four hypotheses simultaneously, only 20% had all four effects when adding an *SD* of 0.1 without controls, and 25% when the baseline control was added. With an *SD* of 0.2, which was the planned effect size, both models had significant results in every attempt. Further simulations found that the four hypotheses were falsified with 80% probability with an effect size of 0.12 *SD*. In practical terms, this amounts to raising the level by one category on the Likert scale for 1 in 10 students, or relieving 1 in 30 students from experiencing severe bullying.

Table 4 about here

4. Randomization

Causal inference based on this trial relies on the comparison of schools that were randomly selected to receive an extra school nurse resource with schools whose nurse-to-student ratio was unaffected by the trial. For this trial, we used a stratified, cluster-randomized design. First, the selection of schools was stratified by municipality. Within each municipality, four schools were selected to receive the treatment and all other schools that fulfilled the selection criteria were followed as a control group. The reason for stratifying at the municipal level was both practical and purposeful. As the responsibility for the school

health service lies with the municipality, an equal allocation of resources to each municipality was necessary for recruitment. Since factors that are likely to influence the learning environment (such as socio-economic background, prior nurse coverage, and school quality) vary among municipalities, stratification at this level improves balance.

We then stratified a second time within each municipality, based on the measure of well-being presented in Section 3.5, and the number of children who reported being bullied 2–3 times per month or more frequently, a limit recommended by Olweus (1991). This was done to improve the balance between the control and trial groups along relevant dimensions. In this way, we followed Athey and Imbens (2017) who argue that stratification until there are two treated units within each stratum is the method that leads to the smallest standard error (*SE*), tangent to other methods such as re-randomization.

Each municipality was thus divided into two strata to balance both the combined well-being indicator and the bullying indicator. To do this, we followed a similar strategy as that used by Greevy, Lu, Silber, and Rosenbaum (2004) and King et al. (2007) for optimal multivariate matching before randomization. Within each municipality, we ranked each school according to student well-being and bullying. With these two rankings, we calculated the Mahalanobis distance to the top ranking (1,1). Each municipality had from 7 to 13 eligible schools, and the lowest performing half, based on the Mahalanobis score, became one stratum, and the highest performing half, another stratum. In cases where there was an odd number of schools in the municipality, a random school was randomly placed in the lower or the upper stratum. The process from recruitment through school selection is described in the flow chart (Fig. 2).

Fig. 2 about here

4.1 Tests of randomization

To test whether the randomization successfully balanced treatment and control schools along significant dimensions, we conducted several tests of balance for relevant outcomes (Table 5). We performed a simple linear regression for each outcome, with a treatment indicator as the explanatory variable and controlling for strata. For the school health services and school traits outcomes that are observed at the school level, we used the number of students within the targeted group at each school as weights in the regression.³

In September 2017, before the municipalities knew which schools were selected to get the extra school nurse resource, we collected data on several school nurse variables. In column 1, we first consider the total school nurse coverage, that is, the total school nurse manpower assigned to the school, expressed as a share of full position equivalents. However, the number of grades a school nurse covers varies among schools, and this creates differences in the school nurse coverage assigned to the target group, depending on how many other grades the nurse is responsible for. In column 2, we therefore consider the school nurse coverage for 5th-7th grade, based on an assumption that the nurse divides the time equally between grades. In column 3, we consider how the randomization is balanced across schools with varying number of students in the target group, and column 4 considers the student-to-nurse ratio in the target group. We combine the data on nurse coverage with data from the GSI database (www.gsi.udir.no) on the number of students in the 5th-7th grades to obtain this ratio.

Table 5 about here

³For 14 schools, we do not have information on the school nurse's years of experience, for 20 schools the age of the school nurse is missing, and for seven schools, we do not have information on the educational background of the school nurse.

The results of the balance tests on school health services and school traits presented in Table 5 indicate no significant difference between treatment and control schools regarding school nurse coverage at the schools (column 1) and in the 5th–7th grades (column 2), or the number of students in the target group (column 3). We find that the student-to-nurse ratio on average is higher in treatment schools by 120 students per nurse (column 4).⁴ For the schools where we have available data, we do not find significant differences between treatment and control schools regarding years of experience, age, or educational background of the school nurse (columns 5 to 7).

During the autumn of 2017, all students in the 5th–7th grades at the 107 schools in the research project were given the additional questions in the Norwegian Pupil’s Survey. We tested whether the randomization successfully balanced three of the primary outcomes described earlier: social well-being, emotional well-being, and bullying.

