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Review article

Developmental Education in Dutch primary schools: Review of research outcomes from a CHAT-based teaching approach

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ARTICLE INFO

Keywords:

Developmental education
 Primary education
 Learning outcomes
 Cultural-historical activity theory (CHAT)
 Literature review

ABSTRACT

In this literature review, we evaluate the learning outcomes of Developmental Education (DE) in The Netherlands. This CHAT-based teaching approach has been around for over 30 years and is constantly being developed in collaboration between teachers, teacher educators and researchers. Although outcomes of this approach are evaluated in educational practice and several research studies, no systematic review study has been carried out to present an overview of the learning outcomes of DE. Therefore, we conducted a systematic narrative literature review study. We found that research in the field of DE varies both in domain and design. We conclude that pupils in DE meet national norms on language development, show sufficient to good scores on mathematical development and seem to have higher scores on social-emotional development compared to pupils in non-DE schools. These conclusions should be interpreted with caution, as this review study includes mainly small-scaled studies. Therefore, we recommend that future studies should adopt a longitudinal design, include more schools and pupils, and apply appropriate tests to evaluate the learning outcomes in a way that fits the DE approach.

1. Introduction

Due to the increasing international interest in educational innovations since the 1970s, the attention for the potentials of the Vygotskian approach to human learning and development also has been growing considerably. Especially with regard to early childhood education, many academics all over the world have been involved in building and evaluating new educational programs for young children, with the intent to promote children's development from the perspective of the Cultural-Historical Activity Theory (CHAT; e.g. Bodrova & Leong, 2007; Fleer, 2010). Despite the differences among these programs, they are all committed to applying CHAT-concepts in early years practices.

In the Netherlands, for over 30 years, a large community of teachers, teacher educators and researchers have been involved in the development, implementation, and evaluation of such a CHAT-based approach in primary education schools, called Developmental Education (DE) (for an extensive description of the history of Vygotskian thinking in the Netherlands, see: Van Oers, 2012a, 2015). To date, over 300 schools have successfully implemented (elements of) this Vygotskian inspired approach to education, which was

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<https://doi.org/10.1016/j.lcsi.2021.100596>

Received 11 June 2021; Received in revised form 5 November 2021; Accepted 25 November 2021

Available online 11 December 2021

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developed as a response to seeing teachers as mere executors of a fixed curriculum (cf. van der Veen & Wolbert, 2014). One of the main goals of DE schools is to promote ‘children’s meaningful learning and cultural development in an emancipatory way’ (van Oers, 2012a, p. 59). In other words, DE gives room to agency of both teachers and pupils, who shape the curriculum collaboratively. As teachers in DE schools work with half-open curricula, invite children to participate in a playful way in socio-cultural activities that are thematically organised, and use method books mainly as sources, the effectiveness of this approach for children’s learning and development is often under discussion. For example, critics of this approach argue that pupils acquire less knowledge as compared to schools in which teachers strictly follow a method book. Therefore, in the current study we systematically review the available results of the DE approach in terms of pupils’ learning and development. We aim to answer the following research question: *What kinds of learning outcomes for children aged 4–12 does the Developmental Education approach in the Netherlands produce?* Specifically, we report on results in the domains of language development, mathematics, social-emotional development and other domains (for example, music education) as these are the domains that have been studied thus far.

As a first step, we briefly discuss the basic tenets of DE and present a paradigmatic case that shows what DE looks like in practice. Next, we systematically review the available empirical evidence on DE in the Netherlands.

1.1. What is Developmental Education?

DE is deeply grounded in Vygotskij’s cultural-historical activity theory (CHAT). Concepts such as leading activity, play as a context for learning, and zone of proximal development spring from CHAT and are translated into classroom practices. In DE schools, teachers aim to promote critical agency and cultural development of children to foster their full potential. It is:

...based on an image of the child as an inherently socio-cultural being whose agency and developmental potentials depend essentially on the interaction between inherited bioneurological characteristics, acquired psychological personal qualities, and on the quality of the child’s environment (including socio-cultural interactions).

(van Oers, 2012b, p. 14)

Meaningful learning in this context produces learning outcomes that have general cultural significance (cultural meaning), and at the same time are connected to children’s motives, interests, and prior knowledge (personal meaning, see Leont’ev, 1978). For example, one classroom of a DE school with pupils aged 4–6 years was involved in the theme ‘moving house’. At the start, the pupils may visit professional movers to investigate what they do and how they work. They can also be explicitly taught what it means to move house via shared book reading and classroom talk. And in a ‘moving corner’ of the classroom, they can pack things into boxes, write labels, move the boxes and furniture to another place within the school, calculate the costs, et cetera. In the example of this play activity, pupils learn many new things and acquire new skills: they increase their vocabulary by using the words belonging to the theme, like ‘construction worker’ or ‘to furnish’. And in schematizing activities pupils practice their early mathematical skills, for example by making a scheme of the new house and the place of the furniture in it, or by drawing moving boxes in a truck to see how many boxes can be transferred per ride.

In DE, the curriculum is not prescribed in detail, but is elaborated in a collaborative and interactive process between teacher and pupils. For young children, role-play is the leading activity, driven by social motives (see El’konin, 1972). Role-play consists of imitations of socio-cultural practices such as care taking, hobbies and professions, and should be considered a context in which learning can meaningfully take place. From a CHAT perspective, van Oers (2012a) has argued that a cultural activity can be accomplished in a variety of ways, depending on how three parameters of activities are established. Basically, the format of all cultural activities abides by these three parameters: 1) the shared rules that the actors follow; 2) personal involvement of pupils and 3) degrees of freedom when participating in the activity and in carrying out a personal version of the activity. Play, then, is any rule-guided activity that allows considerable degrees of freedom to the participants, and is carried out with high involvement.

For pupils aged 8–12, the aforementioned format for cultural activities remains the same, but inquiry becomes the main activity, driven by the dominant motive for intentional and conceptual learning, and linked to specific questions emerging in the imitation of cultural practices. In this imitation, pupils’ personally meaningful questions are connected to cultural meanings that are significant within the sociocultural practice they engage in. They may participate in three different types of inquiry-based activities: experimental research, consulting available sources, and inquiry of practices (Dobber & Van Oers, 2015).

