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RESEARCH REPORT

A randomized controlled trial of the effectiveness of teacher continued professional development on student language outcomes

Olof Sandgren¹  | Ketty Andersson¹  | Viveka Lyberg Åhlander^{1,2} |
Ida Rosqvist¹ | Kristina Hansson¹ | Birgitta Sahlén¹

¹Logopedics, Phoniatics, & Audiology, Department of Clinical Sciences, Lund, Lund University, Lund, Sweden

²Department of Speech Language Pathology, Åbo Akademi University, Åbo, Finland

Correspondence

Logopedics, Phoniatics, & Audiology, Department of Clinical Sciences, Lund, Lund University, Lund, Sweden.
Email: olof.sandgren@med.lu.se

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Abstract

Background: Continued professional development (CPD) is required for updated skills and knowledge. This study evaluates the efficacy of a CPD programme for mainstream school teachers.

Aims: In an 11-week intervention programme, speech–language therapists (SLTs) presented the participating teachers with whole-class teaching techniques aimed at creating a language and communication-supporting classroom environment. The effects of the intervention on the language development of the students in the teachers' classes were assessed.

Methods & Procedures: A total of 211 first- and second-year students ($M_{\text{age}} = 7;6$, range = 6;5–8;9) underwent standardized language assessments of receptive and expressive language abilities before and after their teachers' participation in the CPD. The students were divided into intervention and delayed intervention groups to enable randomized intervention allocation. Linear mixed modelling was used to estimate the individual and interaction effects of group, time and demographic factors.

Outcomes & Results: Significant effects of time, group and school, respectively, but no interaction between time and group indicates that while all students advanced between assessments, the progress was not attributable to the teachers' participation in the CPD.

Conclusions & Implications: Results are discussed in light of those of recent studies of universal services to support optimal language development.

KEYWORDS

assessment, continued professional development, service provision, student language outcomes

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WHAT THIS PAPER ADDS

What is already known on this subject

Although inconclusive, previous research indicates that intervention delivered to teachers by SLTs has the potential to improve the language abilities of the students in the teachers' classrooms.

What this paper adds to existing knowledge

This study explored the language development of first- and second-year mainstream school students whose teachers took part in a CPD programme aimed at establishing language and communication-supporting teaching techniques. Results indicate that the development of the students' language abilities could not be attributed to the teachers' participation in the CPD.

What are the potential or actual implications of the work?

SLTs are often asked to guide teachers and teaching staff rather than themselves conduct individual assessments and interventions. The results of this trial can be used to inform the discussion on how to prioritize between tasks.

INTRODUCTION

In recent years, the topic of optimal provision of speech and language services has received considerable research attention, often as part of an on-going debate about equitable health and education services. Following an examination of the evidence base for speech and language intervention, Ebbels et al. (2019) argued that speech-language therapists (SLTs) should focus their attention on individualized services for children with complex speech and language needs, for whom other types of services have been shown not to be effective. Analogously, Ebbels et al. recommended against using SLT services for universal provision to all children and to children with subclinical language weakness, as these groups can be equally helped by well-trained and supported education staff. Although individualized intervention should always be prioritized when resources for speech and language services are limited, Ebbels et al. distinguish between indirect intervention performed by non-SLTs, and direct intervention performed by SLTs. While both options should be led and managed by an SLT, the indirect option should be offered to children who after assessment have been found to have slightly less severe difficulties. For these children, intervention can be delivered by a trained non-SLT, for example, a special needs teacher/educator, under the supervision of an SLT. This way, enough resources will always remain available to offer direct SLT intervention to children with the most severe difficulties.

Ebbels et al.'s (2019) recommendations are not uncontroversial. In a comment to the article, Law (2019) objected to the idea of allowing the current evidence-base to restrict

SLT service provision to individualized intervention. By pointing out that 'lack of evidence should never be confused with negative evidence' (26), Law stressed that the competence of SLTs is needed across all levels of service provision, including universal services to all and targeted intervention to at-risk populations. Directing SLT speech and language services at all levels is, according to Law, more important than ever before, as an increasing number of SLTs in many Western European countries hold positions where they are required to guide their instructions to other professionals, rather than themselves perform individual assessment and intervention. In addition, including all levels in SLT service provision could lead to a much-needed raise in awareness of language disorder and its consequences among, for example, teachers and other school personnel (see also Enderby & Law, 2019, for a clarification of the terminology surrounding public health SLT services).

The evidence base for speech and language intervention, and the objectives of the SLT profession are, however, not the only factors influencing speech and language services. Inclusive teaching is a main objective in many school systems and has received a prominent place in school legislature over the last decades (United Nations General Assembly, 2007). With it follows that traditional service delivery, for example, pull-out models of intervention, are challenged and that schools must offer support for students in need within the classroom and the mainstream teaching. To succeed in this, teachers must be flexible in their choice of teaching strategies and know how to differentiate their teaching to accommodate the individual needs of the students. In previous research, teachers have

found this to be challenging. Dockrell and Lindsay (2001) found teachers of children with language disorder to have gaps in knowledge and experience. In their study, many of the teachers reported problems understanding the nature of the child's difficulties, identifying the appropriate course of action, and with describing their own responsibility regarding intervention. In a more recent review, Gallagher et al. (2019) identified differences in perspectives between SLTs and teachers regarding the understanding and interpretation of developmental language disorders (DLD) as likely to impede inter-professional collaboration for students with these difficulties.

