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Stephanie Rosenstiel[1] · Carmen Volk[1,2] · Maike Dernbach[1,3] · Brit Teutemacher[1] · Yolanda Demetriou[1] · Ansgar Thiel[1,4] · Gorden Sudeck[1]

[1] Institute of Sports Science, University of Tübingen, Tübingen, Germany
[2] Institute of Sports and Sports Science, Karlsruhe Institute of Technology, Karlsruhe, Germany
[3] Institute for Sociology and Gender Research, German Sport University Cologne, Cologne, Germany
[4] German Sport University Cologne, Cologne, Germany

# Process evaluation of a health- and fitness-related physical education program

## Lessons learned from the educational GEKOS program

### Supplementary Information

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## Introduction

A central objective of physical education (PE) in many countries is to promote students' knowledge, skills, abilities and motivation to initiate and maintain a healthy, physically active lifestyle throughout their lifespan (Cale, Harris, & Hopper, 2020; Ptack & Tittlbach, 2018). In German curricula, these objectives are approached through competence acquisition, whereby corresponding educational approaches to address students' knowledge, skills, abilities and motivation are mostly based on a functionally pragmatic understanding of competence (Klieme, Hartig, & Rauch, 2008). In order to address health- and physical activity (PA)-related competences in PE, neither pure theoretical teaching nor pure physical training is adequate (Serwe-Pandrick, 2016). Therefore, the question arises of how and to what extent theory and practice can and be linked through appropriate experiences and situations in PE (Mong & Standal, 2019; Quennerstedt, 2019).

In German PE literature competence acquisition is mainly discussed in the context of the (reflective) capacity to act. Reflective capacity to act enables students to handle their own PA, to accordingly make self-determined and -responsible decisions and to find meaning in PA for their own lives (e.g., Gogoll, 2013). Reflective capacity to act contains a number of theoretical considerations (e.g., learning tasks, reflective practice) on how to methodically implement educational PE programs, linking theory and practice (Pfitzner & Aschebrock, 2013; Serwe-Pandrick, 2013) in a fashion much comparable to practices in constructivistic PE or literacy approaches (e.g., Ennis, 2015; Sun, Chen, Zhu, & Ennis, 2012; Töpfer, Hapke, Liebl, & Sygusch, 2022). Furthermore, a range of different ideas on how to teach health-related topics and content in PE is discussed in the literature (Ptack & Tittlbach, 2018). To date, several empirical effectiveness studies (e.g., Demetriou, 2013; Strobl, Ptack, Töpfer, Sygusch, & Tittlbach, 2020) could be identified that show that health- and fitness-related PE programs which link theory and practice in terms of imparting a combination of knowledge, skills, abilities and motivation are partially effective.

However, to more clearly understand why and how respective programs work in PE and how they might be further improved upon, an evaluation of effectiveness should be accompanied by a process evaluation (Moore et al., 2015; Peters, Adam, Alonge, Agyepong, & Tran, 2013). This includes, among other things, the investigation of intervention *fidelity*, considerations regarding its *acceptance* by participating actors like students and teachers, and the *applicability* of the program in a regular (PE) setting (Moore et al., 2015; Sygusch, Bähr, Gerlach, & Bund, 2013). In addition, in PE, the relationship between theory and practice in terms of movement time is a relevant point of discussion. These aspects can be both facilitating and hindering factors for the long-term implementation of programs (Moore et al., 2015; Peters et al., 2013).

The purpose of the present study is to examine fidelity, acceptance, applicability and movement time in our self-developed manualized PE program "Promotion of PA-related health competence in physical education" (German: Förderung bewegungsbezogener Gesundheitskompetenz im Sportunterricht; acronym: GEKOS; Haible et al., 2019) as part of a process evaluation. This complements a previously conducted evaluation of effectiveness in a cluster-randomized controlled trial (Rosenstiel et al., 2022; Volk et al., 2021). We intend to use the findings to identify potential facilitating and hindering factors that may be relevant to a long-term imple-

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mentation of the GEKOS program in the real-world setting.

## How to link health- and fitness-related theory with practice in PE

For teaching health- and fitness-related content through practice-theory linkage in competence-based PE, one needs to take a closer look at both the possible methodological and content approaches.

Methodologically, competence acquisition in action-related fields of application, as in PE, requires the integration of knowledge, skills, abilities and motivation for successful learning processes (Baartman & de Bruijn, 2011). In the PE literature in Germany, the educational mandate of PE is considered especially in the (reflective) concept of the capacity to act. In order to address this kind of concept in PE it is not sufficient only to exercise or to teach motor skills (Serwe-Pandrick, 2016; Töpfer et al., 2022). Additionally, the dimension of teaching quality cognitive activation (Wibowo, Krieger, & Bükers, 2021) is considered significant. Cognitively activating PE must present learners with action problems that they cannot solve in a routine fashion. It is understood as didactically stimulating offers for students to deal with the subject matter in depth on the basis of existing and newly acquired knowledge (Hapke & Waigel, 2019). Didactical features for a cognitively activating PE include, for example, open-ended problems, reference to prior knowledge, reference to daily life, planning and responsibility for one's own learning process and reflection on sporting actions (Engelhardt, Hapke, & Töpfer, 2023). Corresponding student-centered teaching-learning situations are designed, as in other subjects (Gawatz & Stürmer, 2019; Kleinknecht, 2010), by setting tasks, for instance a learning task. The aim of learning tasks is to encourage students to develop and try out independent solutions to given problems, e.g., by means of subtasks that build on one another (Leisen, 2010; Pfitzner & Aschebrock, 2013). In PE, learning tasks can include movement tasks (Neuber, 2014; Sygusch, Hapke, Liebl, & Töpfer, 2021) and the didactic principle of reflective practice, which postulates that reflection and practice interpenetrate teaching and learning in PE (Serwe-Pandrick, 2013; Serwe-Pandrick, Jaitner, & Engelhardt, 2023). Learning tasks, for example, take into account the interindividual differences of the students by setting differentiated tasks, allow for several ways of solving the problem, show a reference to the students' world and are worked on independently by the students (Pfitzner & Aschebrock, 2013). A prerequisite for these tasks is that teachers withdraw themselves and take on the role of learning guide and moderator for reflection phases, introducing, accompanying and discussing tasks (Kleinknecht, 2010; Pfitzner & Aschebrock, 2013; Sygusch et al., 2021).

With regard to content, health-oriented objectives in PE are approached very differently. Among other things, this involves a different understanding of health (pathogenetic vs. salutogenetic) and associated goals (e.g., increase moderate to vigorous PA [MVPA] vs. promote personal resources regarding physical, psychological and social health) as well as methodological approach (orientation on public health recommendations for PA vs. educational/pedagogical orientation). The concepts and expectations differ not only in the PE curricula but also among teachers and students (Mong & Standal, 2019; Ptack & Tittlbach, 2018; Pühse et al., 2011). In Germany, PE literature regarding the teaching of health-related content is thereby largely characterized by a biopsychosocial understanding of health and educational orientation (Ptack & Tittlbach, 2018). The topic of health is approached from the perspective of health[1] and health-related capacity to act in order to enable students to both take responsibility for their own health and have experienced and learned what personally meaningful healthy PA can look like and how it can be incorporated into their lives (Kurz, 2004; Ptack & Tittlbach, 2018; Tittlbach & Sygusch, 2014).