1.2. Tenets of a Vygotskian teaching approach

Based on our description of DE, we give an overview of the four most important features of this CHAT-based approach (see van Oers & Duijkers, 2013):

- (1) Development-promoting learning, which means that through interactions with more knowledgeable others (i.e., teachers, peers, experts, etc.), learning advances development;
- (2) Aimed at the zone of proximal development (ZPD), which is defined as: ‘those new actions *within the context of meaningfully accessible activities* that can be appropriated under the guidance of more knowledgeable others’ (Van Oers & Duijkers, 2013, p. 3);
- (3) For young children (2–8 years), play in appropriate sociocultural practices (like playing house, shopping, construction, travel agency, etc.) is the leading activity. For older children (8–12 years) the leading activity is formal (intentional, concept-based)

learning in the context of more complex sociocultural practices (like science, court, agriculture, etc.), which is carried out as inquiry-based learning (Dobber & van Oers, 2015);

- (4) Children (2–12 years) participate in activities that are formatted as play, meaning there are ‘(implicitly or explicitly) shared rules, some degrees of freedom for the participants with regard to how the activity should be carried out, and high levels of personal involvement.’ (Van Oers & Duijkers, 2013, p. 515).

These four features are consistent with the work of Vygotskij and his colleagues, and are translated and further developed into practice in a close collaboration between teachers, teacher educators, educational developers and researchers. In using Vygotskij’s (and his colleagues) ideas on learning and cultural development, the aim is to advance and further develop these ideas. For example, in our interpretation of play from a CHAT perspective, we go beyond the original views of Vygotskij and El’konin. In their view, a transition from play as a leading activity to formal learning takes place at the age of 7/8 years, whereas in DE ‘play’ is considered a specific format of cultural practices that runs throughout the whole primary school curriculum for pupils from 4 to 12 years old (Van Oers, 2015). Hence, DE should be characterized as a play-based curriculum.

With the help of these features we can also discriminate DE-schools from non-DE-schools. In contrast to teaching and learning processes in the context of sociocultural practices and the problems that emerge in them, in non-DE schools teaching and learning are not embedded in real practices, but at best in descriptions of real-world situations in which a problem is described. This problem is generally the start of the teaching-learning process in non-DE schools. Moreover, the degrees of freedom for learners in non-DE schools is mostly far less than for pupils in DE. Non-DE pupils are most of the time instructed directly how to act for the solution of a problem, while DE pupils construct, debate and reconstruct possible solutions with the help of teacher, peers or experts.

But how do these different features of this approach translate to practice? We give a paradigmatic classroom example of DE in early childhood classrooms. This example has already been described by Van Oers and Duijkers (2013, p. 517, following Janssen-Vos, 2008, p. 82):

A grade 1–2 combination class (pupils of 4–6 years old) has visited the school doctor. This was an impressive event for the children. The teacher decided, together with the children, to set up a doctor’s consulting room in the play corner. During a classroom conversation, the teacher and pupils decide what they need for making a real consultation room and they start collecting the necessary items. Pupils and the teacher bring paper and pencils, but also a weighing scale, a measuring rod, a stethoscope. Gradually, the consulting room is taking its shape, and the children start playing. Observations of their role-play indicate that they are highly involved, acknowledged some of the rules (like the rules for measuring), but also use some degrees of freedom in the ways they carry out the activity. The teacher also participates in the activity, and adopts multiple roles: an educational assistant (sometimes the children themselves ask for help), a patient, a critical observer (the teacher asks questions and focuses pupils’ attention in a natural way, similar to how children among each other ask questions or shout ‘look here what a big number!’).

The pupils start weighting and measuring. Pascal, for example, plays the doctor and wants to know exactly the weight and length of Hannah. He writes all his measurements down on a piece of paper. The teacher asks: ‘Can you see how much Hannah weighs?’ And Pascal looks at the scale and asks: ‘This mark, Miss, how much is that?’ And the teacher answers: ‘Look at the scale, Pascal, there are numbers on it. Here you see 15, that is 15 kilos. The next mark is 1 kilo more, so that is 16 kilos. So yet another mark further is ... What would that be?’ And Pascal answers: ‘... 17 kilos, so this must be 18 and this is 19. Hannah is 19 kilos!’ He writes it on his paper: ‘That is a one and a nine.’

Other elaborated examples can be found in Van Oers and Duijkers (2013), Van Oers (2012a, 2012b), and Ten Cate et al. (2020). In the latter example, pupils from the upper grades of a primary DE school and their teacher set up a sewing workshop including organisation, acquisition, production of different products, distribution, finance and research. See also: <https://www.youtube.com/watch?v=KZdIV-TycwI>.

1.3. Current study and research questions

For over three decades, a large group of teachers, educational developers, teacher educators, and researchers have successfully and consistently implemented DE in primary schools, under the guidance of experienced curriculum innovators, specialised in Developmental Education. All studies in DE schools in this review were carried out in schools that already had implemented Developmental Education (or in Dutch: ‘Ontwikkelingsgericht Onderwijs’) for several years, under the guidance of a specialised institute for Developmental Education (De Activiteit, Alkmaar, see: www.De-Activiteit.nl), which guaranteed that the implementations were reasonably similar in the different schools, and consistent with the conceptual basis. Besides, teacher educators who guide the DE implementation process are certified by De Activiteit after approximately 80 h of training, and have to be recertified every two years.

In the current study, we systematically review the available research evidence on this teaching approach to answer the following research question: *What kinds of learning outcomes for pupils aged 4–12 does the Developmental Education approach in the Netherlands produce?* For the review, we report on the following learning outcomes: language development, mathematics, social-emotional development and other domains (such as music education). Because DE focuses on cultural meaning (as well as personal meaning), in which moments of meaningfully embedded instruction of knowledge is considered a useful element, we expect that it will be (at least) equally effective compared to traditional education in supporting pupils’ learning in the domains of language and mathematics. Furthermore, as DE stresses the importance of collaboration with peers, meaningful learning, and participation in socio-cultural practices, we hypothesise that pupils will obtain high (or higher) outcomes on social-emotional development, motivation and

working attitude compared to pupils in more traditional schools. The expectations regarding the results of teaching and learning in the context of a DE practice are based upon the hypothesis that *playful* and guided *participation* as *agents* in *sociocultural practices* rouses in pupils new learning needs and related actions that make sense to them, and produce persistent learning results.