In parallel with stronger incentives for inclusive teaching, the concept of evidence has gained ground in schools. In some sense, the call for scientifically evaluated teaching methods clashes with an education policy promoting inclusive teaching with differentiated support to meet the diverse needs of all students in a classroom. While evaluations have found specialized one-to-one intervention to improve, for example, narrative ability (Gillam & Gillam, 2016; Gillam et al., 2018), receptive vocabulary and word-finding ability (Wright et al., 2018), and verb argument structure (Ebbels et al., 2007) for students with language needs, fewer studies have investigated whole-class interventions for this population. Below, studies evaluating teacher-delivered targeted intervention (using the terminology recommended by Enderby & Law, 2019) are summarized followed by studies of population or universal services (provided by teachers to students with increased risk, or to help all students reach their potential, respectively).

To fill the gap in the targeted intervention literature, Starling et al. (2012) investigated the effects of a collaborative classroom-based intervention in which SLTs provided training to teachers in language-supporting instructional techniques. Starling et al. assigned 13 teachers from two schools to either a trained or a control condition and conducted pre-, post- and follow-up interviews and language assessments with the teachers and their 43 students, respectively. The authors specifically targeted students with language disorder in secondary school, an age range often overlooked in intervention studies of language disorder. During a weekly session of approximately 50 min over the course of 10 weeks, Starling et al. provided the teachers with training within four domains: written language, oral language, information processing and vocabulary instruction. The sessions were used to introduce, explain and model the use of new techniques, and to discuss the teachers' experiences before and after trying to implement the techniques in the classroom. The participating teachers were observed and rated on their use of the techniques and evaluation of the teachers' uptake of the new teaching techniques was made during pre- and post-

intervention interviews with a tool assessing the teachers' ability to use the techniques. After the intervention, the teachers in Starling et al.'s study produced higher scores, indicative of an independent use of the techniques. The students participating in Starling et al.'s trial underwent standardized assessment of reading and listening comprehension, as well as written and oral expression, before and after the teacher training. Significant improvements were found for listening comprehension and written expression, compared with the students taught by untrained teachers.

In a study also targeting adolescents with language disorder, Lowe et al. (2019) evaluated the effectiveness of a phonological-semantic intervention delivered by school teachers during science lessons. The intervention, which embedded phonological-semantic information of the target words through use of predetermined activities, had previously only been evaluated as individual or small-group intervention, and was taught to the participating teachers during a 1-h interactive training session. After the intervention, which lasted 10 lessons, the depth of knowledge and use of words taught in the experimental condition were greater than for matched words taught traditionally. The increased use of the words was also maintained at follow-up 5 weeks after completion of the intervention.

Fricke et al. (2017) also selected children with language difficulties and evaluated the effect of manualized intervention, delivered by teaching assistants, on the language and literacy development of the students. They provided teaching assistants with continued professional development (CPD) aimed at establishing methods for individualized intervention to 4–5-year-old children in need of support, and compared the effect of two intervention durations, 20 and 30 weeks, and a waiting control group, on language and literacy outcomes. Both durations significantly improved oral language compared with the control group, with moderate effect, and the effects were maintained 6 months later. However, literacy measures did not improve.

In an evaluation of population services, studying almost 1000 students, Snow et al. (2014) offered 6 days of CPD and year-long access to coaching to primary teachers in socio-economically disadvantaged schools. The CPD aimed to improve the teachers' capacity to strengthen receptive and expressive oral language skills, including narrative ability, to facilitate early literacy and academic development. While both conditions improved, students whose teachers had received intervention outperformed students in the business-as-usual condition on oral language and reading, including vocabulary, syntactic understanding and aspects of phonemic awareness, but not narrative ability. The authors conclude that the psycholinguistic underpinnings of reading must be emphasized in early school years

and suggest that the combined competence of educators and SLTs create optimal educational outcomes.

Wasik and Hindman (2011) provided Head Start teachers with CPD with the purpose of establishing instructional strategies to support vocabulary, alphabet knowledge and phonological sensitivity. After 1 year, teachers who had received CPD had created higher quality classrooms environments in which they modelled language and discussed concepts to a higher extent and provided children with feedback on their language. The students in these classrooms performed better on receptive vocabulary and phonological sensitivity compared with business-as-usual peers. According to Wasik and Hindman, this type of CPD is a way of closing the gap in language and preliteracy skills between underprivileged children and more affluent peers.

In a recent systematic review of experimental and quasi-experimental studies, Dobinson and Dockrell (2021) examined the evidence for universal, or Tier 1, strategies to improve expressive oral language skills during the early school years. Although not an evaluation of CPD per se, Dobinson and Dockrell evaluated components often included in language and literacy CPD. Interactive book reading combined with structured vocabulary instructions, manualized curricula, and collaborative teaching by teachers and SLTs were found to have positive effect on the oral language skills when delivered as part of the universal provision offered to all students.