Table 5 also shows the results from the balance tests of the three primary outcomes.⁵ There was no significant difference between treatment and control schools in any of the three primary outcomes. Overall, the results from these tests indicate that the randomization successfully balanced the treatment and control group along most of the school and nurse traits, as well as the three primary outcomes.

5. Analysis plan

This trial will test the hypothesis that additional school nurse resources contribute to the four primary outcomes defined in this protocol. These four outcomes will be measured at

⁴ Two schools had zero school nurse coverage, and thus, the student-to-nurse ratio was not calculated for these schools.

⁵ The number of observations was larger for the variable reflecting experience with bullying than the other two variables. This was mainly due to six schools failing to let pupils from all three grades answer these questions. A second reason was that some pupils were not included in the analyses because they had failed to answer all the questions included in the well-being factors.

five points in time, before the trial begins at t_0 and each semester during the trial (t_1-t_4). The final analysis will use all time points t_1-t_4 controlling for the levels in t_0 , but a separate analysis will also be conducted at each time point t_1-t_4 . Specifically, we are interested in whether the nurse-to-student ratio affects the outcomes (Guttu, Engelke, & Swanson, 2004). Using the nurse-to-student ratio is a convenient way of handling three factors that may confound a reduced form estimate. First, the school size in our study varies considerably from 20 students in the 5th-7th grade target group to 238 students. We would expect that the same absolute increase in school nurse coverage would have a larger impact in a small school than in a large school. Second, school nurse coverage is decided at the municipal level⁶ and, thus, varies considerably between municipalities. Furthermore, the nurse coverage is likely to increase during the period under study. Third, there is a potential issue of partial compliance (Glennerster & Takavarasha, 2013), and we want to be able to conduct the analysis even if compliance is sub-optimal. Our main specification will therefore use the instrumental variables method to estimate a local average treatment effect (Angrist & Pischke, 2008), given that we obtain a first-stage F -statistic of 10 or above. Results will be interpreted as effects of an increase in the nurse-to-student ratio from the mean which corresponds to the increased resource. Specifically, we will estimate this using the following set of equations:

$$Y_{ist} = \alpha_t + \beta_1 \log(\widehat{Ratio}_{st}) + \beta_{2t}Stratum_s + \beta_{3t}Y(t_0)_s + \beta_{4t}X_{it} + \epsilon_{ist} \quad (1)$$

$$\log(Ratio_{st}) = \gamma_t + \delta_1 Treatment_s + v_{st} , \quad (2)$$

where Y_{ist} is the outcome of child i at school s at time t (running from t_1-t_4), α_t is a constant by time period, $Ratio_{st}$ is the empirically observed nurse-to-student ratio in the 5th-7th grades,

⁶ There is a national norm of a minimum of one nurse per 300 students in primary schools, but the norm is not binding. Only 2.5% of primary schools in Norway adhere to the norm (Waldum-Grevbo & Haugland, 2015).

$Stratum_s$ are dummy variables for each stratum, $Y(t_0)_s$ is the average initial level of the outcome variable in each school, and X_{it} are dummies for sex and grade. In Eq. (2), the nurse-to-student ratio is instrumented by the treatment status of the school, $Treatment_s$, and the equation also includes a constant per time period. SEs are clustered at the school level. We will also conduct a reduced form analysis, using data aggregated to the school level and weighting by the number of respondents.

The outcome variables will be constructed in the following way. For the questions on “emotional well-being,” the two positive emotions (been happy and had fun) will be given values from (1) never to (5) always. The three negative emotions (been sad, stressed, and bored) will be given values from (5) never to (1) always. An average will then be calculated for each child, and we will conduct a log transformation. A similar outcome variable will be constructed for “school belonging” where responses to the three positively loaded questions will be given values from (1) completely disagree to (5) completely agree, whereas the three negatively loaded questions will be given values in the opposite numerical order. An average will then be calculated per child and the variable log transformed. Bullying will be studied using a linear probability model. All three outcomes will be studied using two-stage least squares, whereas a Poisson regression using generalized method of moments will be estimated for days of absence per semester as outcome (Wooldridge, 2010).

With four outcomes, we can then correct the critical levels for rejecting null hypotheses for multiple hypotheses testing. However, the Bonferroni correction method is too restrictive if the hypotheses are correlated, which is an assumption in our study. We will therefore use the false discovery rate method developed by Benjamini and Hochberg (1995) (see also Fink, McConnell, and Vollmer (2014). We will order the four outcomes from the lowest to the highest p -values and assign each outcome rank i . Let k be the lowest i for which

$$p(i) \leq 0.05 * i/m , \quad (3)$$

where $p(i)$ is the i^{th} ranked p -value, and m is the number of hypotheses to be tested. All null hypotheses ranked k or below will be rejected. For the primary outcomes, m is four. For each group of secondary outcomes, a similar correction is conducted.