2. Method

2.1. Literature search

We aimed to systematically review all relevant studies on the effects of (elements of) the DE approach on pupils' learning outcomes and/or studies on the relationship between (elements of) the DE approach and pupils' learning outcomes. In addition to our own studies, we also could include studies from external, independent researchers who were not involved in the elaboration and implementation of the DE concept in classroom practices (see Edelenbosch; Harskamp & Suhre; Helms-Lorenz; Suhre; Veen in reference list at the end). To build our data-base, we executed a systematic search consisting of five steps. First, we searched the electronic databases Web of Science, ERIC and PsychINFO. We used the search terms:

- primary education: *primary education, primary school, elementary education, elementary school, early childhood education*; OR *developmental education* (combined with *play* or *inquiry* to point at the concept we mention in this review); OR *Ontwikkelingsgericht Onderwijs* (the Dutch term for DE)
- AND cultural-historical theory: *Vygotsk**, *CHAT, cultural-historical activity theory, cultural-historical theory, socio-cultural theory*;
- AND outcomes: *effect, effects, achievement, achievements, outcome, outcomes, impact, learning, development, agency, correlations*.

Boolean operators were used to create the right combinations of search terms. No date limit was used. Secondly, we searched through databases of Dutch professional journals to find references to research on DE (*Didactief, HJK, JSW, and Zone*). Third, we scrutinized the Master theses from our own department, which is specialised in research in the context of DE. Fourth, references in this initial set of articles were checked to identify other studies that could be included in this review. Finally, the provisional list was shown to experts in the field of DE to ask whether they knew other relevant studies meeting the inclusion criteria. This search resulted in a first list of 69 studies.

2.2. Inclusion criteria

The following criteria were used to select relevant studies in the initial set of 69 studies:

- (1) The research is based on or using Vygotskij's cultural-historical activity theory and is carried out in primary school settings, or focusses on activities that have a central part in the DE approach. Because of our focus on the unique Dutch concept 'Developmental Education', only research conducted in The Netherlands was included.
- (2) The study reports on empirical research.
- (3) The results report on pupils' outcomes (cognitive and/or social-emotional).
- (4) The pupils are four to twelve years old.

2.3. Selection procedure

The aforementioned criteria were applied to titles, abstracts and keywords first. In case this did not give enough information, other parts of the text were searched for information to make an inclusion/exclusion decision. When more reports or articles were based on the same research data, only the most recent publication was included in this review. 37 studies met all four inclusion criteria. 32 studies did not meet one or more criteria and were excluded. The main reasons for exclusion were: the results did not report on pupils' outcomes (18 studies); the research was not based on CHAT (7); the study did not report on empirical research (5); the pupils' age was other than four to twelve years old (1); there was a more recent publication which reported on the same data or results (1). Independent of the first author, the second author of this paper performed a reliability analysis on a random selection of 20% of all articles. Both authors independently agreed to the inclusion or exclusion of papers with an agreement percentage of 81.25% (Cohen's Kappa = 0.48; moderate agreement). After discussing papers for which no agreement had been reached, the agreement percentage went up to 100% (Cohen's Kappa = 1.00; almost perfect agreement (Higgins & Green, 2008)).

The last phase of the selection procedure focused on the methodological quality. As our aim was to include all relevant studies on effects and/or relations between (elements of) DE and learning outcomes, we did not only select peer-reviewed published articles, but also included so-called 'grey literature': unpublished dissertations, Master theses and other research reports. To guarantee the quality of this study, we only included studies which have been conducted by researchers or Master students, who were supervised by experienced researchers affiliated with a research institute. Moreover, we analysed the quality of the studies that had not (yet) been published and thus did not go through peer review in terms of methodological quality. We thoroughly read and criticized the method sections of these articles by determining the visibility, comprehensibility and acceptability of the choices made (Akkerman et al., 2008). We used rubrics for assessing the methodological quality of Master theses from our own institute. Using these rubrics, we assessed 21 empirical studies on four aspects: sample, materials, procedure and data-analysis. Each of these aspects was assessed as 'insufficient', 'sufficient' or 'good'. If we assessed a study sufficient or good on all four aspects, it was included in our review study. To

ensure the reliability of this selection process, a random selection of 50% was assessed by the second author. With an agreement percentage of 90.9% (a Cohen's Kappa could not be calculated as the value in one of the first two cells was 0) there was an almost perfect agreement between the first and second author (Higgins & Green, 2008). Four studies did not meet our quality standards. One study was excluded because the complete method section was of insufficient quality and clarity. One study only described the used materials, but missed information about sample, procedure and analysis. One study did not meet our standards on the materials and instruments that were used, and for one study the description of the data analysis was insufficient. This resulted in a final list of 33 studies that were included in this review.

2.4. Analysis

Given the differences in design, number of participants, instruments, age of participants, and outcome variables across the selected studies, a narrative synthesis (see Popay et al., 2006) was conducted. The first step consisted of creating an overview of the main aspects of the included studies, see Tables 1–4 in the supplemental material. Studies were grouped based on the nature of the results being reported (Popay et al., 2006). This resulted in four domains: language development, mathematical development, socio-emotional development and other subject-matter domains, such as music education. Next, for all domains we explored relationships within and between studies, by looking at the relationships between study results and key aspects, and comparing and contrasting these relationships across studies (Popay et al., 2006).

3. Results

In this part of our review, the outcomes of our narrative synthesis are presented. First, we give a general overview of the most important aspects of the included studies, such as domain and research design. Next, we provide a narrative synthesis of the studies, separately for each of the five domains.