However, there are still barriers to the implementation of these methodological and content-related teaching approaches in PE. For cognitively activating PE utilizing learning tasks in Germany, there is so far only little methodological guidance for teachers on how content can be taught (Rix & Schulz, 2011). For example, there is a lack of basic textbooks for PE, meaning that teachers have to develop and compile content and materials through their own initiative. In addition, the demand for cognitive activation and health-related capacity to act competes with time spent moving as compensation for other school subjects and students' already sedentary lifestyles (Hapke, 2018; Kastrup, 2011; Quennerstedt, 2019; Serwe-Pandrick, 2016). Ptack and Tittlbach (2020) identified a match between the claims of subject didactics and teachers with regard to the salutogenetic understanding of health and the teaching of objective health parameters. However, the study showed that in actual teaching practices this understanding was reduced to fitness content and assurance of time spent moving. As in other studies (see also Pühse et al., 2011), it was shown that a sports-technique-based multiactivity approach determined the teaching units, and the health perspective is often only marginal. Though individual teachers deemed health-related capacity to act to be worthwhile; however, it still did not find actual implementation in PE classes (Ptack & Tittlbach, 2020).

The aforementioned difficulties lead not only to a lack of practical examples that are both methodologically and substantively sound as well as empirically evident from the perspective of sports pedagogy and empirical PE research, but also to their inability to find their way into the reality of PE.

## Process evaluation and implementation of health-related PE programs linking theory and practice

In order to implement theoretically sound and successfully tested PE programs in the PE setting in the long run,

[1] Multiperspective PE should enable students to look at the subject matter of PE from different perspectives (e.g., performance, health, community/social contact), to know from their own experience what different meanings it can have to be physically active, to experience PE as subjectively meaningful, and to give movement, play, and sport a meaningful place in their lives (Kurz, 2004).

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**S. Rosenstiel · C. Volk · M. Dernbach · B. Teutemacher · Y. Demetriou · A. Thiel · G. Sudeck**

# Process evaluation of a health- and fitness-related physical education program. Lessons learned from the educational GEKOS program


## Abstract

**Objective.** The aim of this process evaluation study was to investigate fidelity, acceptance, applicability and movement time with respect to the health- and fitness-related GEKOS program (*Förderung bewegungsbezogener Gesundheitskompetenz im Sportunterricht*) linking theory and practice in physical education.

**Methods.** Fidelity was investigated by observation, self-report forms and poster documentations. Applicability and students' ($n = 472$) and teachers' ($n = 27$) acceptance were examined by qualitative interviews and surveys directly after the GEKOS program. Movement time was assessed using accelerometer data and compared to students' ($n = 369$) movement time in regular physical education classes.

**Results.** Overall, fidelity was high and statements in the interviews and surveys with regard to applicability and acceptance were heterogeneous. Particularly critical was the low net movement time, which was assessed using device-based accelerometer data.

**Conclusion.** The results allowed us to identify barriers such as standardization and facilitators such as teachers' acceptance of teaching student-centered approaches. Therefore, flexibility in the delivery of programs and the balance between net time moving and theoretical cognitive activating content in PE need to be discussed further in terms of long-term implementation of such a program.



## Keywords

Adolescents · Cognitive activation · Implementation · Fidelity · Accelerometer


a process evaluation must first examine why and how respective programs work and how they can be optimized for practice, if necessary (Moore et al., 2015; Peters et al., 2013). To approach these questions, fidelity, acceptance, and applicability can be examined (e.g., Moore et al., 2015; Peters et al., 2013; Sygusch et al., 2013). In our case, fidelity reflects the extent to which teachers deliver the program as it is planned (Peters et al., 2013). On the one hand, it is assumed that this adherence to the manual supports effectiveness and interpretability of intervention outcomes (Durlak & DuPre, 2008; Zhu, Ennis, & Chen, 2011). On the other hand, low fidelity can also indicate that teachers cannot or do not want to adhere to the manual for some given reason. Therefore, it is important to include the perspectives of the participating actors (e.g., teachers and students) in the evaluation (Peters et al., 2013). In this fashion, the goals, content, and methods of a program should be applicable in PE practice and perceived as acceptable by teachers and students (Sygusch et al., 2013). Insights in these three areas allow factors to be identified that may act as barriers or facilitators to implementation, adoption, and maintenance of a program in the real-world (PE) setting (Peters et al., 2013).

In Germany, there are only few empirical studies that examine the effectiveness of PE programs taking into account the respective methodological and content-related concepts to link health- and fitness-related content to practice and conduct some form of process evaluation. These studies include "HealthyPEP", an 8-week program for 6th graders (Demetriou, 2013) and "Health.edu", which studies the effectiveness of participatory-designed lessons over a school year in grades seven to ten (Strobl et al., 2020).

HealthyPEP had positive effects on girls' physical fitness level, with partial positive stimuli at the psychological level. In addition, the program was positively evaluated by the girls. These effects were not seen in the boys, who also rated the program less positively. Observations showed that teachers made minor adjustments for practical content. In the interviews, teachers described the content and goals of the program as understandable and the materials and preparation as sufficient for implementation. The implementation was described as unproblematic. In boys' classes, a drop in motivation due to a lack of ball games was reported, and the program was sometimes found to be too long (Demetriou, Sudeck, & Höner, 2014; Höner & Demetriou, 2014). A systematic examination of fidelity as well as teacher acceptance was not reported.

Health.edu showed positive effects on students' health-related knowledge and understanding. These effects were higher in the schools with developed units based on a more student-centered approach and a linking of practice and theory (Strobl et al., 2020). Interviews and observations showed that the teachers' orientation in terms of content (understanding of health, content, and goals) continued to be split between traditional and modern thematizations of health. Methodological aspects (cognitive activation, student orientation, openness), though always in contradiction to movement time, have come closer to fulfilling the sports didactic claim. However, this observation has taken place independently of the lessons developed (Ptack, Strobl, & Tittlbach, 2020).

Besides these individual studies, little is known about whether and how such concepts can find their way into teachers' regular PE practices in the long term. Therefore, there is still a need for insights into the implementation of such PE programs. Furthermore, apart from a study involving in a single lesson within a 6th grade class (42% MVPA; Demetriou, Hapke, & Olufemi, 2019), we know little about the actual impact of corresponding programs on movement time in PE. In general, based on individual studies and the objectives of PE, Zeuner (2014) considers a movement time of 20–40% to be a realistic orientation.

## The GEKOS program

Against this background, we developed, piloted and evaluated the educational PE program GEKOS, linking health- and fitness-related theory with practice (Haible et al., 2019). In this process, we made effort to affect fidelity, acceptance and applicability positively:

First, we based our program theory regarding goals, content, and methods on competence-based German PE curricula, German PE literature on learning tasks and cognitive activation (especially

Pfitzner & Aschebrock, 2013; Serwe-Pandrick, 2013) as well as on the concept of PA-related health competence (Sudeck & Pfeifer, 2016). Based on the program theory, six objectives were formulated in terms of competence expectations (e.g., students can measure and assess physical reactions to physical load using various methods). Using these competence expectations as a foundation, the two main topics perception of physical load and control of physical load and physical training were defined. This resulted in six lessons (each 90 min) combining theoretical content on perception and measurement of physiological responses (heart rate and perceived exertion to PA—lesson 1–3) and health-related fitness: strength training and cardiovascular endurance (lessons 4–6) with either running and jumping activities (running) or small-sided ball games (game play). Lessons 1–5 were structured by a learning task following Leisen (2010) including six consecutive subtasks. (1) After the teacher presented the topic (e.g., perception of physiological responses to PA), (2) the students were first asked to express their ideas and assumptions about the topic based on their prior knowledge (e.g., assumptions about changes in the body during PA), (3) then, to gain information about the topic, students were instructed to perform movement tasks or movement instructions (e.g., as part of running activities or 3 vs. 3 soccer games) and reflect (e.g., individual physiological responses to PA) either in or on action (Schön, 2002; Serwe-Pandrick, 2013), (4) subsequently, the learning experiences were discussed with other students and the teacher and then (5) related to the previous assumptions from the beginning; and (6) in subsequent lessons, students were encouraged to apply and practice this newfound experience and knowledge. Lesson 6 was not structured by a separate learning task but was designed to let students apply acquired skills and knowledge by planning a game to promote endurance (Haible et al., 2019; Haible, 2020; Rosenstiel & Volk, 2022; Volk, 2020; Volk & Haible, 2020).