5.1 Subgroup analyses

A few subgroup analyses of particular interest will be undertaken. These will be modelled as interaction effects where both the instrument and the explanatory variable are interacted. We want to test differences by gender. There are few gender differences in reported bullying (Wendelborg, 2017) and well-being (Wendelborg et al., 2016) in the 5th–7th grades. Havik et al. (2015) found that girls report slightly higher absence than boys in 6th–10th grades and that boys report more truancy-related reasons for their absence. Rather than being motivated by differences in outcome levels between boys and girls, the motive for a subgroup analysis by gender is that school nurses, of whom the vast majority are women, may be more able to influence the psychosocial environment for girls than for boys. We will also test whether effects vary by grade.

A second subgroup analysis will be conducted on whether the share of nurse time usage allocated to groups or universal efforts is above or below the level received by the median child. Another interaction term will capture whether the school-to-student ratio without the extra resource is above or below the level for the median child.

Further subgroup analyses relate to the level of the outcome variable at baseline, where we will test whether effects are larger at schools where the levels were above or below that of the median child. For absence, we will test whether effects are larger for individual children with absence above or below the median child at baseline.

6. Issues of validity

This section will examine a number of threats to internal and external validity and provide solutions to how risks can be assessed and handled. First, risks of partial compliance and non-compliance by municipalities and school nurses will be discussed. A second issue is attrition by municipalities, schools, and individuals. Subsection 6.3 discusses spill-overs and externalities, and subsection 6.4 discusses whether results from the study will be generalizable and scalable.

6.1 Partial compliance

Partial compliance may arise as an issue at several levels in the study. First, there may be partial compliance in the allocation of school nurse resources by the municipality. In particular, we worry that municipalities may engage in compensatory allocation of nurse resources to control schools. Two measures have been taken to avoid that municipalities take compensatory measures. First, municipalities are obligated not to undertake compensatory measures through a signed contract. Second, the municipalities are to provide information on the school nurse coverage before randomization and at every second month throughout the project period. If school nurse coverage changes to disproportionately benefit schools in the control group, the municipality will be asked to document the reasons for such allocation. The project also needs to take into account that the school nurse coverage is likely to expand during the project period and that such expansions may not be equally allocated among schools.

Another issue of partial compliance is if the school nurse appointed for the project differs significantly from other school nurses in terms of competence and skills. An issue related to the rapid expansion of the school nurse resource is that municipalities struggle to acquire school nurses, who in the Norwegian educational system are nurses with a

specialization in school health. All municipalities that do not have excess capacity within their ranks are obligated to advertise the school nurse position and to hire a school nurse if there is a qualified applicant. Municipalities may also use the funding to hire a regular nurse or a person with a different profession to lessen the workload of school nurses. If none of these options are available, the municipalities may appoint a nurse to a school nurse position, under the supervision of an educated school nurse. We also want to avoid that the school health service in treatment schools is split between more school nurses than in control schools, and that there are significant differences in educational backgrounds or years of experience. These issues are handled in dialogue with the municipalities.

Given the correct assignment of school nurses by the municipality, a remaining issue of partial compliance rests with the fidelity toward the implementation of the treatment by the school nurse. To that end, all school nurses working in primary schools in the municipality will fill in a time registration survey every fourth week in a rotating system. This will monitor both potential reallocation of resources among schools, and reallocation among the 5th–7th grades and other grades within each school. The municipality will be notified if the extra allocation falls short of the minimum 3.25 hours per week per school in a semester.

According to the contract, partial compliance may lead to the retention of funds. For the analysis, partial compliance may lead to a scale of the treatment that is too small to identify significant effects. However, by using treatment status as an instrumental variable for the nurse-to-student ratio in the analyses, lack of compliance with the scale of the intervention should not affect the estimated effect size, only the *SEs*.

6.2 Attrition

Issues of attrition may arise if municipalities, schools, or individuals opt out of the program. Each municipality has appointed a contact person with whom we are in regular

contact to ensure full participation, and meetings with senior officials have been conducted to ensure that the project is backed at a high administrative level. Nevertheless, municipalities may drop out of the project, which would reduce the sample size and potentially threaten the statistical power needed for the experiment. Since randomization has been conducted within each municipality, this would, however, not affect the estimated results unless correlated with the impact of the school nurse resource.

