

2. Methods

The purpose of this section is threefold: 1) to provide context to the thesis by describing the Danish school setting and the TEACHOUT study, 2) to clarify concepts and steps taken, from planning data collection to final analyses, and 3) to provide a meta-methods section to set the scene before presenting and discussing the research papers and the main results of the thesis. A description of the Danish school setting will provide an overview. Subsequently grades 3 to 6 will be in focus, as they are the target group of the TEACHOUT study.

2.1. The Danish school setting

In Denmark, primary and lower secondary schools are divided into junior (grade 0-3 – grade 0 is a compulsory pre-school class), middle (grade 4-6) and senior (grade 7-10 – where grade 10 is optional). The teachers have ‘freedom of methods’ to achieve specific targets established for each subject by the Minister of Education; these targets are to be in accordance with the ‘*Folkeskole Act*’ legislated by the Danish Parliament. Public, private and international schools in Denmark are all structured in this way. Public schools included 82% of school-aged children in 2012 [83].

A new public school reform was implemented in August 2014 focusing on three objectives: 1) to “challenge all pupils to reach their fullest potential”, 2) to reduce the social gradient for academic performance, and 3) to increase pupil well-being and trust in the public school system through professional knowledge and practice [83]. Various new initiatives were implemented to achieve these objectives, including a longer and more varied school day, inclusion of more PA during school hours, encouragement to work more closely with the local community, development of competencies for teachers and pedagogues, strengthening of classroom management and decreasing disruptions during lessons, as well as increasing pupil participation. In particular, under the new reform, children in grade 3 are to spend 30 instead of 24.5 hours a week at school, and grades 4-6 33 instead of 24.5-25.7 hours. Three of the extra weekly hours for grades 4-6 are planned lessons in existing subjects. Other additional hours at school are to be spent on a combination of supportive teaching, help with homework, classroom time, breaks, and movement; the schools and teachers are to decide how this time is used. Time allocated to PE lessons remains unchanged post-reform (1.5 hours weekly for grade 3 and 2.25 hours for grades 4-6). It is also specified that an average of 45 minutes of daily PA must be provided to children within teaching time, and it is the school principle’s responsibility to ensure provision of PA [83].

2.2. The TEACHOUT study

The overall aim of the TEACHOUT study is to investigate and understand the effects of EOtC on the PA, academic learning, social relations, motivation, and well-being of children in grades 3 through 6 (9-14 years of age). The program theory underlying EOtC is shown in Figure 1 and involves the pedagogy, i.e. enabling

inclusion of more experimentation, problem solving, cooperation, movement, play, and use of senses, and the physical setting, i.e. natural and cultural places in the local community [84]. The study design is quasi-experimental, as effects of EOtC are compared between children in classes where the teacher chose to practice EOtC regularly and children in classes where the teacher did not make this choice. The study is cross-disciplinary and uses mixed-methods evaluation given the range of investigated outcomes. In TEACHOUT, we have operationalized EOtC by defining it as curriculum-based teaching occurring outside the school’s buildings with a minimum average of five hours per week over one school year. The five-hour weekly EOtC minimum was chosen to distinguish the practice from occasional field trips and for it to be a substantial part of the children’s school time.

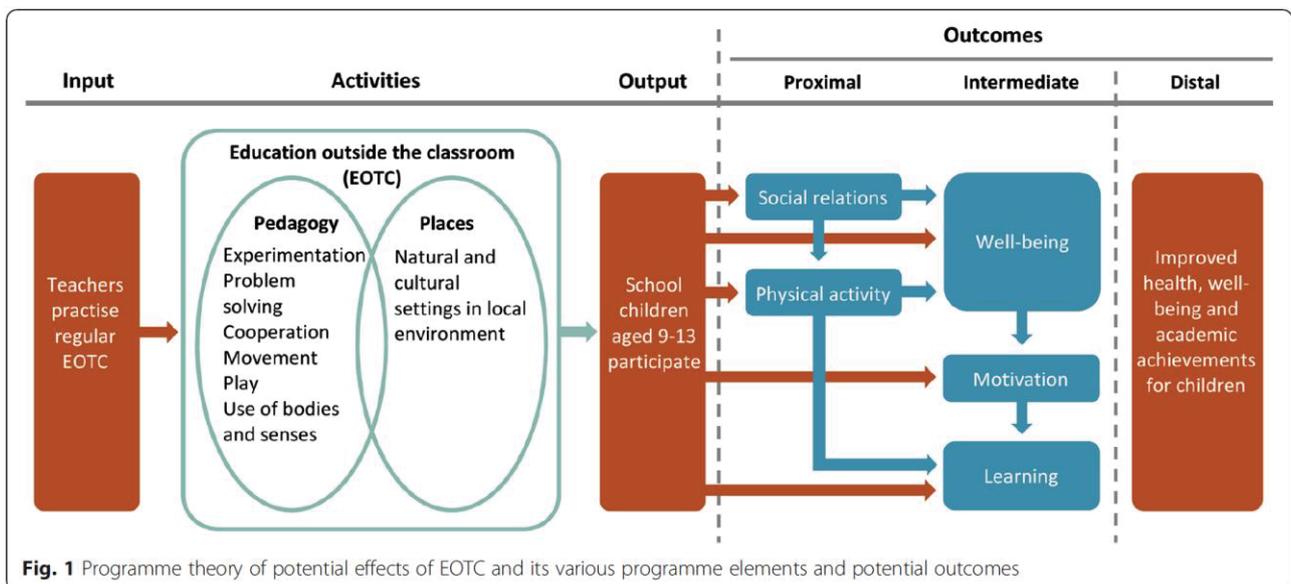


Fig. 1 Programme theory of potential effects of EOTC and its various programme elements and potential outcomes