In general, the 33 studies show a large diversity on several aspects. First, the studies differ in research design and methodology. 15 Studies only reported on quantitative data from quasi-experimental designs, 5 studies only reported on qualitative data from case-studies in DE classrooms, and 13 studies could be characterized as mixed-method. Second, studies differed in the age of the participating pupils: 20 studies focused on pupils in the lower grades of primary school (ages 4–8), 12 studies focused on pupils in the middle and upper grades (ages 8–12) and one study focused on pupils aged 4–14. Third, the studies that were included differed in the domains they focused on. Studies could be classified into four different educational domains: (1) language development, (2) mathematical development, (3) social-emotional development, and (4) other domains (for example, music education). For each domain, we subsequently give a general description, describe the effects or relations between the DE approach and pupils' learning outcomes, and give a general conclusion on how the DE approach supports pupils' learning in that specific domain.

3.1. Language development

Promoting language development is considered an important learning objective in DE schools. Language is seen as a tool children need to acquire to participate in socio-cultural practices and communicate with others. For example, pupils learn new words that fit the themes, and that can be meaningfully used in participating in a specific socio-cultural practice (e.g., pupils apply these words in their role play and research activities). When learning to read, the focus is on communication, reading motivation and text comprehension. Technical reading skills are trained, but always with the aim of reading rich, meaningful texts, which are linked to the socio-cultural practice in the classroom. Learning to write also happens in the socio-cultural practice of the classroom, as appropriating a tool for communication. In the lower grades, writing starts in the context of (role) play: the shop assistant writes a receipt; when the theme is 'moving house', they write on boxes to communicate what stuff is inside, etc. In the upper grades, pupils learn to write their own texts in the context of research activities. For example, when the theme is 'the zoo', pupils write information boards for animals in the zoo, poems about their favourite animals, a formal letter to apply for a job in the zoo, etc.

In this part of our results section, we systematically review the selected studies in the context of DE that report on pupils' language development. Language development is a complex construct that consists of several aspects. Research in the field of DE and language development is therefore multifarious. In the included studies (see supplemental material, Table 1), the following aspects of pupils' language development were investigated: general language skills, vocabulary acquisition, technical reading, reading comprehension, reading motivation, writing skills and oral communication. We discuss the outcomes on those sub-domains.

3.1.1. Language competence

Three studies applied a national standardized test that assesses pupils' language skills in several domains. Two studies were conducted in grade 1 (ages 4–5) and 2 (ages 5–6, Smeerdijk, 2013; Veen et al., 2006), the other in grade 8 (ages 11–12, Krah, 2012). Veen et al. (2006) compared pupils in DE schools with pupils in non-DE schools using a more traditional program (i.e., Piramide). In this longitudinal research, pupils were followed from pre-school to grade 2. In grade 1, DE pupils showed significantly lower scores on a language test ($d = -0.34$, small effect) compared to their peers in the 'Piramide' program. In grade 2, there were no differences in language test scores between both groups. These results are in line with another study on the effects of DE on early literacy by Smeerdijk (2013). She compared results of pupils who were taught by teachers who followed DE training and pupils in classes with teachers who were not trained in DE. Pupils in both groups showed similar results on early literacy. Finally, Krah (2012) found that DE pupils aged 11–12 scored equal to pupils in non-DE schools on a national, norm-referenced standardized test for primary schools. This

test measures spelling skills, reading comprehension, vocabulary acquisition and writing skills.

3.1.2. Vocabulary acquisition

Studies on vocabulary acquisition in DE mainly focus on pupils who speak Dutch as a second language (referred to as SLL: second language learners). The included studies were mostly conducted in the early grades of Dutch primary schools (ages 4–6). Van Oers and Duijkers (2013) found that pupils in DE schools acquire significantly more words during a theme period than pupils in a school with a strictly teacher-driven approach. This was also found for SLL (Van Oers & Duijkers, 2013). Compared to a teacher-driven approach, pupils in DE knew more words both passively and actively, and they used the thematic words more often during school activities and when playing outside. Another study on vocabulary acquisition focused on 5–6 years old Moroccan pupils in DE schools (Helms-Lorenz & Jong-Heeringa, 2006). Results on a national standardized vocabulary test showed equal scores for DE pupils and pupils in traditional education. On a telling-task, Moroccan pupils in traditional education outperformed DE pupils. Van der Veen et al. (2016) used a self-developed instrument for dynamic assessment to measure vocabulary skills after theme periods of 6–8 weeks. The authors elaborated on how this instrument can be implemented in DE schools and presented the first results measured by this tool. Their results show positive effects: participants' vocabulary knowledge significantly increased over the course of a theme period. We should interpret the latter results with caution, because it was a small-scale study in a very specific context: a school in an asylum seekers' centre (children aged 4–14). Finally, a study by Hoffenaar (2015) that focuses on SLL (ages 11–12; grade 8), found a strong positive relation between using vocabulary didactics applied in DE and vocabulary acquisition ($r = 0.58$). Only one study in our review compared DE pupils' vocabulary skills to national norms (Harskamp & Suhre, 2000). It was concluded that DE pupils in grade 3 (age 6–7) score equal to the national norms on standardized vocabulary tests.

3.1.3. Technical reading

Two studies in the domain of language development present results on technical reading skills. Van Oers' (2003) study on technical reading skills of pupils aged 6–8 (grade 3 and 4) showed that DE pupils performed below the national level on technical reading skills (Van Oers, 2003). Second, Van den Bosch (2010) designed an intervention program for writing lessons, based on the DE approach. The intervention group practiced writing their own stories (a core element in DE), the control group focused on design aspects of given texts: they did not write their own story, but designed a little book for an already existing story. The technical reading skills of pupils in the intervention group were expected to increase more than those of pupils in the control group, but no differences were found.

3.1.4. Reading comprehension

Where results on technical reading show that DE students aged 6–8 score equal to or below students in traditional schools, studies on reading comprehension in the same grades show positive effects for DE pupils (Harskamp & Suhre, 2000; Suhre, 2002). Harskamp and Suhre (2000) compared DE pupils' scores with the national level and concluded that DE pupils scored somewhat above the national average. Suhre (2002) conducted a comparative study between DE pupils and pupils in traditional schools. Results showed significantly higher scores on reading comprehension for DE pupils in grade 4 (children aged 7–8).