Second, we engaged teachers in focus group discussions about the initial drafts of our program. We then tested and revised the lesson plans in two pilot studies with a total of 13 classes, taking into account feedback from teachers and students. At the end of the pilot phase, we had a standardized treatment manual (Haible, 2020; Volk, 2020) including a teacher training and a test manual (Haible et al., 2019).

Third, we evaluated the GEKOS program in a cluster-randomized controlled field trial consisting of 27 intervention group and 21 control group classes (gender-segregated[2]) with overall 841 ninth graders. Immediately after the program it was found that the health-related fitness knowledge and control competence of students could, on average, be positively influenced. For strength and endurance, as well as health-oriented motivation, the GEKOS teaching approach appears to be mostly insufficient to achieve significant effects on average (Volk et al., 2021). Nevertheless, it proved to be particularly effective at the individual level for students who had low initial values in terms of knowledge, skills, abilities, and motivation before the program. Some of these students also showed positive developments in all outcome areas (Rosenstiel et al., 2022).

## Present study

With regard to the discussion of goals, content and methods in (health- and fitness-related) PE, the present study aims to investigate the extent to which we have been able to achieve fidelity, acceptance, and applicability with respect to the GEKOS program through a thorough process evaluation incorporating the perspectives of teachers and students.

Against the background of our PE lessons being structured by learning tasks and an increased focus on theoretical content, we additionally investigate actual movement time in corresponding PE lessons in order to enrich this discussion with the help of an empirical data base. Furthermore, we examine whether fidelity, acceptance, applicability, and movement time differ with respect to gender and the fields of movement (a) running and (b) game play. Thus, with regard to the former, it has been shown that girls are more likely to deal with theoretical content in PE in depth (Ayers, 2004; Höner & Demetriou, 2014). Regarding the latter, we are interested in whether the combination of health- and fitness-related content with more classical practical components such as running or with more innovative components in the context of small-sided ball games make any difference. Building on subsequent findings, we aim to identify possible barriers and facilitating factors for the implementation of the GEKOS program in regular PE for the long-term. In particular, we investigate the following:

Fidelity:
- To what extent did teachers deliver the GEKOS program as planned? Is there a difference between genders and between different fields of movement (running vs. game play)?

Acceptance:
- To what extent did students perceive the GEKOS program as acceptable in particular? Is there a difference between genders and between different fields of movement?
- What attitudes towards health- and fitness-related content in PE and PE programs linking theory and practice did teachers have? Is there a difference between genders and between different fields of movement (running vs. game play)?
- To what extent did teachers perceive the GEKOS program as acceptable?

Applicability:
- To what extent did teachers consider the GEKOS program as applicable?
- What possibilities did the teachers see for optimization?

Movement time:
- What impact did the GEKOS program have on students' PA levels compared to regular PE classes? Is there a difference between genders and between different fields of movement (running vs. game play)?

[2] In 9th grade in the federal state of Baden–Württemberg, Germany it is common practice to teach PE in gender-segregated classes.

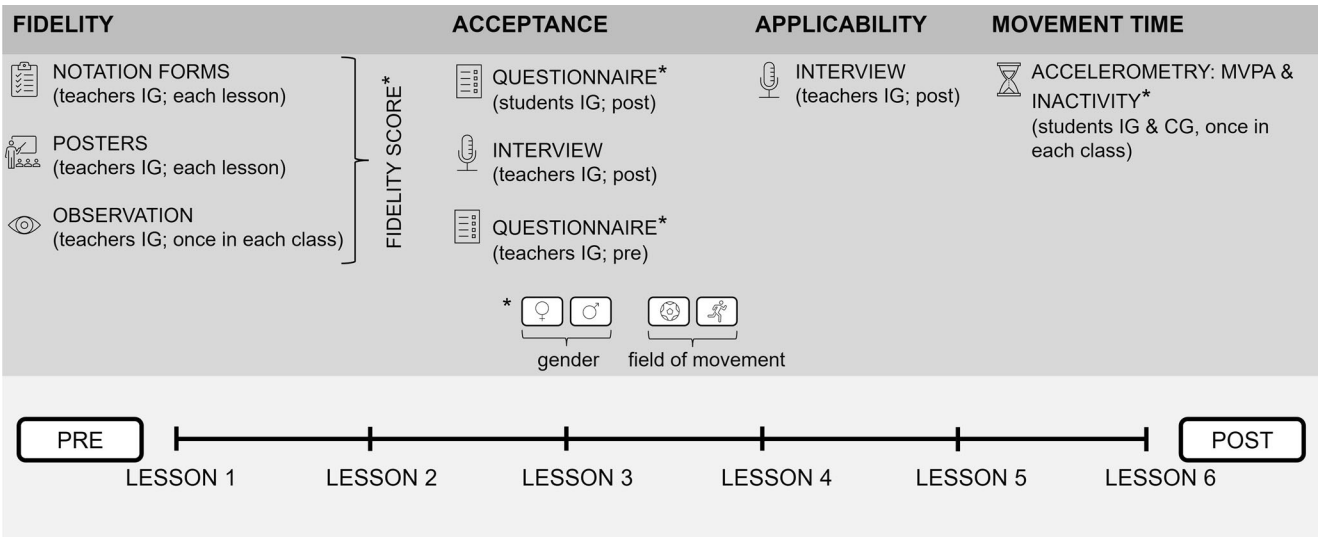


**Fig. 1** ▲ Overview of the methodological procedure in the four research areas. *MVPA* moderate to vigorous physical activity, *CG* control group, *IG* intervention group

## Methods

### Design and procedure

In addition to the published study protocol of the GEKOS study (Haible et al., 2019), we focus here on aspects that play a role for fidelity, acceptance, applicability, and movement time (**Fig. 1**).

To assess fidelity components during the intervention phase, we proceeded as follows: Each intervention group class and their teacher were observed once during the intervention. Care was taken to ensure that all six PE lessons were observed with equal frequency across the intervention classes. In addition, after each lesson, the teachers sent us photos of the posters they created together with the students on the different steps of the learning task. Furthermore, teachers filled out self-report forms after each lesson to assess possible deviations and incidents that occurred. To investigate the acceptance and applicability of the program from the teachers' and students' perspectives, intervention group teachers filled out a questionnaire before conducting the program and were also interviewed once after conducting the program. Students completed questionnaires before and directly after the intervention. Measurement of the students' movement time (duration and MVPA) was performed in parallel with the observation. For this purpose, all students in a class wore accelerometers during one of the six PE lessons. This recording was also done in the classes of the control group to have comparative data. We received approval from the Ethics Committee for Psychological Research at the University of Tübingen (Revision_1_2017_0825_78) for our study and written informed consent was given by students, parents, and teachers.