The figure is copied from the TEACHOUT study protocol [84]

2.2.1. Sampling and participants

The inclusion criteria for classes in TEACHOUT were class pairs consisting of at least one EOtC class agreeing to practice at least 5 hours of weekly EOtC on average for the duration of the school year, and one control parallel class at the same school and grade level that would not practice EOtC regularly. In Danish public schools, children living in a school’s enrolment area are randomly assigned to classes when they are formed in grade 0 [85]. As such, the recruitment of parallel classes provides a form of randomization of children between the EOtC and control groups in terms of socioeconomic background, local community and school resources. In addition, measurements were conducted at the same time for all outcomes, ensuring comparability in weather conditions and occurrence of cultural events between groups.

Schools known to practice EOtC were identified via a database based on a national survey [48], by contacting school officials at the municipalities, and by contacting schools and leaders in our networks directly. In total, 549 schools were contacted between February and May 2014 by a member of the

TEACHOUT research group in order to recruit class pairs that were eligible for inclusion and willing to participate. Of the 549 schools, 13 schools with 17 EOtC and 16 control classes, comprising 663 children, met the parallel class inclusion criteria. Participants from these 33 classes were included in analyses conducted for effects of EOtC on PA (Aim 2 and 3). We had intended to include more classes, but the lack of a comparison class and lack of time (many teachers “blaming” implementation of the new reform) made recruitment difficult. We therefore decided to include an additional 13 classes at four schools, comprising an additional 240 children, that did not meet the parallel class criteria, but could meet the inclusion criteria in some analyses in TEACHOUT. Eight of these classes were from three rural schools in which the EOtC and control classes attended school at two different addresses. Another four did not have control classes because the two participating control class teachers decided to practice EOtC regularly. The last of these 13 classes was an EOtC class without a control class, but at a school with an included pair in the grade below. The participating schools were located in northern Zealand (the Capital Region) and Jutland. Participants from all 46 classes were included in the analyses conducted to evaluate the methodology developed to assess free-living PA (Aim 1).

Participating EOtC teachers were invited to a two-day seminar aimed at providing inspiration and networking opportunities for their EOtC practice and in-depth information on their participation in the TEACHOUT study. Inspiration was provided through three 1.5-hour workshops showcasing examples of EOtC practice, a 1.5-hour supervised session to plan own use of EOtC in groups based on subject for EOtC implementation, and a presentation of inspirational materials, such as EOtC-related websites and books. Networking opportunities were provided throughout the seminar, along with a list of the participating EOtC teachers’ contact details for networking opportunities afterwards (all teachers gave their consent to be included on the list). Personal information meetings with participating teachers were held at each school prior to the intervention school year to inform participants of the content and obligations of the study. Teachers who provided all necessary information received a gift certificate worth 500 DKK on two occasions: midway and upon completion of the school year.

2.2.2. Data collection

A pilot study of three classes with 57 pupils was conducted in April 2014 to test all intended data collection procedures, and all data in the full study were collected during the school year spanning from August 2014 to June 2015. Table 1 shows an overview of data collected in the TEACHOUT study. Throughout the intervention school year, we monitored the day-to-day EOtC practice of each participating class using an e-based tool. Questions were designed to include any EOtC practice lasting at least 45 minutes in both EOtC and control classes. Children’s and teachers’ background data were surveyed using electronic questionnaires distributed to the parents and teachers (Appendix 2), respectively. Academic performance, school motivation, social relations, and well-being were assessed by questionnaire or test using repeated measures at

the beginning and end of the school year. Case observations and group interviews were performed during the school year in an attempt to understand how the quantitative effects of EOtC on learning processes, well-being and motivation could be explained.

PA and anthropometric measurements were performed and information about class activities and participant leisure time activities was collected for a 10-day period once per class pair between November 2014 and June 2015. This allowed for overall assessment of children’s PA behavior as well as across a range of everyday life contexts. PA was measured using two skin-taped Axivity AX3 accelerometers attached to the lower back and the front of the thigh with instructions not to reattach an accelerometer should it fall off before the end of the 10-day period. We chose not to reattach accelerometers if they stopped being worn prematurely to eliminate issues of wear-time validation of the measurements. Information on everyday life contexts during school hours was obtained through class timetables and a class-level standardized diary (Appendix 2) reporting EOtC activities and changes in school activities compared to those described in the class timetable. The class activities diary was filled in by the class teacher in cooperation with three pupils he/she selected. Leisure time contexts, school absence and sickness were reported through a standardized participant diary (Appendix 3).