Van Rijk (2017) compared grade 7 (aged 10–11) DE and non-DE pupils' reading comprehension skills while reading informative texts. Her study showed equal scores on reading comprehension and knowledge of reading strategies for both groups (Van Rijk, 2017). In another study by Van Rijk, the effects of DE were also compared for ethnic minority pupils and low SES pupils. The only significant difference she found was a better knowledge of reading strategies for ethnic minority pupils in DE schools (Van Rijk et al., 2018).

3.1.5. Reading motivation

Harskamp and Suhre (2000) did not find statistically significant differences in reading motivation between 6–8 years old DE pupils and pupils in non-DE schools (grades 3 and 4). However, based on teacher evaluations also conducted in grades 3 and 4, Van Oers (2003) found that DE pupils – despite their lower scores on technical reading – are highly interested in books and show a higher level of reading motivation. In Van Rijk's study on 10–11 year olds' reading motivation, no differences between pupils in DE and pupils in non-DE schools were found (Van Rijk, 2017; Van Rijk et al., 2018). She paid particular attention to low SES pupils and ethnic minority pupils. Comparing pupils in those groups also did not result in differences on reading motivation. Based on interviews with pupils in DE and traditional education, Van Rijk (2017) described three reader identities: *discoverer* (reads to discover the world), *instrumentalist* (reads to have social success), and *complier* (reads because he has to do it in school). She did not find differences on those identities between pupils in DE and traditional education. However, based on the interviews, it seemed that DE pupils talk more often about the texts they read at school.

3.1.6. Writing skills

Two studies investigated writing skills of 6–8 year olds (grades 3 and 4) (Harskamp & Suhre, 2000; Suhre, 2002). Harskamp and Suhre (2000) concluded that during grade 3 in a DE school, pupils show a remarkable increase in writing skills. In another study, Suhre (2002) compared DE pupils in grade 3 and 4 with their peers in traditional schools. In grade 3, they scored equal on writing skills. In grade 4, the DE pupils showed significantly higher test-scores on writing skills.

3.1.7. Oral communication

Studies on oral communications skills were conducted in lower and higher grades of primary education. Kiebert (2017) measured pupils' (aged 4–6) oral language skills. Her main focus was on 'listening skills', tested by using the sub-tests 'critical listening' and 'passive vocabulary knowledge' of a national standardized test. No differences were found between pupils in DE schools and traditional

schools. Van der Veen (2017) designed a CHAT-based intervention to support teachers in using dialogic classroom talk in grades 1 and 2 (ages 4–6). This intervention was tested in a quasi-experimental study in which classes were assigned to a dialogic classroom talk condition or a non-dialogical classroom talk condition. Pupils that participated in the dialogic classroom talk condition outperformed pupils in the comparison group on oral language skills (effect size 0.62, medium to large).

In another study on oral communicative competence, pupils aged 11–12 (grade 8) were observed during conversations in small groups (Slingerland, 2010). DE pupils expressed themselves more often in long claims (claims with at least 100 characters) than non-DE pupils. Furthermore, they used more exploratory talk, meaning that they were dealing critically and constructively with each other's ideas, discussed claims and proposed arguments and hypotheses (see Mercer & Littleton, 2007). DE pupils showed a higher level of elaboration and expressed themselves more often by using claims. Slingerland did not find any differences on other aspects of oral communication, such as number of words used, number of utterances, average of words per utterance and time spent on the conversation.

3.1.8. General conclusions on language development

Considering this domain, we can conclude that DE pupils gain sufficient knowledge and skills on several aspects of language development. On technical reading, only two studies were carried out and one of them resulted in scores below the national level on standardized tests (Van Oers, 2003). This might be explained by the fact that teachers in early grades of primary DE schools are more focussed on text comprehension and reading motivation, resulting in less time spent on formal technical reading instruction in the early years than in traditional schools. Moreover, as this is a small study from a long time ago (based on results from the period 1998–2000) and the other study (van den Bosch, 2010) found no differences, we have to be cautious to make statements on DE pupils' technical reading skills and more research on this domain is needed. Because language is seen as a personal and cultural tool in DE schools, much attention is given to reading motivation, reading comprehension, writing skills and oral communication. On these domains, the reported studies show that effects of DE are average to good. For SLL, the DE concept also seems to be effective: several studies show sufficient or better scores on vocabulary acquisition for SLL in DE schools. However, the study by Helms-Lorenz and Jong-Heeringa (2006) showed that Moroccan pupils in traditional education outperformed DE pupils. This latter result can possibly be explained by the different tests used in the studies. Van Oers and Duijkers (2013) measured vocabulary acquisition after a theme period with a self-developed instrument to test pupils' acquisition of theme related words, while Helms-Lorenz and Jong-Heeringa (2006) used a national standardized language test to measure pupils' general vocabulary knowledge. It might be that Duijkers' test was more sensitive for DE: testing the acquisition of words that were used during a theme period.

3.2. Mathematical development

In DE, pupils are meaningfully involved in socio-cultural practices. In their play or inquiry they come across situations where they need mathematical knowledge, tools and skills. They have to pay in a shop, measure whether something fits, plan how long something will take, etc. Mathematical activities are embedded in the socio-cultural practices as much as possible, so that they are meaningful for pupils. In DE schools, schematization activities have a major role in the mathematical education as a means to communicate about the structure of objects, composition of quantities, dynamic relations (e.g. direction). We will discuss this further in Section 3.2.2. In both the lower and upper grades, important mathematical knowledge and skills are also taught, practiced and automated through explicit instruction.

In this second section we report on studies that focus on pupils' mathematical development (see supplemental material, Table 2). Studies in this area focus on general mathematical knowledge and skills, schematizing and solving mathematical problems. Outcomes in these sub-domains are reported in the next paragraphs.