### Participants

A total of 48 teachers ($c_{female} = 24$) with their gender-segregated PE classes in secondary schools from the federal state Baden–Württemberg, Germany participated in the GEKOS study. They were randomly assigned to intervention ($c_{girls} = 14$, $c_{boys} = 13$; $c_{running} = 14$, $c_{game\ play} = 13$) or control ($c_{girls} = 10$, $c_{boys} = 11$; $c_{running} = 10$, $c_{game\ play} = 11$) groups in advance. One female intervention group teacher (game play) was unable to continue after she taught the first PE lesson due to taking sick leave. A total of 860 students participated. The class that had to stop after the first PE lesson consisted of 19 female students. Of the remaining 841 students ($M_{age} = 14.20$ years, SD = 0.51), 472 (53.8% girls) were in the intervention group ($n_{running} = 255$, $n_{game\ play} = 217$) and 369 (47.7% girls) were in the control group ($n_{running} = 150$, $n_{game\ play} = 219$).

### Measures

To assess fidelity, we conducted an observation, teacher filled out self-report forms and documented posters of the lessons (**Fig. 1**). First, two observers conducted a single preannounced observation per class. A standardized observation sheet (example: Online Resource 1) was used. For fidelity, we considered the delivery of the steps and substeps of the corresponding learning task of the lesson to be relevant. We recorded whether or not (presence = yes; absence = no) teachers carried out the steps and substeps of the learning task (e.g., lesson 1, step 2 [teachers ask students]: What changes can you feel in or on your body when you exercise? Give your guesses). From this, we calculated the percentage of the given steps the teacher actually taught. We used the mean of the observation results of the two raters, which correlated with $r = 0.89$. Second, two raters assessed the presence or absence of elements predefined in the manual (e.g., poster 1 in lesson 1 = max. 4 points: elements regarding respiration, cardiovascular system, muscles, temperature) on the outcome posters of the six PE lessons. This allowed us to calculate an overall percentage score across all posters. In the rating

process, the raters agreed on a point value. Third, the one-page self-report form (example: Online Resource 2) contained the predefined relevant steps of the learning task in each PE lesson (presence = yes; absence = no). It was completed by the teachers after each lesson. We then calculated the percentage value over all six PE lessons. The three measurements (observation, poster, self-report form; correlations: Online Resource 4—Table A1) were combined into a fidelity score to provide a global measure of teachers' adherence to the manual (Cronbach's $\alpha$ = 0.70).

To investigate acceptance and applicability (**Fig. 1**), we asked intervention group students about their opinions on the program after the intervention using a total of eight items (**Fig. 3**). The items, which were adapted from the HealthyPEP study (Demetriou, 2013), questioned students on a Likert scale from strongly disagree (1) to strongly agree (5). Before the intervention phase, we assessed teachers' attitudes towards cognitive activation in PE (method) in the ninth grade (following Rischke (2008); Cronbach's $\alpha$ = 0.81) with six items (e.g., *It makes sense to constantly combine practice and theory in secondary school PE classes*) using a Likert scale ranging from disagree (1) to totally agree (4). Attitudes towards health and fitness content (content) in PE in the ninth grade (following Hoffmann (2006); Cronbach's $\alpha$ = 0.90) was also assessed using seven items (e.g., *Students should learn how to plan and conduct an exercise workout on their own by the end of ninth grade*) with a Likert scale ranging from unimportant (1) to important (6) before the intervention phase. In the semi-structured interview (interview guide: Online Resource 3) after the intervention, we asked the teacher to give feedback on the applicability of the program, their opinions towards the programs' content and methods, their acceptance of the program, their perception of students' acceptance and about optimization possibilities.

Movement time (**Fig. 1**) was assessed using validated accelerometer sensors (Move III sensor, movisens GmbH, Karlsruhe, Germany). Students of both the intervention and control groups wore the sensors attached to their right hip once during a selected PE lesson. Using the output metabolic equivalent (MET) value, we calculated the time spent in different intensity levels based on the cutpoints of the German PA recommendations (Rütten & Pfeifer, 2016). We report movement time in minutes and relative values for the time between the official begin of the lessons and the actual end of the lessons for the intensity level MVPA and for the time when students are physically inactive (inactivity). Within the lessons of the intervention classes, we distinguished in the presentation of results between the lessons 1–5, which were structured by a learning task and lesson 6, which contained the sixth step of the previous learning tasks (application of acquired skills and knowledge—planning a game to promote endurance).

## Analyses

Statistical analyses were conducted using SPSS version 26 (IBM, Armonk, NY, USA). In order to compare groups, we calculated independent sample *t*-tests (95%; confidence interval; missing cases excluded analysis by analysis, effect size: Cohen's *d*) for acceptance (gender: female vs. male, field of movement: running vs. game play) and ANCOVAs for movement time (intervention vs. control group; effect size: partial $\eta^2$) controlled for gender and fields of movement. We examined fidelity measures and teachers' attitudes on the class/teacher level (intervention group only). Thereby, we had no missing data except for one teacher that did not return the self-report forms (fidelity) after the intervention. We examined students' acceptance (intervention group) and movement time data (intervention and control group) on the student level. For students' acceptance, we had between 6.4% ($n$ = 30) and 7.0% ($n$ = 33) missing data due to the absence of students during the test and isolated items remaining incomplete. For movement time, we had 16% missing data (intervention group: $n$ = 66, control group: $n$ = 50) due to absence of students, inactivity due to injury or illness and missing data on weight and size—a prerequisite for the evaluation of MET data.

All semi-structured interviews with the teachers were conducted by the two main researchers of the project (CV and SR), audio-recorded and then transcribed and inspected by two separate research assistants with the software f4transkript (v7, dr. dresing & pehl GmbH, Marburg, Germany). The interviews lasted an average of 29 min. SR and MD then analyzed the interviews with the software MAXQDA (version 2020, VERBI Software GmbH, Berlin, Germany) in an inductive–deductive process following the steps of a content-structured qualitative content analysis (Kuckartz, 2016). The aim of the process was to explore themes and topics that were discussed by the teachers in connection with the acceptance and applicability of the GEKOS program and to obtain suggestions for optimization. SR and MD deductively derived the initial main categories (acceptance, applicability, suggestions for improvement) from the existing topics and questions of the interview and coded each of the two interviews separately from each other. After matching, MD coded all interviews regarding the main categories. On this basis, SR and MD inductively determined subcategories from the material, then went into an exchange process with GS, whereupon MD coded all of the interviews once more. Throughout the process, SR and MD kept reviewing the categories and subcategories and sharpened the definitions.

# Results

## Fidelity

To answer the research question—*To what extent did teachers deliver the GEKOS program as planned?*—the fidelity score (observation, posters, notation forms; **Fig. 1**) was used. Overall, adherence to the manual (fidelity score) was at 86.0% (SD = 10.10, min = 45.6%, max = 97.7%). Divided among the three individual fidelity measures, the score was distributed to observation 91.2% (SD = 13.14, min. = 50.0%, max. = 100.0%), for posters 75.7% (SD = 15.86, min. = 28.5%, max. = 94.3%), and for self-re-