Schools that drop out of the project are a concern in the case of private schools, which may not be instructed to participate by the municipality. We therefore have separate contracts with the private schools that are binding and that were made prior to randomization. In the event of a school dropping out of the project, the entire stratum must be excluded from the study.

A particular cause for concern is if individuals opt out of the program, especially since individual non-response to the questionnaire might be correlated with the response. The most obvious case is that of students who are absent from class on the day of the survey. If the treatment has reduced absence, there might also be higher absence during the day of the survey in the control schools than in the treatment schools, and the participating students may thus report a better learning environment in the control schools. Another special source of missing response is if students attend special needs education during class. If the treatment has reduced the number of students in need of special education, this might have similar effects during the day of the survey. We will therefore conduct an analysis of whether attrition is higher in the control schools. If attrition is the same in control and treatment schools, the missing observations can be characterized as being missing completely at random (MCAR). If, on the other hand, attrition is not evenly distributed but unrelated to treatment status once absence and/or special needs education is controlled for, the missing observations are

conditionally missing at random (MAR). In this case, structural equation modelling using full information maximum likelihood will be attempted, using absence and special needs education as auxiliary variables (Collins, Schafer & Kam, 2001). Another sensitivity analysis will exclude strata with selective attrition.

A similar issue arises if students who experience a poor psychosocial environment change to a school with a better learning environment. We will analyze whether there are differences in how the number of students in control and treatment schools change over time. Depending on evidence for such differential change, we will impute values and run the analysis when such strata are excluded, in the same manner as with absent students. This rests upon the assumption that students who change schools are not replaced by a new student, which is unlikely in the Norwegian school system where primary schools rarely have students on waiting lists.

6.3 Spill-overs and externalities

This study seeks to test whether an extra school nurse resource which is used in systemically and in structured collaboration with schools has an impact on the learning environment. To that end, a number of measures have been undertaken to ensure that the school nurse in the treatment schools adheres to best practice. Treatment schools and treatment school nurses are given a guide on how to work with the learning environment, they are invited to workshops, and headmasters are responsible for structuring the collaboration with established meeting points. Both headmasters and school nurses in the control schools may learn from their colleagues and are equally encouraged by the health authorities to follow recommendations for systemic collaboration in new guidelines. Our experiment will determine whether an extra resource used for these purposes affects the learning environment, and not the effects of systemic and structured collaboration itself. Spill-overs and externalities

of the resource usage are expected to be small, and those related to the type and quality of service delivery will have to be considered when interpreting results. A survey directed to the school nurses will track whether practice is very distinct in the treatment schools, to ease such interpretation.

6.4 Generalizability and scalability

The school health service in Norway is rapidly expanding, yet nurse-to-student ratios are still well below the coverage recommended by the government. We claim that the size and content of the extra service provided in this experiment is relevant and scalable for the Norwegian government, should they wish to expand current coverage.

The average school size in our sample is 84 students in the target grades. If schools fulfil the ideal coverage, that should imply a 28% nurse position devoted to this group. The additional resource increases the service with a 12.5% position, which implies a 45% increase. Given the rate of upscaling over the years 2010–2015, this corresponds to nine years of expansion of the service at its current pace. Thus, the intervention tests a politically feasible effect size which is relevant for national authorities.

We have also made attempts to make the intervention replicable and relevant for possible upscaling in the Norwegian context. The requirements of systemic and structured work are closely aligned to new policy guidelines for the school health service, as well as new requirements on the school's responsibility to ensure an adequate school environment. By testing an intervention where the collaboration is in line with these guidelines and supports improvements in the psychosocial environment but where the local actors are otherwise free to shape the content of the intervention, the experiment tests conditions that are similar to those that would be in place if scaled up.

One challenge to scalability is whether general equilibrium effects would make recruitment of school nurses difficult if the service were to expand. Availability of school nurses is already a challenge in the project. In line with Norwegian law, a regular nurse may be hired temporarily in a school nurse position if supervised by an educated school nurse. In this project, municipalities are allowed to hire a regular nurse if recruitment of a school nurse is not possible. This allowance makes the findings more generalizable, as a nationwide expansion would be likely to encounter problems in the recruiting of school nurses.

As the municipalities were not recruited at random, due care needs to be taken if extrapolating the results from this RCT to the national context. All municipalities are medium-sized, yet scattered across the entire country. To address this, an analysis of differences between the participating municipalities and other municipalities will be undertaken, and the study of heterogeneous effects will be able to tell us whether there are characteristics that will make a successful finding more likely.