3.2.1. General mathematical knowledge and skills

Five studies investigated DE pupils' scores on general, national-referenced standardized mathematical tests. Veen et al. (2006) compared 4–6 years old DE pupils with pupils in the programmatic 'Piramide' program and found equal scores for both groups on a test measuring basic math skills. Research in grade 2 to 4 (ages 5–8), concluded that DE pupils score at or somewhat above the national level (Suhre, 2001; Van Oers, 2003) and show better results on arithmetic facts in grade 4 (i.e. addition and subtraction until 20; Edelenbos, 2003). DE pupils aged 11–12 score equal to non-DE pupils on the primary school final test in grade 8 (Krah, 2012).

3.2.2. Schematizing

Several studies in the domain of mathematics focused on schematizing activities in various grades of primary education. Informed by our conceptual background (CHAT), we focused on tools that could guide the pupils' acting, speaking and thinking when solving mathematical problems. For the younger children we supposed that their own drawings of the problem situation could serve as such tools. In the interactions with the children, the teacher directed children's attention to those aspects of the situation that were considered helpful in solving the problem. Step by step the children were led to the idea of 'schematic representation of the situation', such as a schema of something they had built (see van Oers, 1994, 1996). In the upper grades such schematisations evolved into conceptual models, like drawings representing the relationships among different concepts, equations, graphs. Longitudinal research on the effects of schematizing activities in the early grades (ages 4–6) on mathematical performance and understanding in grade 3 (age 6–7) showed positive results in favour of DE (Poland, 2007; Poland et al., 2009; Van Oers & Poland, 2007). The first conclusion of these studies was that schematising is within the learning range of young pupils. Moreover, active formation of the ability to schematize problem situations has an effect on the way pupils schematize: after acquisition of such schematizing skills, pupils mainly created

dynamic schematizations, which focussed on processes and changes (for example, with arrows), rather than just representing situations (like maps or routes). In other words, pupils with experience in the formation of schemes focused more on what changes in a certain situation. For example, they schematized a moving car they had played with, by drawing an arrow for the representation of the movement. Pupils with less experience in schematizing mostly made simpler, static schematizations. The second finding was that schematizing in the early grades has a positive effect on mathematical skills in grade 3 (age 6–7). On the post-test, pupils in the experimental group scored significantly higher on a national, norm-referenced, standardized test compared to pupils in the control group. Apparently, schematizing supports the transition from informal to formal thinking (Poland, 2007).

Other studies on schematizing with young pupils were executed as case studies or exploratory studies, with qualitative analyses of schematizing activities and effects on pupils' mathematical performance and thinking (Van Oers, 1994; Van Oers, 1996; Van Oers, 1998). Observations indicate that pupils are highly involved when they schematize in the context of play situations (Van Oers, 1994). Young pupils are motivated to solve mathematical problems that arise in play, and they are also willing to apply their new schematizing skills in other activities.

The effects of schematizing activities for children in the upper grades (aged 8–12 years) has also been investigated (Terwel et al., 2009; Van Dijk et al., 2003). Again, it appeared that schematizing is something pupils can learn. After an intervention focussing on guided construction of schemes, pupils in the experimental group judged themselves more experienced at model constructing than pupils in the control group. The pupils who practiced schematizing obtained higher scores at the post test with problems directly related to those used during the lessons ($d = 0.40$, moderate effect). Post-hoc transfer tests, with relatively new mathematical problems, also resulted in higher scores for the experimental group ($d = 0.23$, small effect). A possible explanation is that when pupils construct models and schemes by themselves, it supports them in getting insight in the structure of problems (Terwel et al., 2009). Schematizing in the upper grades was also discussed in a study conducted on study skills (Van der Bijl, 2013). This study focused on inquiry skills in an experimental research task. During inquiry activities, DE pupils more often used measuring-instruments and drawings (e.g., schematic representations of what happened during an experiment), and were better able to articulate what they did afterwards. The outcome that DE pupils made more drawings during the process can possibly be explained by the role of schematizing in play- and research activities in DE: DE pupils might be used to make visualizations of their thoughts, ideas and plans.

3.2.3. Mathematical problem solving

Edelenbos (2003) investigated DE pupils' mathematical skills by using a self-designed test. We have to interpret the results carefully, because of the small sample size and a small number of questions in the test. The conclusion was that pupils aged 7–8 (grade 4) in DE schools are better able to explain the strategy they used to solve a mathematical problem. It also was expected that DE pupils would find it easier to solve mathematical problems in new situations, because DE pupils learn to apply knowledge in new situations in the context of thematic activities (Edelenbos, 2003). However, this hypothesis was not supported by the data: no differences were found between DE pupils and their peers in traditional education. This is in contrast with the outcomes of a study by Kessels (2004). She investigated the level of mathematical problem solving in the context of word problems and concluded that DE pupils are better able to solve those problems than pupils in more traditional schools. Kessels (2004) also used a test that examined pupils on their ability to determine whether a word problem provides enough information to actually solve it, like in the well-known maths assignment: "How old is the captain?" (https://en.wikipedia.org/wiki/Age_of_the_captain). Some items in this test gave too little information to answer the mathematical question, making the question unsolvable. DE pupils were better able to determine whether such an assignment could be solved or not than pupils in traditional schools. Apparently, pupils in DE schools are better in (1) understanding the meaning of a math problem, and (2) reasoning whether or not it can be solved.

Research on schematizing in the upper grades (see Section 3.2.2), showed that pupils who were trained in schematizing, showed better results on the transfer test with relatively new mathematical problems (Terwel et al., 2009). Similar results were found in another study on solving mathematical problems. Matthijssen (2014) compared operation procedures of 10–12 years old DE pupils and pupils in traditional education. Results showed that DE pupils more often used complex word processing activities to solve problems (e.g., underlining/markings important numbers) and verified their actions more often than pupils in non-DE schools. Van Houten et al. (2013) found a relation between narrative competence (pupils' knowledge, skills and attitudes to understand texts) and mathematical skills. Pupils' (aged 6–8) results of a narrative assignment - writing a story based on an illustration - were positively related to scores on a national-standardized mathematical test. This research was executed in regular education, but due to the great value DE attaches to narrative competence, this research has been included in this review.