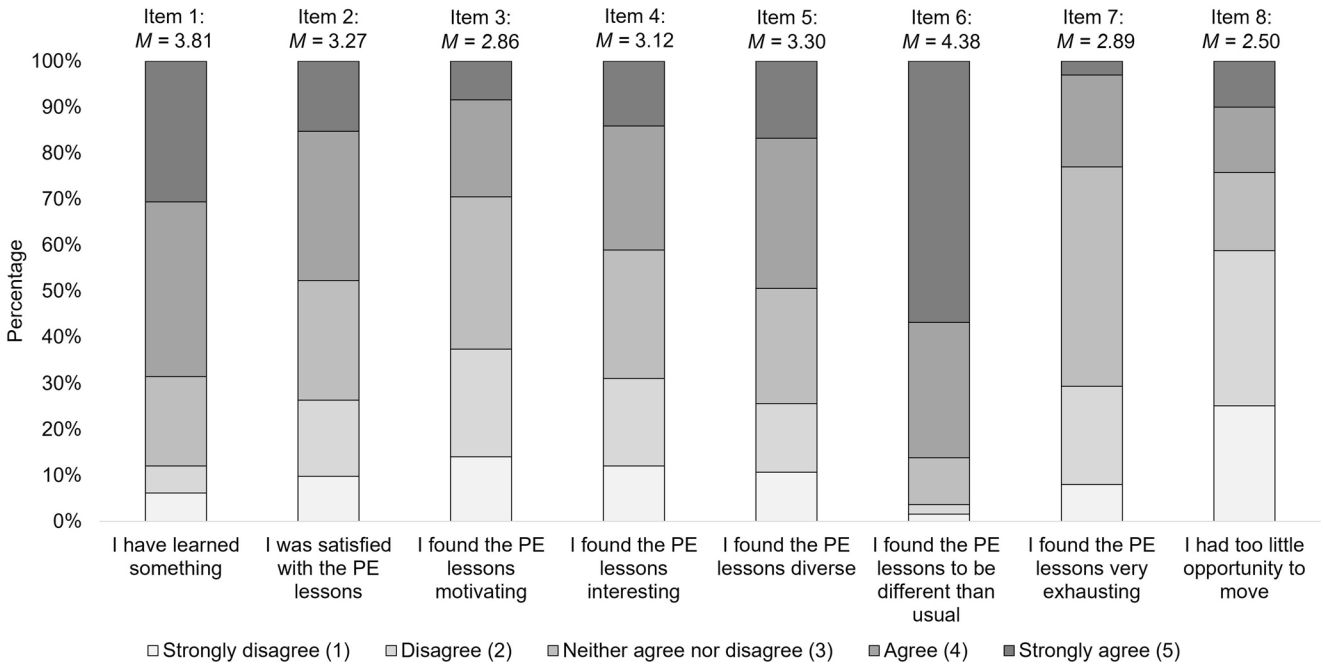


**Fig. 2** ▲ Students' perspectives ($n = 439–441$) on the GEKOS program

port forms 91.3% (SD = 8.44, min = 58.3%, max = 100.0%). Table A1 (Online Resource 4) shows correlations among the fidelity measures, Figure A1 (Online Resource 4) shows the distributions of individual measures including outliers across classes, while Figure A2 (Online Resource 4) shows the individual measures of each teacher. The fidelity score did not differ significantly between gender ($t_{(24)} = 0.77$, $p = 0.45$) or between fields of movement ($t_{(24)} = -0.48$, $p = 0.64$).

## Acceptance (students)

To answer the research question—*To what extent did students perceive the GEKOS program as acceptable in particular?*—the questionnaire data of the students were used (**Figs. 1 and 2**). Students mostly agreed that they learned something (item 1: $M = 3.8$, SD = 1.1; **Fig. 2**), with girls having higher scores than boys ($t_{439} = 3.89$, $p < 0.001$, $d = 0.37$; Table A2). On average students rated the PE lessons as medium satisfying, motivating, interesting, diverse and exhausting (items, 2–5, 7: $M = 2.86–3.30$; **Fig. 2**) and found the PE lessons to be different than usual (item 6: $M = 4.38$, SD = 0.87; **Fig. 2**). **Figure 2** also shows at the individual level that students perceived the GEKOS program differently. Also, there was a significant gender difference in ratings with higher scores among girls (Online Resource 4—Table A2) regarding satisfaction ($t_{438} = 4.07$, $p < 0.001$, $d = 0.39$, $M_{min} = 1.7$, $M_{max} = 4.6$), motivation ($t_{439} = 3.45$, $p < 0.01$, $d = 0.33$, $M_{min} = 1.8$, $M_{max} = 4.3$), interest ($t_{439} = 4.51$, $p < 0.001$, $d = 0.43$, $M_{min} = 1.5$, $M_{max} = 4.4$), and diversity ($t_{439} = 2.81$, $p < 0.01$, $d = 0.26$, $M_{min} = 1.7$, $M_{max} = 4.4$). Students mostly disagreed that they had too little opportunity to move (item 8: $M = 2.50$, SD = 1.28, **Fig. 2**). However, girls disagreed less compared to boys ($t_{440} = 2.82$, $p < 0.01$, $d = 0.27$). With regard to the fields of movement, there were no significant difference in any of the items (Online Resource 4—Table A3).

## Acceptance and applicability (teachers)

To answer the research question—*What attitudes toward health- and fitness-related content in PE and PE programs linking theory and practice did teachers have?*—we used the questionnaire data of teachers (**Fig. 1**). Before the intervention, teachers' ratings concerning their attitudes towards cognitive activation in PE in ninth grade before the intervention were at an average of 2.44 (SD = 0.55, min = 1.67, max = 3.83, scale of 1–4) and their attitudes towards health and fitness content in PE in ninth grade at an average of 4.68 (SD = 0.90, min = 2.29, max = 6.00, scale of 1–6). Figure A3 (Online Resource 4) shows the distribution of individual measures for both attitude scales by teacher. Teachers' attitudes did not differ significantly with respect to gender and fields of movement (Online Resource 4—Tables A4 and A5).

With regard to the research questions—*To what extent did teachers perceive the GEKOS program as acceptable?, To what extent did teachers consider the GEKOS program as applicable?* and *What possibilities did teachers see for optimization?*—we explored the themes and topics discussed by teachers during the interviews about teaching the GEKOS program. We coded the interviews with regard to the three main categories of acceptance, applicability and suggestions for improvement. In the process, we found several subcategories, including global acceptance and movement time related acceptance for main category Acceptance, challenges and functionality for main category Applica-

**Table 1** Main categories and subcategories deductive–inductive derived from analyzing the interviews

| Main categories | Acceptance | Applicability | Suggestions for improvement |
|---|---|---|---|
| Subcategories | Global acceptance<br>Acceptance related to movement time | Challenges<br>Functionality<br>Adoption<br>Perceived student reactions<br>Approaches to teach theoretical content in PE | Theoretical parts of the program<br>Practical parts of the program |
| Common content | Structure of the program/lessons<br>Content of the program/lessons<br>Material | | Manual<br>Scope<br>Movement time |

bility, and aspects regarding theoretical/practical parts of the program for main category Suggestions for improvement (**Table 1**).

Also, we found commonalities across the three main categories and in relation to the research questions, which also seemed to have an impact on each other. It was evident that teachers' views about the GEKOS program regarding acceptance and applicability were diverse (**Table 2**). Thus, teachers frequently expressed positive and negative aspects. In the following, we report selected results from the interviews.

One issue that came up was that the recurring *structure* of the lessons (learning tasks) was described as logical and easy to implement. At the same time, it was also mentioned that the rather unfamiliar structure and method led to uncertainty, particularly in guiding students in student-oriented phases.

Another topic in the interviews was the *content* of the program and of the lessons. The responses of the teachers included that the lessons were perceived feasible, useful and interesting for the students, for example, regarding the lessons on heart rate, perceived exertion, and strength training. However, among the responses given were also statements that some topics were too complex and not relevant to students of grade 9 (e.g., content regarding health and training theory). Some teachers pointed out that in lesson 6 it was difficult for the students to apply what they had learned and to design a correct exercise with regard to the continuous or interval methods, while others also described this sixth lesson as very motivating and well received by the students.