7. Personnel

7.1 Principal investigators:

- Research professor Roger Andre Federici, Nordic Institute for Studies in Innovation, Research and Education (NIFU).
- Senior researcher Idunn Seland (former), Nordic Institute for Studies in Innovation, Research and Education (NIFU).
- Researcher Arnfinn Helleve, Norwegian Institute of Public Health.
- Professor Lars Edvin Bru, Centre for Learning Environment at the University of Stavanger.

- Professor Unni Vere Midthassel, Centre for Learning Environment at the University of Stavanger.
- Researcher Ester Rønsen, Nordic Institute for Studies in Innovation, Research and Education (NIFU).

7.2 *Co-investigators and administrative coordinator:*

- Senior researcher Martin Flatø, Norwegian Institute of Public Health.
- Senior researcher, Ingunn Holden Bergh (former), Norwegian Institute of Public Health.
- Administrative coordinator Karin Vaagland, Nordic Institute for Studies in Innovation, Research and Education (NIFU).

8. **Timeline**

The workplan and timeline and for the project “Increased School Nurse Resource in Systemic and Structured Collaboration with Norwegian Primary Schools” is presented in Table 6.

 Table 6 about here

9. **Ethics**

The researchers will follow the Ethical guidelines established by the National Committee for Research Ethics in the Social Sciences and Humanities (NESH). Moreover, the questionnaires, interview guides, procedure, and ethical considerations were approved by the Norwegian Centre for Research Data (NSD). Project managers from the Norwegian Directorate for Education have reviewed the protocol. An earlier version of the protocol is registered in the American Economic Association (AEA) RCT database with registry number 2628.

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Figure captions:

Figure 1. Theoretical model. PO and SO indicate primary and secondary outcomes, IV indicates instrumented variable, TS, NS and PS indicates surveys to teachers, nurses and principals, Qual indicate qualitative interviews.