The studies cited above all share some of the features associated with greater success summarized in a review of CPD literature by Markussen-Brown et al. (2017). These include CPD with multiple components, that is, CPD combining course work, coaching, feedback on new practices, and reflection on progress. CPD of greater intensity and duration were also positively associated with better teacher outcomes. Greater effects were also found for teachers serving children in disadvantaged areas. In addition, smaller studies were found to yield greater effects than larger studies, possibly because more support could be offered to the participating teachers in smaller trials, perhaps in combination with a publication bias favouring positive findings.

In contrast to the positive outcomes of CPD reported above, others have failed to show similarly clear effects. In an evaluation of a CPD directed at preschool teachers and aimed at facilitating the language development of 0–3-year-old children, Clegg et al. (2020) found no interaction between time and group, which indicates that the development over time recorded for the participants could not be attributed to the teachers' participation in the CPD. However, the authors emphasize the results of post-hoc analyses which tentatively can be interpreted as evidence for a greater development in receptive, expressive and total

language scores for the two intervention groups compared with the control group.

Gerholm et al. (2019) compared the effect of two teacher delivered interventions with that of regular preschool teaching on the development of 4–6-year-old children. The interventions targeted communicative development and language skills, or mathematics and attention, respectively. Standardized assessments of language, communication, executive function, math and socioemotional comprehension were included as outcome measures. Neither intervention showed effects beyond those recorded for the control group.

To summarize, previous studies have reported positive effects of CPD and teacher delivered intervention on the language abilities of younger as well as older children, with confirmed, or at risk for, language difficulties or with typical language development. In addition, many studies have shown these effects in children from less affluent areas. In this study, we therefore include school year (as proxy for age), school and school district (as proxies for socio-economic status —SES) in the models under evaluation.

THE CURRENT STUDY

Encouraged by the results of Starling et al. (2012) and those of other successful CPD trials (e.g., Fricke et al., 2017; Lowe et al., 2019; Snow et al., 2014; Wasik & Hindman, 2011), we test here the hypothesis that an SLT-delivered practice-embedded CPD aimed at modifying mainstream primary school teachers' verbal and non-verbal instructional communication can improve the core language abilities of the students in the teachers' classes. Unlike Starling et al. (2012) we made no preselection of participating students based on language ability; instead we test whether the promising results for students with language disorder reported by Starling et al. can be replicated in the diverse student population of a mainstream classroom. The research question we set out to answer was:

- Do primary school students who have been taught by teachers taking part in the CPD exhibit improvements in core receptive and expressive language abilities, as measured with CELF-4 Core, in comparison with students taught by teachers in the waiting control group?

We predicted, in line with the results of Starling et al. (2012), that the CPD would have positive effects on the language abilities of the students taught in the participating teachers' classrooms. Given the large variation in language abilities among the students in a mainstream classroom, as well as in a primary school-age population



as compared with older students, we expected large individual variation in the students' benefit from any changes in the teachers' instructional behaviour. However, we recognize that the predictions may be rendered false by an increased experimental control added to the trial, in comparison with the method used by Starling et al. For example, we have increased the number of participating schools, teachers and students, and use of two control groups to better control for any contamination effects and differences in demographic characteristics between participating schools.

METHOD

Design

In this study we tried to meet the methodological demands necessary to produce generalizable results, while remaining sensitive to the practical requirements and requests of the participating schools and teachers. Data were collected in five public schools from two school districts during the autumn and spring semesters of 2017–18 (school district A) and 2018–19 (school district B). In both school districts we reached out to administrators of schools that previously had taken part in a research project on classroom acoustics and teacher well-being in third- to sixth-year teachers, headed by the third and sixth authors. As requested by the schools, teams of teachers, as opposed to individual teachers, were randomly assigned to either an intervention condition (i.e., the CPD programme) or a delayed intervention control condition. The teachers in the intervention condition received 90 min of weekly intervention over the course of 11 weeks, focusing on hands-on training of evidence-based techniques to create a language and communication supporting classroom, and on offering the participating teachers the opportunity to try new methods under the supervision of experienced SLTs (the second, third, fourth and sixth authors). The first session offered an opportunity for the SLTs and teachers to get to know each other. The rationale for the CPD was presented along with rules for the upcoming sessions. In addition, the teachers were asked to set their own learning goals and discuss their expectations on the CPD. Remaining 10 sessions focused on one of three themes: teachers' verbal and non-verbal communication (e.g., how best to use communicative resources when giving out instructions and asking questions, and how to provide students with useful feedback), introducing activities to promote language learning in the classroom (e.g., dialogic book reading, vocabulary training through the use of, for example, word walls and picture walks, and meta-strategies) and presenting easily realized alterations to the

physical properties of the classroom to offer better language learning conditions for the students. The themes were derived from the Communication Supporting Classroom Observation Tool (Dockrell et al., 2015), comprising evidence-based classroom activities within three domains: language learning opportunities, language learning interactions and language learning environments. For more details on the CPD, including, for example, how coaching, observation and peer-learning were incorporated, see Andersson et al. (2022).