*Materials* were discussed in the interviews as being well-prepared and easy-to-understand, but also with reference to the amount for the individual lessons (posters, worksheets, handouts) as very cumbersome overall and sometimes a bit complex for the students. Some teachers, therefore, said that they did not always use all the material provided.

Responses related to the *manual* included statements that lesson plans were well prepared, but also that applying lessons not developed personally was difficult and more flexibility in implementing the program would have been appreciated.

Another thing that was mentioned was that the *scope* of the program and of the individual lessons was too large, which created a lot of pressure and constant time constraints. For some teachers, as a result, it was sometimes necessary to deviate from the manual, for example, by omitting the final game.

*Movement time* during the GEKOS program was discussed, for example, regarding a lack of practical components in the program. Among the responses given were statements that the most important goal in PE is to get students to move and exercise. Some teachers pointed out that the students wanted to move more and that this also led to motivational problems in some cases. However, some teachers also reported that students who are otherwise not high achievers in PE showed increased responsiveness, interest, and acceptance and perceived the teaching concept as a form of PE in which they could also participate and perform well.

For optimization, teachers' suggestions in the interviews included reducing the theoretical content of the program, to teach part of the content on other subjects such as biology, as an interdisciplinary teaching approach or to spread the content over several lessons. This could reduce the scope and time constraints and increase the amount of time spent on PA. Recommendations made also included reducing the amount of material and providing more teacher-centered theoretical input.

All in all, both positive and negative aspects regarding the GEKOS program were expressed in the interviews. Table A6 (Online Resource 4) compares key statements from teachers who were predominantly positive or negative about the GEKOS program for illustrative purposes. Some teachers indicated that they were generally in favor of teaching theory in PE, but still prioritize a high amount of MVPA. Some expressed that they were happy about the new ideas and stated that they would definitely like to adopt content into their lessons, to use the method (learning tasks) selectively or to carry out the program again in other classes.

## Movement time

To answer the research question—*What impact did the GEKOS program have on students' PA levels compared to regular PE classes?*—data of accelerometry of intervention and control group students were used. On average, during a 90 min PE lesson, the intervention group students moved 23.12 min (25.7%, SD = 6.49, min = 3.67 min, max = 41.33 min) at MVPA, while they were physically inactive for 62.91 min (69.9%, SD = 7.52, min = 42.67 min, max = 81.67 min). Control group students were physically active at MVPA for 37.08 min (41.2%, SD = 9.86, min = 10.00 min, max = 61.17 min) and physically inactive for 41.51 min (46.12%, SD = 10.48, min = 13.83 min, max = 70.00 min). With regard to teaching time from the official begin to the actual end of the lessons (Online Resource 4—Table A7), after adjusting for gender and fields of movement, control group students moved significantly more at MVPA ($F_{(1, 721)}$ =

**Table 2** Exemplary positive and negative statements from teachers regarding the GEKOS program and the lessons

| Themes | Positive statements | Negative statements |
|---|---|---|
| Structure | Personally, I think, the structure served its function well for the students and for me as a teacher as well. Because all lessons were structured the same, but also because of the method itself which practically gives the students an idea of what is coming at the beginning of the lesson and makes them think about what he/she knows already. And the understandable structure, I do something and at the end I check whether what I already knew is correct and what I have gained from the process. I think the methodology, I apply it too in regular lessons at the start or whatever. Collecting assumptions and checking them. This is often an easy way to motivate the students. To consider, okay, was my assumption at the beginning correct—I found that to be a great approach. (Teacher A) | So, as I said, I have already noted that a total of three reflection phases or three theory phases are too much, from my point of view (Teacher B) |
| Content | The methodology is rather new, collecting things, or what is of course quite great is this Borg scale. I think that it was rare to reflect on the load without necessarily measuring it, but rather to really reflect on it, which is actually a good aspect, but we haven't discussed it like that before, and that was certainly new. (Teacher N) | And I think, what maybe also altogether this question misses a little bit is the, well, how should I say it, the reality of the young people, is, I think they are not interested in health. Not for the health-oriented execution of sports. Rather, either maximum performance or just increase in strength, strength training, muscles, that that would be important. (Teacher E) |
| Material | I found the materials for the perception and measurement of heart rate, especially gluing the points on the posters very good. Like this the group could see what happens generally and specifically and everyone knows where they stand, how they can evaluate this and what it means. I think this is really good and I might adopt this. (Teacher F) | I just found that it was an extreme amount of material, and that the social form was changed extremely often. And, then you had to take the pulse and note the subjective sense of exertion. I found that was simply too much and I as a teacher somehow became frantic because I sat there on my mountain of materials and thought to myself: Wow, I'm about to go crazy. (Teacher H) |
| Manual | So, for preparation, the materials were very well prepared, and I always read through the more detailed draft, as there were two drafts. And then I was actually well prepared. (Teacher D) | They were already very stressful hours for me in terms of organization. Not in terms of dealing with the students, but in terms of organization. To make sure that I really followed all the steps that were on the schedule. Because I had the ambition to carry out the study the way it should be carried out. That was the thing that concerned me the most. (Teacher A) |
| Scope | I think it's good, I already did it that way in my upper secondary classes. Now that was super intensive because every lesson was like that. It is certainly a bit more pleasant for the students if it can be set more selectively. That's still a lot of content, I'm aware of that, but it was too much action knowledge for me. What helped them or what we could always fall back on was this Borg scale, for example, I find that to be super well-applied knowledge. Or that they simply know in a moment, ok, this is how I measure my pulse, now I've ran, now I'll have a look, that was applicable knowledge. But, if one would transfer it now to normal sport instruction, I would not do it so concentrated in one piece, but a little bit distributed. But otherwise I think that is also the right way for the students to think about it themselves and to explore it and I think you can educate them in that direction. (Teacher Z) | But it was probably far too much information for the students at some point. (Teacher V) |
| Movement time | I would say is despite the fact that we now had more interruptions for the theory, movement time was still the same as compared to my normal lessons. (Teacher L) | So overall I have to say that when I look back at it again, that if I had known how it would be, I probably wouldn't have participated. Because for me the movement time in physical education lessons is the most important and here it was too short. (Teacher E) |

716.85, $p < 0.001$, partial $\eta^2 = 0.50$; 43.0% vs. 25.3%) and were significantly less physically inactive ($F_{(1, 721)} = 957.61$, $p < 0.001$, partial $\eta^2 = 0.57$; 46.8% vs. 67.4%) than intervention group students. For the intervention group, we also took a closer look at the distribution of the different activity levels (**Fig. 3**) which were higher in the lessons 1–5 structured by a learning task and lower in lesson 6, which focused on the application of acquired knowledge and skills of the students.