Figure 2: Flow chart of recruitment and randomization

Figure 1

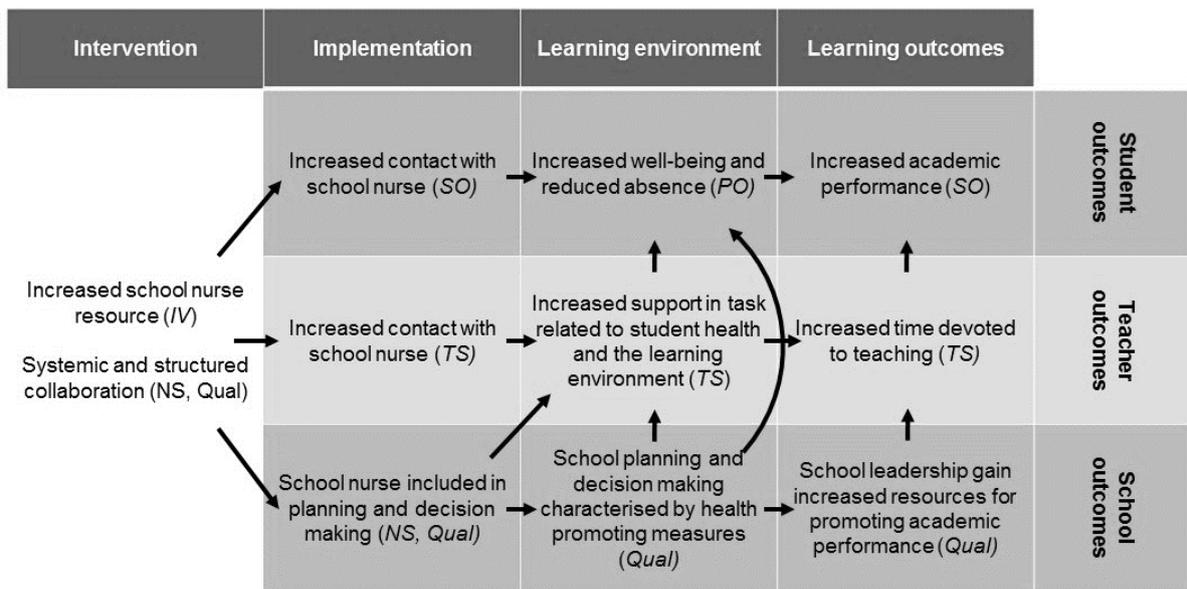


Figure 2

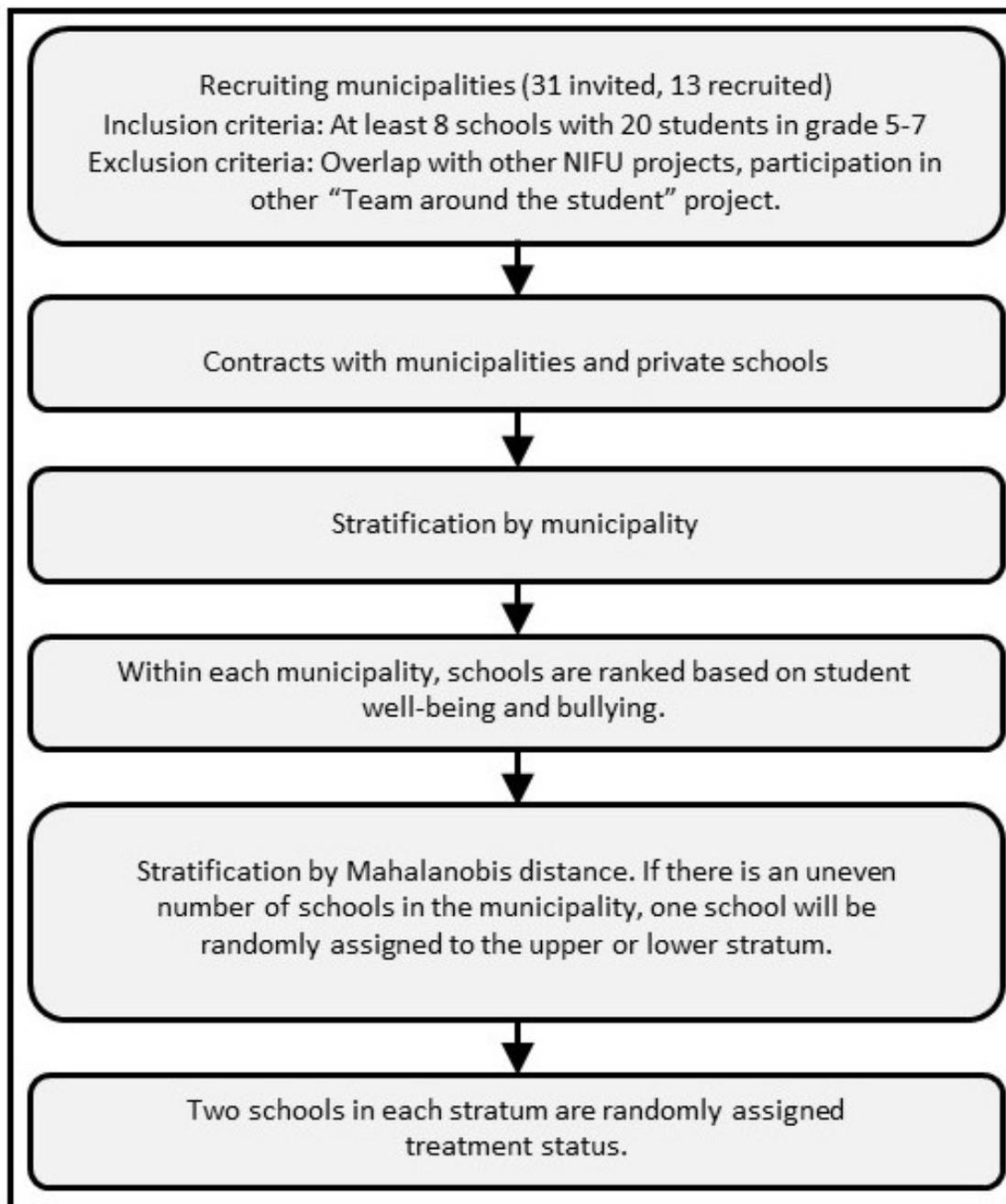


Table 1

Participants in the present study.

Municipality	County	Participating schools	Number of students 5–7
Eidsvoll	Akershus	8	916
Grimstad	Aust-Agder	8	875
Kvinnherad	Hordaland	10	495
Lindås	Hordaland	9	601
Melhus	Trøndelag	9	667
Nes	Akershus	8	723
Porsgrunn	Telemark	13	1,220
Rana	Nordland	9	852
Stjørdal	Trøndelag	9	877
Østre Toten	Oppland	8	462
Alta	Finnmark	9	776
Gran	Oppland	7	474
12 municipalities	8 counties	107	8,938

Table 2

Primary outcomes.