During the intervention, the teachers in the delayed intervention condition followed business-as-usual classroom practices, before the conditions were reversed and the CPD instead was provided to the delayed intervention group. Critical to our design was the allocation of two delayed intervention control groups: one at the same school as the intervention group, to offer experimental control over any differences in socio-economic characteristics between schools, and one at another school, to control for any contamination effects resulting from details of the CPD being disclosed across intervention groups, for example, in the teachers' lounge.

A total of 25 teachers agreed to participate in the study. The schools granted time for the CPD sessions and guaranteed that the participating teachers would not be required to take part in any other course work or coaching sessions for the duration of the CPD.

Participating teachers and children were assessed on three occasions: before and after the CPD and at a 3-months follow-up for the intervention group, and twice before the CPD and once after for the delayed intervention group. Language testing and scoring were made by assessors blind to the intervention group status of the students' teacher. In addition, the teachers were blind to which of their students had consented to participate in the study, to prevent any changes in the teachers' behaviour towards participating children.

Participants

All students in the teachers' classes were invited to take part in the study, with no preselection of participants based on language risk or special education needs. Written information about the study was relayed to the children's parents or legal caregivers along with a sealed return envelope, to avoid revealing the decision to participate or not to the teacher, who collected the envelopes. Written informed consent was received from 224 children ($M_{\text{age}} = 90.8$, $SD = 7.3$, range = 77–105 months), representing 57% of the students in their first and second years from the five participating schools. Within the sample, the distribution of girls and boys (120 girls, 104 boys) did not differ



TABLE 1 Sample descriptives

		Intervention (<i>n</i> = 115)	Delayed intervention (<i>n</i> = 96)
Gender	Boys	55	44
	Girls	60	52
Bilingualism	Monolingual	75	41
	Bilingual	40	55
Year	1	59	32
	2	56	64
School	1	33	52
	2	0	22
	3	15	22 ^a
	4	57	0
	5	10	0

Note: Distribution of participants (*n* = 211) for the intervention and the delayed intervention groups across gender, bilingualism, year and school.

^aTeacher absent due to sick leave. Postassessment (T3) scores excluded from the analyses.

significantly ($\chi^2(1) = 1.14, p = 0.29$). In addition, a one-sample *t*-test confirmed that the study sample was representative of the school student cohorts regarding the proportion of mono- and bilingual participants ($t(223) = 5.53, p = 0.58, d = 0.04$; see Andersson et al., 2019, for an exhaustive description of the study sample). The present study reports results on 211 participants ($M_{\text{age}} = 91.0, SD = 7.1, \text{range} = 77\text{--}105$ months) for whom data were collected on at least two assessment points. As in the original sample, the distribution of girls and boys (112 girls, 99 boys) did not differ significantly ($\chi^2(1) = 0.08, p = 0.77$), and the sample was representative of the school student cohorts regarding the proportion of mono- and bilingual participants ($t(210) = 1.21, p = 0.23, d = 0.08$). Descriptive data on participating students and schools are shown in Table 1.

Assessment tools

All participating children were assessed with four subtests from the Swedish version of CELF-4 (Semel et al., 2013), which together form a core language score clinically used for screening and diagnostic purposes. In the subtest Concepts and Following Directions the child is required to point to pictures according to increasingly complex oral instructions from the examiner. Word Structure uses a sentence completion format to assess morphological ability, and requires the child to mark noun, verb and adjective inflections. In Recalling Sentences, the task is to produce a verbatim repetition of a sentence. Lastly, in Formulated Sentences, the child freely formulates a sentence appropriate to a picture stimulus, including a target word provided by the examiner.

Raw scores from each subtest were converted to subscale scores with a mean of 10 and SD of 3, in accordance with the test manual. The subscale scores were collapsed into a core language score with a mean of 100 and SD of 15, to allow comparison with the normative sample of the CELF-4.

The sample specific reliability, as estimated with Cronbach's Alpha, was good for all subtests when compared with the reliability estimates of the normative sample presented in the test manual (range for the age groups = 6;6–8;11 within parentheses): Concepts and Following Directions: 0.96 (0.94–0.94), Word Structure: 0.94 (0.78–0.80), Recalling Sentences: 0.91 (0.89–0.89) and Formulated Sentences: 0.90 (0.93–0.94).

Procedure

Approval for the study was granted by the Ethics Review Board of Southern Sweden (approval number 2016/567). As described above, written informed consent was retrieved from the parents of all participants, in accordance with the Declaration of Helsinki. All examiners were native Swedish-speaking SLTs (the first, second, third and fifth authors) or final-year SLT students with special training in the assessment tools and procedures. All language testing was conducted during school hours in rooms near the children's classrooms. The language assessment took approximately 40 min and also included assessments reported elsewhere. All verbal instructions were scripted, and the subtests were administered in a fixed order, to avoid inter- and intra-rater inconsistencies.