## Discussion

In the present study, we complemented the pre-existing evaluation of effectiveness of our manualized health- and fitness-related PE program GEKOS, a program which aims to link theory and practice. With a thorough process evaluation, we investigated adherence to the manual (fidelity), teachers' and students' acceptance and teachers' perceived applicability of the program as well as the impact of the program on the actual movement

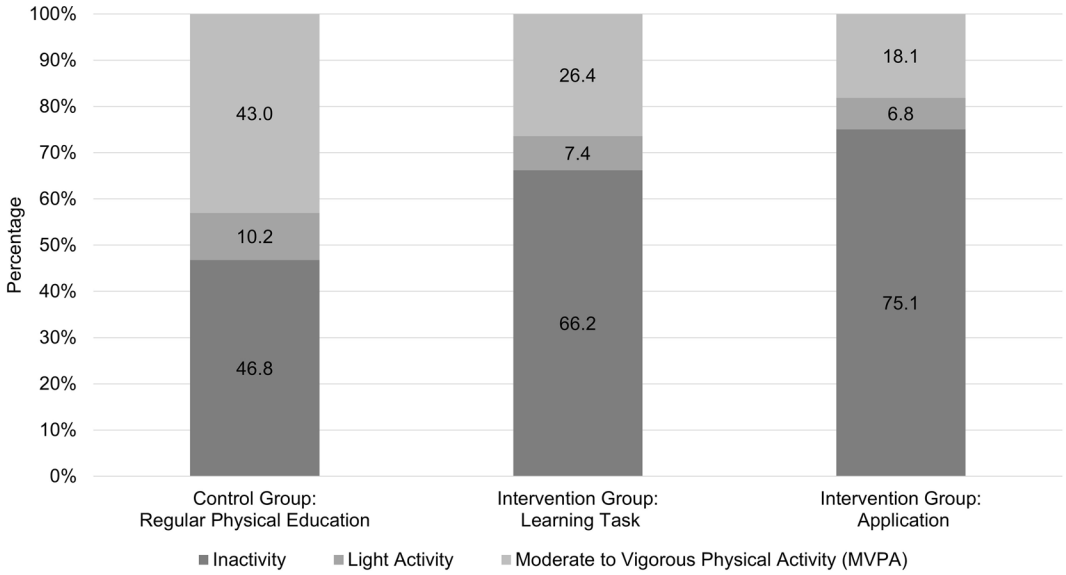


**Fig. 3** ◀ Movement time from the official begin to the actual end of the lessons divided into inactivity, light activity, and moderate-to-vigorous activity (MVPA) for the control group and the intervention group once in relation to the five learning tasks in lessons 1–5 and once to the application lesson in lesson 6

time of the students. Therein, we have attempted to identify possible barriers and facilitating factors for the long-term implementation of the GEKOS program.

## Integrative discussion regarding fidelity, acceptance, applicability, and movement time

Overall, teachers adhered to the manual (fidelity score), although there were isolated outliers with lower scores regarding observation, posters, and self-report forms. The scores of the posters were on average somewhat lower than the scores of the observation and self-report forms. This may be due to the fact that the latter, in contrast to the observation, is composed of values from all six lessons. Also, in comparison to the self-report forms, which were filled out by the teachers, we evaluated the posters strictly according to objective criteria. Although some teachers reported that they had decided to reduce the usage of provided materials due to their high quantity and the limited time, the poster scores were still high.

Overall, students' acceptance of the GEKOS program was average, with girls scoring slightly more positively than boys (small effect), as in HealthyPEP (Demetriou et al., 2014). The scores of the items spread across the entire scale from one to five. It can therefore be assumed that the students' opinions about the program on an individual level were very heterogeneous. We would like to highlight the item 'I have learned something', which received one of the highest scores by the students. The subjective perception of the students is also reflected objectively in the effects of the GEKOS program on their health-related fitness knowledge (Volk et al., 2021). The high score in the item-rating may indicate that the students, on the one hand, were aware of the content taught in the lessons and, on the other hand, that they used the program-offer at least for their subjective learning process. However, we slightly changed the item from its original wording (Demetriou, 2013) and we do not have a comparison to the control group. In this context, students also consistently noticed that the lessons were quite different from their regular PE lessons. In contrast, the item 'I found the PE lessons motivating' was rated with the lowest score. Also, some teachers pointed out in the interviews that they had sometimes noticed a loss of motivation among the students. This may be one reason as to why the program did not have effects on students' health-related motivation on average (Volk et al., 2021). Some other teachers emphasized that students who had previously tended to be nonachievers in particular seemed to become more involved in PE classes. These different perceptions in students and teachers were also reflected in the results of the person-oriented evaluations, where there were both positive and negative developments in the area of motivation in certain profiles among the students (Rosenstiel et al., 2022). Thus, this type of teaching could represent an opportunity to appeal more to students with a lower affinity for PE. Nevertheless, the demand should be to create reasonably motivating lessons for all students.

Prior to conducting the GEKOS program, 25 of 27 teachers in the intervention group found health and fitness content to be rather important to very important in grade nine. This is in line with results of the Health.edu study in which health content was consistently accepted by teachers (Töpfer, Ptack, Tittlbach, Brandl-Bredenbeck, & Sygusch, 2020). The teachers in the GEKOS study were rather critical of teaching theoretical content in the sense of cognitive activation in grade nine, which was also discussed in the interviews. One theme mentioned in the interview in this regard was that movement time in PE comes first and that teacher-centered approaches to knowledge transfer are preferred. These findings are compatible with results of other studies on this topic (e.g., Hapke, 2018; Ptack & Tittlbach, 2020; Serwe-Pandrick et al., 2023). Also, teachers tended to show ambivalent reactions to the GEKOS program in the interviews. Themes and topics that were mentioned were related to the areas of content, structure, manual, material, scope, and the low movement time. Overall, the feedback in the interviews on the acceptance

and applicability of the program was diverse, with teachers making both positive and critical comments on the individual topics. Despite these different attitudes, the teachers participating in the GEKOS intervention study delivered the manualized lessons as they were planned, with very few exceptions. Therefore, we assume that adherence worked well due to the teacher training and the provided manual, regardless of teachers' initial attitudes and teachers' acceptance of the program.

The perceived low movement time of students, which was a theme in the teacher interviews (intervention group), was in line with the device-based observed reduction of students' MVPA over the six lessons. This is also a not unexpected explanation for the nonexistent effects on students' physical fitness through the GEKOS program (Volk et al., 2021). Control group students moved (MVPA) on average 41.2% of the PE lessons, while students in the GEKOS program moved (MVPA) significantly less (25.7%). Nevertheless, intervention group students demonstrated between 20–40% (including light PA) movement time, which was issued by Zeuner (2014) as orientation. Also, it must be considered that for organizational reasons, control group teachers knew exactly when we were going to measure movement time in their classes. As reactivity, however on the level of individuals, has already been observed in other studies (Burchartz et al., 2020), this may have had an impact on their PE lessons, which were potentially more focused on MVPA and less on acquisition of knowledge and educational tasks. Noteworthy regarding movement time is lesson 6, which has the highest level of inactivity overall due to its structure (particularly student-centered designing of a game by the students). Nevertheless, this lesson was positively mentioned by some teachers, as from their point of view it likely had a special learning quality. This shows that the critical attitude of the teachers towards cognitive activation was positively evaluated in concrete individual cases where the content was regarded as relevant and important. In general, contrary to the many critical statements of the teachers, on average, the students did not register the low amount of movement time as very problematic. We return to these different perspectives on health-oriented PE such as GEKOS in the balance between theory and practice in the chapter Lessons learned and outlook.

## Strength and limitations

With our GEKOS study (Haible et al., 2019), we have now conducted a comprehensive process evaluation building upon the outcome evaluation that had already been carried out (Rosenstiel et al., 2022; Volk et al., 2021). As recommended, we used quantitative and qualitative data and addressed different perspectives by including the opinion of teachers and students. We used a great variety of device-based and subjective data sources such as questionnaires, observation, accelerometer-based data, and interviews.