Scale	Items (Norwegian)	Items (English)	Source and comments
Psychological dimensions			
Emotional well-being at school	Tenk på hvordan du har hatt det i klassen den siste uken. Hvor ofte har du?	Recall how you've felt last week in class. How often have you felt the following?	Russell (2003)
	Har du vært glad?	Been happy?	
	Har du vært trist?	Been sad?	
	Har vært stresset?	Been stressed?	
	Har du kjedet deg?	Been bored?	
	Har du hatt det morsomt?	Had fun?	
Social dimensions			
School belonging	Det virker som de andre elevene liker meg.	Other students seem to like me.	OECD (2013)
	Jeg får lett venner på skolen.	I make friends easily at school.	
	Jeg føler at jeg hører til på skolen.	I feel like I belong at school.	
	Hender det at du føler deg ensom på skolen? ¹	Do you sometimes feel lonely at school?	
	Jeg føler meg annerledes og at jeg ikke passer inn på skolen.	I feel different than others and out of place in my school.	
	Jeg føler at jeg blir holdt utenfor på skolen.	I feel like an outsider (or excluded out of things) at school.	
Bullying	Er du blitt mobbet av andre elever på skolen de siste månedene?	Have you been bullied by other students at school during the past few months?	Wendelborg (2017) Wendelborg et al. (2014)
Student absence	-	-	Obtained from the municipal authority

Note. ¹Question asked in the compulsory part of the Norwegian Pupil Survey.

Table 3

Secondary outcomes.

Scale	Items in Norwegian	Items in English	Source and comments
Psychological dimensions			
Motivation	Er du interessert i å lære på skolen?	I am interested in learning at school.	Wendelborg et al. (2014) Federici et al. (2016)
	Hvor godt liker du skolearbeidet?	I like schoolwork.	
	Jeg gleder meg til å gå på skolen.	I look forward to school.	
Academic self-concept	Jeg lærer lett i alle fag på skolen.	Doing work in all school subjects is easy.	Skaalvik & Skaalvik (2013)
	Skolearbeidet er lett for meg.	School work is easy for me.	
	Jeg trenger mye hjelp med skolearbeidet.	I need a lot of help with my schoolwork.	
	Skolearbeidet er ofte vanskelig for meg.	School work is often hard for me.	
Social well-being at school	Trives du på skolen?	Do you like being at school?	Wendelborg et al. (2014)
	Har du noen medelever å være sammen med i friminuttene?	Do you have other students to be with in the breaks?	
	Trives du sammen med elevene i gruppa/klassen din?	Do you like being with your fellow students?	
	Trives du i friminuttene/fritimene?	Do you enjoy the breaks?	
Social dimensions			
Bullying	Gjorde skolen noe for å hjelpe deg?	Did the school provide any help?	Wendelborg (2017) Wendelborg et al. (2014)
	Er du blitt mobbet digitalt (mobil, iPad, PC) de siste månedene?	Have you experienced cyberbullying the last months?	
	Har du selv vært med på å mobbe en eller flere elever på skolen de siste månedene?	Have you bullied other students during the last months?	
	Har du mobbet andre digitalt (mobil, iPad, PC) de siste månedene?	Have you bullied others using you cell, iPad, or computer the last months?	
	Er du blitt mobbet av voksne på skolen de siste månedene?	Have any adults bullied you during the last months?	
Work environment	Det er god arbeidsro i timene.	In class, we can work undisturbed.	Wendelborg et al. (2016)
	I klassen min synes vi det er viktig å jobbe godt med skolearbeidet.	In my class, we think it is important to work with school tasks.	
	Mine lærere synes det er greit at vi elever gjør feil fordi vi kan lære av det.	My teachers think it is okay to make mistakes, because we learn from them.	
	Når jeg har problemer med å forstå arbeidsoppgaver på skolen, får jeg god hjelp av lærerne.	When I don't understand school work, the teachers help me.	Wendelborg et al. (2016)

Instrumental support	Jeg ber læreren om hjelp hvis det er noe jeg ikke får til. Lærerne hjelper meg slik at jeg forstår det jeg skal lære.	I ask my teacher for help if there is something I don't understand. My teacher helps me to understand what I have to learn.	
Emotional support	Mine lærere behandler meg på en vennlig måte. Jeg føler at lærerne vil mitt beste. Lærerne oppmuntrer meg når det er noe jeg ikke får til.	My teachers treat me nicely. I feel that my teachers want what's best for me. My teachers encourage me if there is something I don't master.	Federici & Skaalvik (2014b)
Meals	I klassen min er det ro og orden når vi spiser skolematen vår.	In my class, calm and order is typical when we eat our meals.	Developed for the present study
Cognitive dimension			
Results on national tests		Student scores on national tests in mathematics, reading, and English	Register data obtained from Statistics Norway
Implementation			
School nurse	Jeg vet hvem helsesøster er på skolen. Helsesøster på skolen er en voksen det er lett å snakke med.	I know the school nurse. The school nurse is a person who is easy to talk with.	Developed for the present study

Table 4

Simulated probability of detecting effect.