Statistical analyses

We fit linear mixed models (LMMs; also referred to as multilevel models or linear mixed-effects regression models) to evaluate the dependent variable (CELF-4 Core) as a function of time, group, year, school and school district. For the analysis of longitudinal data, several arguments promote the LMM approach over a more traditional repeated-measures analysis of variance (ANOVA) (for a tutorial, see Walker et al., 2019), including, for example, a reduced vulnerability for missing data (which in LMMs are replaced by extrapolating observed values, rather than removing the case from the analysis, resulting in greater power) and the opportunity to include not only fixed effects (e.g., group effects) but also random effects (e.g., individual differences between participants in pre-intervention scores, and in responsiveness to changes in teacher behaviour). In addition, the LMM allows hierarchical modelling of nested correlations, which offers an opportunity to control for non-independence in the data, for example, children in the same school or year performing more similarly to each other than to other participants (for an in-depth discussion on the benefits of LMMs to fit non-independent data, see Brauer & Curtin, 2018).

To answer the research question a series of LMMs for CELF-4 Core were explored, with Time (assessment 1–3), Group (intervention, delayed intervention), Year (first, second), School (1–5), School district (A, B) and Time \times Group interaction as considered factors. In all models, a random intercept for Participants was included to account for within-subject correlations. To identify the most parsimonious model we used a forward selection approach starting with a minimal model to which we added predictors until further additions no longer resulted in improvements of the model, as evidenced by a lower Akaike information criterion (AIC) and significant χ^2 tests when comparing models (Heck et al., 2014). In addition, likelihood ratio tests were used to evaluate whether the addition of the random intercept for participants resulted in significant improvements of the model ($\alpha = 0.05$). Satterthwaite adjustment was used to estimate the degrees of freedom. Maximum likelihood was used to estimate and compare all models. All statistical analyses were performed using the General Analyses for Linear Models (GAMLj) module in Jamovi, version 2.2.5.

The factors School and School district were autocorrelated which affected model convergence. School district was therefore left out of the analyses after initial inspection. Model 1 was a minimal model with Time, Group and Time \times Group interaction as included factors, and a random intercept for Participants. Year and School were added in models 2 and 3, respectively. Finally, model 4 was

the theoretically motivated maximal model, included for reference.

Post-hoc analyses with Bonferroni correction were used to evaluate the effect of intervention for each group and each time point separately. Furthermore, based on their CELF-4 Core scores at assessment 1, the intervention effects of students with low, mid and high language scores were compared in a one-way ANOVA.

RESULTS

Descriptive CELF-4 Core scores, presented separately per school and timepoint, are found in Table 2. Descriptive CELF-4 Core and subscale scores are found in Table 3.

All models were significantly improved by the inclusion of a random intercept for participants. Optimal fit was achieved in model 3 which modelled CELF-4 Core scores as a function of Time, Group, School and Time \times Group interaction. Model 3 (AIC = 4442.8; $\chi^2(1) = 105.09$, $p < 0.001$) and 4 (AIC = 4443.9; $\chi^2(1) = 105.97$, $p < 0.001$), but not model 2 (AIC = 4538.4; $\chi^2(1) = 3.52$, $p = 0.061$) showed significantly improved fit over model 1. The superior fit of model 3 over model 4, as expressed by its lower AIC, was non-significant ($\chi^2(1) = 0.88$, $p = 0.347$). When examined separately in univariate models, all factors provided significantly worse fit than model 3 (p 's < 0.001).

We found significant main effects for Time ($F(2) = 64.49$, $p < 0.001$), Group ($F(1) = 6.81$, $p = 0.006$) and School ($F(4) = 34.13$, $p < 0.001$), but a non-significant Time \times Group interaction ($F(2) = 1.87$, $p < 0.155$). Table 4 summarizes parameter estimates for the model. The model estimates a CELF-4 Core score of 86.20 when all parameters are set to the reference value of zero (Time 0 = assessment 1, Group 0 = delayed intervention group, School 0 = school 1). The model predicts an increase in CELF-4 Core scores from assessment 1 to assessments 2 and 3 of approximately 5.4 and 8.4 points, respectively. A change in group status from delayed intervention to intervention is predicted to be associated with a decrease in CELF-4 Core scores of 8.7 points. The estimated influence of School ranges from a decrease of approximately 17 points (School 2) to an increase of almost 39 points (School 5). Non-significant effects of the interaction between Time and Group indicates that the predicted changes in CELF-4 Core scores are unrelated to the intervention. Post-hoc analyses, with Bonferroni correction, of the interaction between Time and Group confirmed that both groups developed from assessments 1 and 2 (Intervention: $t(369) = 6.88$, $p < 0.001$; Delayed intervention: $t(368) = 4.49$, $p < 0.001$). From assessments 2 and 3 the delayed intervention group, now receiving intervention, showed non-significant development ($t(373) =$

TABLE 2 Descriptive results (mean, standard deviation, range) of CELF-4 Core per school and timepoint

Assessment	School				
	1	2	3	4	5
	<i>n</i> = 84	<i>n</i> = 21	<i>n</i> = 37	<i>n</i> = 57	<i>n</i> = 10
	68.07 (20.91)	53.95 (16.13)	86.92 (15.40)	93.19 (19.34)	100.20 (10.90)
	40–114	40–98	63–118	40–123	83–115
	<i>n</i> = 82	<i>n</i> = 20	<i>n</i> = 37	<i>n</i> = 55	<i>n</i> = 10
	71.95 (20.82)	58.25 (17.99)	97.11 (13.71)	101.73 (17.15)	105.70 (17.22)
	40–115	40–104	68–122	49–128	77–137
	<i>n</i> = 66	<i>n</i> = 16	<i>n</i> = 15	<i>n</i> = 56	<i>n</i> = 9
	74.94 (23.42)	62.75 (19.43)	97.47 (14.09)	103.63 (19.15)	107.44 (10.31)
	40–120	40–96	80–122	47–132	86–120

Note: Mean, SD and range of CELF-4 Core scores of participating schools across assessments. For Schools 1 and 3, which offered both treatment conditions, intervention and delayed intervention scores are collapsed. School 2 offered delayed intervention, while Schools 4 and 5 were assigned to the intervention condition.