However, we must also note the limitations of our study. At the class level, especially when focusing on the intervention group, we could only draw on a relatively small sample for quantitative analyses. This did not leave us room for a robust investigation of class differences and testing of causal assumptions. In contrast, for the qualitative analyses we could rely on a large sample with diverse information and could present heterogeneity aspects within and across classes that need further exploration. We refrained from making quantitative statements on the different topics that arose in the interview, as we wanted to explore themes in relation to the GEKOS program and did not want to make any generalizable statements. In addition, quantification is partially difficult in our case, as the respective topics were mainly discussed both positively and negatively by the teachers in the interviews. This could lead to confusion in the presentation of results and would require more extensive explanations. Due to the complex data structure (varying number of substeps of the learning task in different lessons [1–6] in two fields of movement), it was not possible to calculate Cohens Kappa for the evaluation of the observation. Also, we only assessed acceptance in intervention group students. This does not allow group comparison and limits the possibilities for interpretation.

## Lessons learned and outlook

What have we learned from our study with respect to the GEKOS program, but also in general for the implementation of competency-based health- and fitness-related programs that link practical and theoretical content with cognitive activation in PE.

First, study-related conditions and experiences could be a barrier to long-term implementation of PE programs. Schools differ greatly from one another in terms of school-specific curricula, equipment, structures and processes. Likewise, a high degree of standardization of study conditions and manualization of teaching units poses an additional challenge. Feedback from teachers included that the GEKOS manual and materials were good and the lessons well structured. The high level of detail and the given concept that was not self-developed still required a lot of preparation time and put them under pressure.

Second, as also shown in other publications (e.g., Silva, Farias, & Mesquita, 2021; Zhu et al., 2011), the teachers are an important facilitator of program implementation in PE, while their acceptance, perceptions of applicability, and their personal teaching style play a central role. Thus, despite high fidelity and positive feedback on applicability, critical attitudes toward cognitive activation and student-centered approaches emerged. These may even have been reinforced by experiences with the GEKOS program due to the limited amount of time students spent moving. Independently of the GEKOS program and irrespective of curricula objectives and academic discourse regarding health-related capacity to act and cognitive activation, it seems that in the real-world setting PE often tends to focus primarily on the time students' move and exert themselves. This observation is also shared by researchers nationally (e.g., Hapke, 2018; Ptack et al., 2020; Serwe-Pandrick et al., 2023) and internationally (e.g., Australia: Pill & Stolz, 2017). Furthermore, our program,

the content and method of which should not be completely unknown due to the curricula, was described by teachers as a new and unfamiliar way of teaching. This statement was underlined by the results of the student survey, which described the PE program as different from usual PE. Also, our teachers stated that they are generally open to teaching theoretical content in PE. However, they described that they prefer to do so in a teacher-centered manner through lecture. This is an indication that, as also observed in different studies (Engelhardt et al., 2023; Hapke, 2018; Ptack et al., 2020; Ptack & Tittlbach, 2020; Serwe-Pandrick et al., 2023), methodological criteria for cognitive activation and task-related action such as reflection, openness, and student orientation are not sustainably implemented in PE practice. In international literature, similar findings have been observed with regard to the implementation of student-centered teaching concepts (e.g., Pill & Stolz, 2017; Silva et al., 2021; Zhu et al., 2011).

These aspects raise the question: What does it take to support teachers in terms of their task-related actions and set them on the path of a more cognitively activating PE?

Specifically, with regard to the GEKOS program, it would make sense to provide for more flexibility. In the past, manualization and standardization were considered to be important indicators for the evaluation of such programs. In the modern era, however, implementation research in particular has called for more flexibility and adaptivity in the delivery of programs, as long as the underlying processes and functions of a program are preserved (e.g., Durlak & DuPre, 2008; Peters et al., 2013; Skivington et al., 2021). Against this background the GEKOS manual could be reduced to the steps of the learning tasks as the core elements of the program. Furthermore, since we could not identify any differences between the two variants *running* and *game play* in terms of fidelity and acceptance by students and teachers, the theoretical content in combination with the method, as key functions of the program, may be addressed as desired with different practical sports content. In particular, the result with regard to outcomes (Volk et al., 2021) and to movement time in the variant *game play* also underlines the notion that it does not always have to be classical running activities and strength training when it comes to the topic of health and fitness in PE. Therefore, teachers could decide for themselves over which period of time and in connection with which practical content they want to implement the learning tasks. In addition, the teachers would be enabled to alternate or accompany the GEKOS content with other topics over the course of a school year. Thus, the suggested procedure could increase the amount of time students spent moving, would be perceived as more diversified and would support the long-term acquisition of knowledge, skills, abilities, and motivation.

In general, the tension between movement time and reflection time as two key principles of PE (Serwe-Pandrick et al., 2023) should be further addressed. For instance, Mong and Standal (2019) and Quennerstedt (2019) propose that a compromise must be found such that neither a narrowed focus on only increasing health-enhancing PA nor a purely theoretical discussion of the topic becomes the main goal of PE. For this, it is important that sports didactic and curricular demands and real-world PE converge. It can help, as called for in the Health.Edu study, for stakeholders of teacher training in the first phase (university) and the second phase (seminars) to engage in intensive exchange (Töpfer et al., 2020). Furthermore, teacher education and training could focus more on student-centered and task-related teaching practice and on how to design (health-related) content and the methodological characteristics of cognitive activation in PE. Additionally, it is considered worthwhile to provide teachers with good practice examples, perhaps even in the context of textbooks, on the basis of which they can design their own PE with regard to competence orientation and reflective capacity to act (Töpfer et al., 2020). We tried to facilitate this for the GEKOS program by providing different materials (see Haible, 2020; Rosenstiel & Volk, 2022; Volk, 2020; Volk & Haible, 2020).

For the research practice, the individual conditions at the respective schools should be taken into account in corresponding studies and principals and regional councils should be involved to a greater extent. Despite the great support of both institutions during the GEKOS project, the main organizational work remained in the hand of the teachers. During studies, it would be very helpful to provide teachers with more time to focus on the content and methods of PE programs. Furthermore, one possibility would be to develop corresponding programs using participatory approaches, as done in the case of Health.edu, and to not only involve teachers in the revision process, as with GEKOS. However, it should be considered that this, in turn, entails a significant time investment for the involved stakeholders, and program concepts can vary greatly in terms of their content and methodological orientation. To capture this, systematic evaluations and documentations are necessary (Töpfer et al., 2020). In addition, in future studies, the interaction between the teacher, the program, and the students should be investigated in greater depth. The different assessments and feedback on an individual level indicate that the interaction between the teacher and the program may also play a role in students' evaluation. For further interpretation, however, insights into teaching quality would be useful.

With the GEKOS program, we hope to advance the discussions about competence, health-related (reflective) capacity to act, cognitive activation, and movement time in PE. With the optimization proposals, we also hope to provide a good practical example for teachers and research for promoting students' knowledge, skills, abilities, and motivation to initiate and maintain a healthy, physically active lifestyle throughout their lifespan.

## Corresponding address

**Stephanie Rosenstiel**
Institute of Sports Science,
University of Tübingen
Wilhelmstraße 124,
72074 Tübingen, Germany
stephanie.rosenstiel@uni-tuebingen.de

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## Declarations

**Conflict of interest.** S. Rosenstiel, C. Volk, M. Dernbach, B. Teutemacher, Y. Demetriou, A. Thiel and G. Sudeck declare that they have no competing interests.

All procedures performed in studies involving human participants or on human tissue were in accordance with the ethical standards of the institutional and/or national research committee and with the 1975 Helsinki declaration and its later amendments or comparable ethical standards. The GEKOS study was approved by the Ethics Committee for Psychological Research at the University of Tübingen (Revision_1_2017_0825_78) and registered in the German Clinical Trial register (DRKS), DRKS-ID: DRKS00016349. Informed consent was obtained from all individual participants included in the study.



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