3.2.4. General conclusions on mathematical development

Research on DE pupils' general mathematical skills shows pupils scores equal to the national level (Krah, 2012; Suhre, 2001; Van Oers, 2003; Veen et al., 2006). Therefore, we can conclude that DE schools meets the objectives stated by the Dutch government. Other research in this area focused on activities that have an important place in mathematics in DE: schematizing and problem solving. Most of these studies used self-designed tests or a combination of self-designed tests and national standardized tests. It can be concluded that pupils, already in early childhood, can learn to schematize in meaningful situations. Schematizing has positive effects on children's mathematical knowledge and skills and problem solving (Poland, 2007; Poland et al., 2009; Terwel et al., 2009; Van Dijk et al., 2003; Van Oers & Poland, 2007). Only one article reported similar scores on problem solving skills in new situations for DE pupils and pupils in traditional schools (Edelenbos, 2003), while other research did find positive effects for DE pupils in this area (Kessels, 2004; Terwel et al., 2009). The differences between those outcomes can be explained by several factors: different age groups, study designs and sample sizes (i.e., sample sizes were larger in the studies of Kessels and Terwel et al. compared to the study by Edelenbos).

Pupils' narrative competence seems to have a positive effect on mathematical problem solving (Van Houten et al., 2013). This can

be explained by the fact that in CHAT and DE, language is seen as an important tool for children to communicate (Vygotsky, 1986). It appears that when pupils are supported in understanding the structure in stories and text, which is a main activity in DE, they are also able to understand or discover structures in mathematical problems (Van Houten et al., 2013). The outcome that pupils were able to discern whether a word problem could be solved or not, might be explained by the focus on meaning within DE (Kessels, 2004).

3.3. Social-emotional development

In DE, the pupil's well-being is seen as an important precondition for learning. Teachers create learning environments where pupils feel free, are curious and may take initiatives. As participants in socio-cultural practices in the classroom, pupils have to empathize with their role, communicate with their peers and learn to solve problems which can arise in their play or inquiry activities. Learning takes place in pupil's zone of proximal development (ZPD): 'new actions *within the context of meaningfully accessible activities* that can be appropriated under the guidance of more knowledgeable others' (Van Oers & Duijkers, 2013, p. 3). In this third section, we will review studies that report on pupils' social-emotional development (see supplemental material, Table 3).

Two studies looked into effects of the DE-approach on children's social-emotional development in grade 1 and 2 (age 4–6). First, Mohamed (2017) pupil's social-emotional skills in DE and traditional education. No differences were found on pupils' relations with adults, their social relations with other pupils and play development. Second, Veen et al. (2006) conducted a longitudinal study on the effects of DE from pre-school to grade 2. In grade 1, they did not find differences between DE pupils and pupils in traditional education, but in grade 2 pupils in DE schools significantly scored higher on 'pleasant behaviour' (relates to how pupils interact with their peers; i. e., being nice, complimentary, sympathetic).

Two other studies on social-emotional development were conducted in grade 8 (age 11–12) and focused on self-confidence. In a large-scaled study of the effects of DE on several variables, Krah (2012) found that grade 8 pupils in DE have more cognitive self-confidence than grade 8 pupils in traditional education ($\eta^2 = 0.02$, small effect). Başaran (2013) confirmed these results: DE pupils in grade 8 showed higher levels of self-confidence than their peers in traditional education ($d = 1.14$, large effect). Krah (2012) has also compared the motivation of DE pupils with pupils in traditional education. DE pupils score higher on learning motivation: they were more autonomously motivated and had a higher task motivation compared to pupils in traditional schools.

3.3.1. General conclusions on social-emotional development

Because of the small number of studies (i.e., four studies) that reported on pupils' social-emotional development, it is as yet not possible to draw firm conclusions on the effects of DE in this domain. Two studies did not find differences between DE and non-DE schools. However, outcomes of two other studies showed positive effects of DE on 11–12 years old pupils' self-confidence (Başaran, 2013; Krah, 2012) and motivation (Krah, 2012). We argue that more research is needed on the possible benefits of the DE-approach for children's social-emotional development.

3.4. Other domains

Finally, we will report on two studies concerning outcomes in other domains (see supplemental material, Table 5). We describe the outcomes of those studies, but do not end this paragraph with a general conclusion, as we only included two studies that were conducted on different subjects. One study investigated pupils' knowledge in the domain of world orientation (i.e., a Dutch subject that combines history, geography, and biology; Krah, 2012), and one study focused on music education (Hogenes, 2016).

In Krah's (2012) study, 11–12 years old pupils in DE and traditional education were compared on their knowledge in the domain of world orientation. Pupils in traditional education showed significantly higher scores on a national standardized test ($\eta^2 = 0.02$, small effect). As a possible explanation, Krah (2012) states that pupils in traditional schools followed standard world orientation lessons, during which teachers strictly followed method books. Those method books are based on the core goals that are tested in the national standardized test that Krah used in her study. Teachers in DE implement the core goals of world orientation in thematic activities and use method books as one of their sources. DE pupils may, therefore, have a less broad knowledge of the various subjects, but their knowledge could be more in-depth, which was not measured in this test (Krah, 2012).

The study on music education focussed on music composition as a classroom activity (Hogenes, 2016). In the experimental group, pupils (8–10 years old) actively participated in music composition activities. The control group followed a teacher-centred approach where the main activity was reproduction of music. The aim was to investigate whether a CHAT-based approach of music education, where pupils have an active role and compose their own music, had effects on pupils' achievements. No effects were found on intelligence, mathematics, spelling and singing. The experimental group did, however, score significantly higher on engagement in music lessons (partial $\eta^2 = 0.937$; large effect) and on reading comprehension (partial $\eta^2 = 0.06$; moderate effect).

4. Discussion

The current review study was conducted to answer the following research question: *What kinds of learning outcomes for pupils aged 4–12 does the Developmental Education approach in the Netherlands produce?* We conducted a systematic narrative review on 33 studies

that focused on DE and learning outcomes in four domains: language development (17 studies), mathematical development (17 studies), social-emotional development (4 studies) and other domains (2 studies).¹ In total, this review reports outcomes for $N = 3419$ pupils, of which $n = 1985$ pupils in DE schools or in schools using elements of the DE approach. Although there were major differences among the included studies in design, domain, instruments, and number of participants, this body of research did give us important insights in the value and quality of DE in relation to pupils' learning.