1.92, $p = 0.84$), while the group not receiving intervention continued to develop ($t(369) = 3.92$, $p = 0.002$).

To better understand the difference in development from pre- to post-intervention between the intervention group and the delayed intervention group, differential effects of the intervention on participants with varying language abilities were explored. Participants were divided into subgroups based on their CELF-4 Core scores at assessment 1. Scores were binned to create roughly equal sized groups with low ($n = 49$), mid ($n = 53$) and high ($n = 56$) language scores. A change score from pre- to post-intervention was calculated by subtracting the collapsed pre-intervention score from the collapsed post-intervention score (i.e., the pre- and post-intervention scores of all participants, regardless of when they received intervention). A one-way ANOVA revealed no significant difference between the groups ($F(2, 155) = 2.12$, $p = 0.12$, eta squared = 0.03). Although the subgroups did not differ significantly, a tendency towards greater benefit from the intervention was found for participants with mid language scores ($M_{\text{change}} = 7.50$, $SD = 9.27$) than for participants with low ($M_{\text{change}} = 4.08$, $SD = 8.29$) and high ($M_{\text{change}} = 5.20$, $SD = 8.11$) scores.

DISCUSSION

SLTs employed by schools are often encouraged, either directly, as a means of collaborative intervention and cross-disciplinary exchange, or indirectly, as a consequence of an otherwise unmanageable caseload, to guide teachers and teaching staff, rather than conduct assessment and intervention themselves. The evidence supporting this approach is limited, likely for several reasons. First, teacher intervention or professional development is often evaluated without taking the perspective of the student into account. Consequently, the evaluation of the efficacy of the intervention is only based on the opinions of those directly involved, which increases the risk of a positive bias. Second, even when considering the perspective of the student, the timeframe for many studies does not allow reliable conclusions to be drawn on the duration of the effect. Finally, even with longitudinal data available, many studies have insufficient experimental control to make reliable predictions of cause and effect.

In this study, an 11-week teacher CPD course, aimed at establishing communication enhancing teaching techniques, did not produce changes to the developmental trajectory of language of the students in the teachers' classes, as was hypothesized following previous successful intervention trials. As expected, all participants developed between the assessments, however, with no difference in the rate of development between the intervention and

TABLE 3 Descriptive results (mean, standard deviation, range) of CELF-4 Core and subscales

Assessment	Composite subscale	Intervention <i>n</i> ; mean (SD), range	Delayed intervention <i>n</i> ; mean (SD), range
1	CELF-4 Core	<i>n</i> = 114	<i>n</i> = 95
	C&FD	84.13 (23.93), 40–123	72.53 (21.56), 40–118
	WS	23.08 (10.31), 1–38	18.03 (9.51), 0–37
	RS	28.82 (8.86), 3–39	25.86 (7.65), 1–38
	FS	22.46 (10.45), 0–40	17.74 (8.92), 1–40
		17.07 (10.06), 0–38	13.88 (8.34), 0–32
		Training	No training
2	CELF-4 Core	<i>n</i> = 111	<i>n</i> = 93
	C&FD	91.03 (24.37), 40–137	77.48 (22.19), 40–122
	WS	26.18 (9.37), 3–38	21.03 (9.77), 0–37
	RS	30.73 (7.85), 4–39	27.81 (7.59), 4–39
	FS	25.76 (10.43), 2–47	21.30 (9.24), 2–40
		21.32 (10.53), 0–39	18.27 (8.18), 0–34
		No training	Training
3	CELF-4 Core	<i>n</i> = 113	<i>n</i> = 49
	C&FD	93.14 (25.53), 40–132	74.63 (20.54), 40–104
	WS	27.87 (9.64), 1–38	20.90 (9.97), 2–35
	RS	31.11 (8.23), 3–39	27.78 (7.81), 6–37
	FS	27.67 (11.47), 0–47	21.51 (9.34), 0–36
		22.59 (10.75), 0–40	18.02 (8.26), 0–32

Notes: Mean, SD and range of CELF-4 Core scale scores ($M = 100$, $SD = 15$) and subscale raw scores for the intervention and delayed intervention groups at assessments 1–3.

C&FD, Concepts and Following Directions (maximum score = 38); FS, Formulated Sentences (maximum score = 54); RS, Recalling Sentences (maximum score = 44); and WS, Word Structure (maximum score = 39).