	<u>Effect size 0.1 SD</u>	
	<u>without controls</u>	<u>with baseline control</u>
1 significant	100%	100%
2 significant	89%	92%
3 significant	50%	57%
4 significant	20%	25%

	<u>Effect size 0.2 SD</u>	
	<u>without controls</u>	<u>with baseline control</u>
1 significant	100%	100%
2 significant	100%	100%
3 significant	100%	100%
4 significant	100%	100%

Note. 95% significance level using *SEs* clustered by school, using two-tailed tests.

Table 5
Results from balance tests on school health services, school traits and primary outcomes.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	School nurse coverage at school level	School nurse coverage for target group	Number of students in target group	Student-to-nurse ratio in target group	Years of experience	Age	Percentage of nurses with specialization	Social well-being	Emotional well-being	Bullying
Treatment	0.018 (0.04)	0.00384 (0.02)	14.36 (8.58)	119.9* (52.31)	-1.403 (1.26)	-1.293 (1.72)	-0.0656 (0.04)	0.0413 (0.03)	0.00385 (0.03)	-0.00825 (0.01)
Constant	0.448** (0.03)	0.190** (0.01)	105.3** (5.91)	593.3** (28.33)	7.414** (0.99)	44.28** (1.31)	0.898** (0.03)	-0.0292 (0.02)	-0.00381 (0.02)	0.0714** (0.00)
Strata controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i> pupils	9018	9018	9018	8859	7813	7281	8520	7608	7642	8160
<i>N</i> schools	107	107	107	105	93	87	100	107	107	107

Note. * $p < 0.05$, ** $p < 0.01$, *SEs* in parentheses.

Table 6

Workplan and timeline.

Task	Date (month/year)	Responsibility
Project starts	05/2017	
Project management and quality assurance	Continuous	Group of principal investigators
Recruitment of municipalities	05/2017–12/2017	Federici, Vaagland
Qualitative pilot study with municipalities, concepts, and development of instruments	06/2017–01/2018	Seland, Federici, Flatø, Helleve, Vere Midthassel, Vaagland
Development of indicators (surveys) including quantitative pilot study	07/2017–01/2018	Helleve, Holden Bergh, Vaagland, Federici
Development of study manual and guide	07/2017–12/2017	Helleve, Vere Midthassel, Bru, Federici, Flatø, Vaagland
Randomization	10/2017–01/2017	Flatø, Vaagland
Time registration survey	10/2017–12/2019	Rønsen, Vaagland
Pupil survey, each semester during the project (T ₀ –T ₅)	10/2017–12/2019	Federici, Vaagland
Principal, teacher, and nurse surveys (each semester)	01/2018–04/2020	Federici, Vaagland, Bru
Workshop for municipalities, trial start-up	01/2018	Helleve, Federici, Vere Midthassel, Bru, Rønsen, Vaagland
Implementation and process evaluation (qualitative)	05/2018 and 05/2019	Vere Midthassel, Helleve, Vaagland
Midterm quantitative impact analyses	12/2018	Rønsen, Flatø, Bru
Final quantitative impact analyses	02/2020	Rønsen, Flatø, Bru
Dissemination	Continuous Final report 06/2020	Federici, group of principal- and co-investigators
Project ends	07/2020	
Possible follow-ups	07/2020–12/2022	Group of principal investigators

Table A1

Inputs, activities, outputs, and impacts.

Context	Input	Activities	Output	Impact	
				Short-term	Long-term
Rapid expansion of school health service	Funding	Workshops	Increased presence of school nurses at each school	Improved learning environment	Learning outcomes
New national guidelines for school nurse services	Manual for how to structure collaboration between school and school nurses (meeting series)	Meeting series between school and school nurses	Minutes from regular meetings between school leaders and school nurses	Increased well-being of students Reduced absenteeism Increased school belonging	Increased academic performance
Revision of education act	Guide for working with learning environment		Joint plan between school and school nurse on how the increased school nurse resource is to be used Local school plans for improvement of the school learning environment	<i>Increased focus on teaching for teachers</i> <i>More structured and systemic collaboration between school and school nurse</i>	

Note. *Italic* = investigated in the implementation and process evaluation.