4.1. Conclusions

Based on our systematic review, our most important conclusions are that (1) pupils in DE meet the national norms on general language development and seem to score higher on vocabulary acquisition than non-DE pupils. This was also found for SLL: SLL in DE schools scored higher on several language tests compared to SLL in non-DE schools; (2) DE pupils have similar to higher scores on mathematical tests compared to pupils in non-DE schools; and (3) pupils in DE seem to have higher scores on social-emotional development, self-confidence and learning attitude compared to pupils in non-DE schools.

What are possible explanations for these conclusions? To answer this question, we start from the most important aims of the DE approach: promoting 'pupils' meaningful learning and cultural development in an 'emancipatory way' (van Oers, 2012a, p. 59). In DE, pupils' personal meanings and interests are connected to cultural meanings and goals of teachers, by getting them involved in sociocultural practices (like agriculture, bookshops, sewing workshop, post office, doctor's practice, etc.). Participating in these practices in playful ways allowed them to act as real agents. While playing, learning, and interacting in these practices, pupils and teachers discover actions, knowledge, attitudes or skills that children cannot (yet) perform independently and for which they need help of the teacher or a more knowledgeable other (i.e., the ZPD). Furthermore, in DE schools, pupils get opportunities to discover the world in joint activities. This may explain why DE pupils show higher scores on motivation and other social-emotional skills. Besides, the meaningful learning environment in DE-schools could also explain why pupils in DE score higher on vocabulary acquisition: in a meaningful learning environment pupils are motivated to use and learn thematic words to enrich their play activities (Van Oers & Duijkers, 2013).

DE pupils' average to higher scores on mathematical tests could be explained by the role of schematizing and problem solving in DE schools. In schematizing activities, pupils are encouraged to structure and relate actions from their play or inquiry activities. In DE, meaningful schematizing activities are widely implemented in early years education. In play-activities, pupils get used to structure their thinking and solve mathematical problems by making schemes. This could lead to better use of symbols and being able to structure their thinking by using models.

4.2. Research quality

In this paragraph, we describe how our systematic review meets the quality requirements as discussed in the method section. There, we described our procedure to check the methodological quality of the studies that we selected but had not (yet) been published. We assessed the quality of these studies by determining the visibility, comprehensibility and acceptability of methodological choices (Akkerman et al., 2008). In our review, we described the steps taken in selecting and reviewing studies (visibility), explained why we made certain choices (comprehensibility), and we carefully assessed the quality of the non-published studies and increased the reliability by working with a second assessor when selecting studies using the inclusion criteria and methodological criteria (acceptability).

4.3. Limitations

As with any study, our systematic review suffered from several limitations that we will address in this section. First, the included studies are diverse in terms of design, research area, and number of participants. Because of the large differences among the studies, we weren't able to conduct a meta-analysis. As a result, we must be cautious in drawing conclusions based on the results of our review. Besides, we included both peer-reviewed studies and grey literature such as Master theses. Because of our aim to give an overview of all research in the field of DE and the outcomes on pupils' learning, we chose to include those studies after checking the inclusion criteria and assessing the methodological quality thoroughly (see also Section 4.2).

A second limitation of the current study relates to the appropriateness of the administered tests in the included studies for assessing the learning outcomes of the DE approach. Many of the tests measured rote knowledge, without taking the context into account or connecting to the themes that had a central part in the DE classrooms. As learning in DE schools takes place in the context of meaningful activities, some of the administered tests might not be appropriate and/or sensitive enough to measure the outcomes of the DE approach, as is also problematized in some of the studies we reviewed. Research in which tests are administered that fit the goals and content of DE classrooms could be helpful to evaluate the effects of DE in a meaningful way and may add to our knowledge of the effectiveness of this approach (see for example van der Veen et al., 2016).

¹ 30 studies focused on one domain, one study on two domains, one study on three domains and one study on all four domains.

4.4. Future research

In the current study, we reviewed many studies with an exploratory design and small number of pupils. We suggest that future studies on the effects of DE on pupil's learning and development should adopt a quasi-experimental, mixed-methods or longitudinal design and include more pupils. Besides, the majority of studies in our review focused on the domains of language and mathematics. This focus can be explained by the Dutch government's emphasis on pupils' basic skills and knowledge in the domains of mathematics and language (Krijnsen, 2010). We acknowledge that results on language development and mathematical development need to be permanently assessed, as these are important domains in DE as well. However, more research is needed on how the DE approach supports pupils' social-emotional development, executive functions and their learning and development in other subject domains, such as world orientation, music education, arts, citizenships education, etc. As described in the section above, prospective researchers should carefully consider which measurement instruments they use to evaluate the outcomes of DE.

4.5. Final remark

How do educational practices benefit from the outcomes of our literature review? DE schools in the Netherlands, and schools abroad that adopt a similar CHAT-based approach, find grounds in our findings that pupils in a DE-schools meet the national norms on language development and mathematical development, and seem to have higher scores on social-emotional development, self-confidence and learning attitude compared to pupils in non-DE schools. These results are also informative for policy makers and the inspectorate of education. For example, the results of our review might support policy makers or the inspectorate in evaluating DE-schools. Our earlier recommendation to future researchers also applies to teachers: do not only rely on standardized testing in assessing pupils' learning and development, but also use instruments that fit the DE concept. Dynamic Assessment, formative assessment, and action oriented observations are examples of such instruments.

Despite the differences among international CHAT-based early years programs (see: van Oers, 2018), the conceptual elaborations of the CHAT approach, its practical applications and empirical research in the context of DE-schools in Netherlands are important input for the international CHAT discussions about education in schools and endorse the international trust that CHAT is a progressive research program.

Declaration of competing interest

None.

Acknowledgements

We are grateful to CorDeo Scholengroep and the Vygotskij Foundation for giving the first author the opportunity to conduct this research, in addition to her work as teacher and team leader in primary education.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.lcsi.2021.100596>.

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