TABLE 4 Parameter estimates

Parameter	Effect	Estimate	SE	95% CI	d.f.	<i>t</i>	<i>p</i>
Intercept	(Intercept)	86.20	1.636	82.99–89.40	209	52.70	< 0.001
Time 1	Time 2–Time 1	5.36	0.671	4.05–6.68	364	7.99	< 0.001
Time 2	Time 3–Time 1	8.38	0.782	6.85–9.91	368	10.72	< 0.001
Group 1	Intervention–Delayed intervention	–8.67	3.323	–15.19 to 2.16	210	–2.61	0.010
School 1	School 2–School 1	–17.35	4.629	–26.43 to 8.28	208	–3.75	< 0.001
School 2	School 3–School 1	23.65	3.534	16.73–30.58	211	6.69	< 0.001
School 3	School 4–School 1	33.01	3.659	25.84–40.18	207	9.02	< 0.001
School 4	School 5–School 1	38.62	6.289	26.29–50.95	207	6.14	< 0.001
Time 1 × Group 1	T2–T1 × Intervention–Delayed intervention	1.78	1.343	–0.86 to 4.41	364	1.32	0.187
Time 2 × Group 1	T3–T1 × Intervention–Delayed intervention	2.88	1.564	–0.18 to 5.95	368	1.84	0.066

Note: Parameter estimates including standard error (SE), 95% confidence intervals, degrees of freedom (d.f.), *t* and *p* values for a linear mixed model with Time, Group, School and Time × Group interaction as fixed effects and CELF-4 Core scores as the dependent variable.

delayed intervention groups. This implies that the gains in language ability cannot be attributed to the CPD but, rather, to general developmental transitions. Several factors may have contributed to the null results, and the differences between the current study and those reporting intervention effects, as well as the similarities to those also failing to show such effects, must be analysed and evaluated.

Starling et al. (2012), who found positive effects on the listening comprehension and written expression of students taught by teachers who had received training from SLTs, specifically targeted students with language disorder, a group which can be expected to benefit from more similar adaptations to the teaching than the participants in the current study. In the present study, the participants represented the full range of abilities present in a mainstream classroom which would have required instructions to be individualized even further. Consequently, the CPD content offered here, although tailored to the needs of the participating teachers, may have failed to specifically meet the individual needs of the students, and build on their potential, and can therefore have fallen short of achieving measurable change in the language ability of the students. Markussen-Brown et al. (2017) emphasize that successful teacher CPD must focus on clearly delineated subject areas and grant teachers sufficient time to develop in-depth knowledge and reflect on their learning. In future studies, the design of the CPD content should, therefore, be based on objective analysis of individual student needs and requirements, as described in the curriculum, rather than an interpretation of the needs as expressed by the participating teachers.

Although unsurprising, a positive finding from the current study is that all participants showed development of their language abilities over time, as also reported by

Clegg et al. (2020). This can be seen as an indication that all teachers, regardless of intervention group, were well-equipped to provide their students with high-quality instructions already at the first assessment. The finding can also be seen as evidence that the language development is robust and likely to proceed regardless of any changes to the teaching practices directed at the children. However, the finding can also reflect that the participants, many of whom were initially largely unfamiliar with assessments, as perceived by the assessors, gradually grew more acquainted with the method of analysis and, therefore, performed better. While this familiarization effect may have influenced the main effect of time, the participants were randomized to conditions and the interaction between time and group can, thus, be expected to have been unaffected by any familiarization effects.

The lack of an intervention effect may indicate that the teacher CPD failed to establish new ways of teaching in the teachers. Although they gave positive evaluations of the CPD, which indicated that intervention content was likely to be added to their teaching practices, the teachers showed non-significant development between assessments, as measured by self-report questionnaires targeting, for example, perceptions of activities and interactions in the classroom, and self-efficacy (Andersson et al., 2022). Alternatively, the outcomes may have been assessed too soon (e.g., see Snow et al., 2014, whose post-intervention data were collected 18 months after pre-intervention assessments). In addition, adopting new teaching methods is a time-consuming process that will only take place if it is explicitly required. In contrast to studies that have assessed teacher change by observing the teachers in the classroom (e.g., Starling et al., 2012; Wasik & Hindman, 2011), no formal observation or assessment of the post-intervention teaching practices was conducted in the present trial,



which only evaluated the teachers' self-reported development. This method of assessment may have been too lax to commit rapid change in the teachers, and, if no change has had time to take place in the teachers and in their practices, it is probably unrealistic to expect change in the students.

Since the CPD was intended to strengthen overall language abilities, CELF-4 Core was chosen as outcome measure. Although there are previous studies which report effects of CPD on this type of global language measures, assessing both receptive and expressive abilities (e.g., Clegg et al., 2020; Starling et al., 2012), many studies choose more specific outcomes, more closely matched to the intervention content, or combine global and local measures. For example, Haley et al. (2017) used CELF scores to select participants most in need of intervention but assessed their gains from the intervention by using measures that aligned with the intervention offered to their teachers, for example, vocabulary knowledge, narrative and grammar. It is worth considering the ability of our outcome measure to detect change in the children, and in future studies, we will use other outcome measures collected at the same time, to assess, for example, the vocabulary development of the participants, which was in focus during several CPD sessions in the current trial.