Table 1 Data collected in the TEACHOUT study and time of collection

Construct/Measure	Data collection instrument/method	Number of items/tasks	Time of collection
Pupils’ physical activity	Axivity AX3 accelerometers		10-day periods from November 2014 to June 2015
Context of PA	Schools’ class time tables Activity questionnaires	Questionnaire: 50 items	10-day periods from November 2014 to June 2015
Anthropometrics	Height Measure Body Composition Monitor		At the beginning of the 10-day periods from November 2014 to June 2015
Pupils’ background	Electronic Questionnaire to parents	33	March 2015
Teachers’ background	Electronic questionnaire	13	March 2015
Degree of implementation of EOTC	Online platform	16	Throughout the school year
Pupils’ academic performance in Reading and Mathematics	Sentence reading test Mathematical basic skills test	Reading: 15-24 tasks Math: 50-87 tasks	August 2014 and May 2015
Pupils’ social relations	Social Network Analysis Social Cognitive Mapping	21	August 2014 and May 2015

Pupils' well-being	Strength and Difficulty Questionnaire	25	August 2014 and May 2015
Pupils' motivation for school	Academic Self-Regulation Questionnaire	17	August 2014 and May 2015
Processes and interactions of importance to social relations, well-being and motivation	Qualitative case observations, focus-group interviews and personal interviews		Throughout the school year
Learning processes	Qualitative case observations, focus-group interviews and personal interviews		Throughout the school year

The table is based on and modified from Nielsen et al. 2016 [84].

2.2.3. Processing and analyzing physical activity data

The following text provides a brief definition of concepts and an overview of the data processing and conducted analyses. More in-depth information is provided in Paper 1-3.

All participants in the entire sample of 46 classes were pooled in the analyses conducted in Paper 1. The reliability of measurements was assessed for the PA constructs LPA, MVPA and vector magnitude of three axes (VM3) for lower back and thigh placement, respectively, using data from participants with seven days of 24h wear time. Mean wear time was compared between lower-back- and thigh-placed monitors for all participants with monitors attached at setup. Associations between wear time and the participant characteristics PA level, sex, age and weight status were analyzed to investigate how well the characteristics predicted wear time.

In Paper 2 and 3, all participants included in the analyses had seven full days of accelerometer data. If a participant was sick or had any absence from school, he or she was excluded from the analysis. In Paper 2, analyses were conducted on participants in the 33 classes adhering to the pairwise parallel class design to compare the average daily minutes of PA of participants with seven days of 24h accelerometer wear time between EOtC and control groups. Data from participants in the 33 paired classes were pooled in Paper 3, and analyses were conducted to compare average proportions of time spent in different PA intensities for participants with seven days of 24h accelerometer wear time between day types and domains.

The analyses conducted to investigate the effects of EOtC on PA were designed to complement each another. In Paper 2, I investigated the effects of participating in regular EOtC on children's weekly PA. Through the recruitment of parallel classes, I could investigate how EOtC can be expected to influence daily life PA in a case-control design. This provided evidence of the combined effects of degree of implementation and effect of EOtC on PA in an everyday school setting. This was done using an 'intention-to-treat' approach that monitored EOtC implementation, but still included all participating classes, regardless of whether or not they adhered to the definition of EOtC. Additionally, I performed a 'per-protocol' approach to maximize the

difference in the amount of EOtC practiced between EOtC and comparison classes and, thereby, to maximize the potential of the intervention if implemented fully. Inclusion of a class pair in the per-protocol sample required more than 150 minutes of EOtC practice in the EOtC class and less than 150 minutes in the control class during the measured week.

What these analyses lacked, however, was evidence that EOtC is in fact responsible for the differences in PA measured between groups. Investigating Aim 3, which was to compare accumulated PA in different day types and domains at the individual level, provided this evidence by segmenting weekly PA during time in EOtC and other domains for comparison. Six domains were included in this thesis: EOtC, curriculum-based classroom activities, PE, recess, leisure time on school days, and leisure time on weekend days. Sleep was excluded from the domain analysis. However, in this case, the link between EOtC and impact on children's PA and whether or not the intervention is effective at increasing PA is lacking. Analyzing data pooled by day types provides information that is closer to existing practice and explores differences in PA that are more strongly associated with health. For this analysis, I included four distinct day types, with an included day always representing 24h of accelerometer data from midnight to midnight. The four day types were: days with EOtC, school days without EOtC and PE, school days with PE, and weekend days. To qualify, an EOtC day required at least 150 minutes of EOtC and a PE day at least 45 minutes of PE. The connection to existing practice relates to EOtC typically being practiced at least half a school day, one or two days a week [51]. Implementing EOtC in a class for approximately five hours per week is a representative method of implementation, and the difference in PA between a school day with EOtC and a school day without EOtC or PE is therefore a realistic indicator of EOtC's effects on children's PA in a real-life setting. This approach also captures potential compensating mechanisms that could be hypothesized if PA were to increase or decrease during the first half of the day. The combination of analyses therefore provides a package that documents differences in effects on PA among children in the EOtC group compared to the control group, suggesting that any such differences can, at least partly, be ascribed to EOtC.