While many studies have used strict inclusionary criteria, often targeting children with, or at risk for, language difficulties, we chose a public health approach, with no preselection of participants, and invited all students in the teachers' classes to participate. Our choice was based on previous studies showing gains from intervention for all participants, regardless of language or cognitive level (e.g., Throneburg et al., 2000), and an interest in evaluating the possibility of using teacher CPD to improve the universal provision, or primary prevention, offered to students to reduce the risk of adverse development (e.g., Enderby & Law, 2019).

The predicted influence of school year, used in this study as a proxy for age, was negligible. Instead, school was assigned greater value than any other factor. Consequently, school factors must be closely examined. The participating schools represented two school districts, with differences in demographic characteristics. School district A is predominantly urban, and the student population includes a high proportion of bilingual students or students with bilingual parents/guardians. School district B, in contrast, is a suburban district, in close vicinity to a city with academic and professional opportunities. While the demographic characteristics of the schools did not differ from those of their districts, differences between the districts in student language proficiency are evident. However, the results lend no support for an effect of the CPD in either of the districts, if analysed separately. However, as explored

by Clegg et al. (2020), post-hoc analyses with participants stratified in other ways, for example, selecting only bilingual students, or participants with a history of contact with SLT or special needs education services, might have yielded other results and possible interpretations of the data. In the present study, however, stratifying the participants based on their pre-intervention language scores revealed no differential intervention effects, although a tendency towards greater benefits for students with mid language scores was detected.

A limitation of the study is that the randomization of the teachers, and, thereby, of the students, preceded the baseline assessment. This resulted in significant differences at baseline between the intervention and the delayed intervention group, with better results for the intervention group. In part, the difference was the result of an effort to accommodate two of the schools which requested teachers in the same school year to be assigned to the same intervention group, to facilitate scheduling. This resulted in first- and second-year students not being equally distributed across intervention groups. However, since school year was not included in the final model, this group difference did not affect model predictions.

Another potential limitation concerns the timeframe of the study. It can be argued that processing the intervention content and incorporating new teaching routines takes time, and that an intervention duration of 11 weeks may be too short to modify the practices of the participating teachers. While, for example, Starling et al. (2012) were able to show effect after an intervention of similar type and length, the review of CPD literature by Markussen-Brown et al. (2017) indicates that a positive correlation between intervention duration and teacher outcomes can be expected. In our study, the intervention duration was a compromise between scientific rigor and a desire to accommodate the participating schools. Although a longer intervention duration was considered, extending the intervention would entail an increased risk of confounding factors, including other interventions directed at the teachers. Extending the duration of intervention would also mean that the post-intervention assessments would be conducted after the summer holidays, which can be expected to negatively affect student language outcomes (Rosqvist et al., 2019). If it can be done without adding confounding factors, future studies should, however, modify the number of intervention sessions and the total duration to further evaluate the effect of time on intervention outcomes.

To conclude, the null results of the current study make an important contribution to the intervention literature and to on-going discussions about provision of language services during the school years. As have been shown in previous studies, positive effects of CPD can be achieved

if sufficient time, effort, and devotion is exerted. However, as pointed out by Markussen-Brown et al. (2017), effects are not necessarily found on the ways teachers interact with their students, but rather on structural aspects, for example, physical properties of the classroom and access to relevant teaching material. Therefore, positive effects on the language abilities of the students are not certain. As indicated by the results of the stratified analyses in the present study, changes to structural aspects may not be sufficient for students with low language scores, who tended to benefit less from the intervention than students with mid language scores. To achieve positive effects a close and long-lasting relationship with the student is necessary. This requires a close partnership and shared teaching responsibilities with the teacher, as shown by Dobinson and Dockrell (2021). Close collaboration with teachers is perhaps even more necessary to promote the development of students with low language scores, whose needs teachers feel ill-equipped to meet even after taking part in CPD (Andersson et al., 2022). A natural question is, however, whether this time could be better spent on direct intervention with students in need of language support, for whom an increasing number of studies show intervention effects (e.g., Ebbels et al., 2019). A risk of devoting too much SLT time on CPD and other types of indirect intervention is a shift in mindset, whereby the teacher becomes the focus of the SLT's attention, not the student. Problematically, such a mindset is encouraged, directly or indirectly, and must be discussed in terms of evidence.

Finally, any school-based intervention must be evaluated on its ability to aid the learning or development of the students. If the intervention lacks this ability, it should be avoided (Timperley, 2011). All studies evaluating teacher interventions should, therefore, include student outcomes as a natural component, and the results, positive or not, will help develop the evidence-base for school-based intervention.

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CONFLICT OF INTEREST

The authors report no conflict of interest.

DATA AVAILABILITY STATEMENT

Data are available from the corresponding author upon request.

PATIENT CONSENT STATEMENT

Written informed consent was retrieved from the parents of all participants, in accordance with the Declaration of Helsinki. A randomized controlled trial of the effectiveness

of teacher continued professional development on student language outcomes

ORCID

Olof Sandgren  <https://orcid.org/0000-0002-5098-6096>

Ketty Andersson  <https://orcid.org/0000-0003-2680-9660>

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