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A successful professional development program in history: What matters?

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HIGHLIGHTS

- A PDP with timelines showed significant student learning gains in history.
- Educative curriculum materials contributed to the success of the PDP.
- Feelings of autonomy and competence stimulated teachers' intrinsic motivation.
- Teachers' beliefs and attitudes changed during the PDP.
- Teachers' instructional behavior appeared to relate to student learning gains.

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ABSTRACT

This study focuses on a successful Professional Development Program for improving students' understanding of historical time, consisting of a training and the implementation of Timewise, a teaching approach in which timelines were used consistently. The PDP was carried out with 16 elementary school teachers in grades 2 (ages 7–8) and 5 (ages 10–11). Results indicate that the highest student learning gains were reached by teachers who successfully implemented the instructional behavior aimed at, while using educative curriculum materials. The clear structure of Timewise and the user-friendly materials, which included room for autonomy, supported teachers in their learning and teaching.

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1. Introduction

In the past decades multiple reviews discussed professional development programs (PDPs) of teachers, although PDPs in the field of social studies are rare. However, in the fields of science and mathematics many studies on K-12 teachers' professional development provide insights, into the question under what conditions, why, and how teachers learn (see e.g., Kennedy, 1998; Loucks-Horsley & Matsumoto, 1999; Penuel, Fishman, Yamaguchi, & Gallagher, 2007; Blank, de las Alas, & Smith, 2008; Blank & de las Alas, 2010; Sztajn, Campbell, & Yoon, 2011). Not so many studies include measurements of student learning outcomes and even less studies focus on the relation between specific features of the PDP and student learning (Kennedy, 1998; Knapp, 2003; Van Veen,

Zwart, & Meirink, 2012). According to Hattie (2005) too little focus on the improvement of student learning could be a reason for lack of success of PDPs for teachers.

The present study focuses on a PDP aimed at the improvement of students' understanding of historical time. The understanding of historical time is a very important part of the learning of history and essential for understanding events in today's society (Barton & Levstik, 2004; Wilschut, 2012). Understanding historical time includes reasoning about change and continuity, which is considered to be a core concept of historical thinking (Lévesque, 2008; Seixas & Morton, 2013) and of historical consciousness (Grever, 2009; Rösen, 2012; Seixas, 2006). However, research indicates that the teaching of historical time in elementary schools, at least in England and the Netherlands, does not always lead to optimal student learning outcomes (De Groot-Reuvekamp, Van Boxtel, Ros, & Harnett, 2014; Ofsted, 2011; Wagenaar, Van der Schoot, & Hemker, 2010). In the PDP in this study teachers adopted a teaching approach, named Timewise, in which they consistently made

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connections between historical events and the timeline, while using stories, pictures and videos to develop their students' understanding of time. In a previous study, we investigated the effects of the implementation of the Timewise approach on students' learning outcomes in a pre-/post-test design with students in grade 2 (ages 7–8) and grade 5 (ages 10–11) in an experimental ($n = 396$) and a control condition ($n = 392$). Linear mixed model analyses showed that students in grade 2 as well as grade 5 scored significantly higher on the post-test compared to the pre-test and compared to the control condition. The Timewise approach had a medium effect on students' achievements of .44 for grade 2, and .54 for grade 5 (De Groot-Reuvekamp, Ros, & Van Boxtel, 2017).

The PDP in the present study consisted of a training of two sessions of 4 h combined with curriculum materials and activities teachers could adapt to their own needs during the implementation of Timewise. Considering the short training time of the PDP the effects were remarkable, since positive results for PDPs with such a short training are rare (Desimone, 2009; Van Veen et al., 2012). Therefore, the main research question in this study is: “Which components of the PDP for improving elementary school students' understanding of historical time were relevant for the success of the PDP?” The study will focus on changes in teachers' knowledge and beliefs and their instructional behavior (Desimone, 2009; Kennedy, 2016), as well as on the materials that were used to support teachers in their learning and teaching (Ball & Cohen, 1996; Davis & Krajcik, 2005; Davis, Sullivan-Palincsar, Smith, Arias, & Kademian, 2017; Remillard, 2005).

2. Theoretical background

Although research indicates that changing teachers' behavior is hard to realize, many studies identify characteristics for PDPs that could be effective in improving teaching practices. The so-called “theory of improvement” (Desimone, 2009; Van Veen et al., 2012; Wayne, Yoon, Zhu, Cronen, & Garet, 2008) defines several relationships between PDP characteristics. Firstly, the “theory of change” refers to the relationship between characteristics of an intervention and teachers' learning and behavior. Secondly, the “theory of instruction” relates to the relationship between the content of the intervention and student learning. Thirdly, the relation between structural and cultural conditions in the school is captured in the “theory of context”.

The theory of improvement is represented in Desimone's (2009) much cited framework for the design, implementation and evaluation of PDP's, in which relations are shown between *design features* of the PDP, *increased knowledge and skills*, *changes of teachers' attitudes, beliefs*, and *instruction*, and *improved student learning* (Fig. 1). The arrows in Fig. 1 show that there are interactive, non-recursive relations between the different components (Desimone, 2009). Below we will elaborate on the components of this framework in relation to the PDP for the improvement of elementary students' understanding of historical time. We will finish this section with a description of the PDP in the present study (Fig. 1).

2.1. Design features of professional development programs

In studies on PDPs various design features are mentioned that could be effective for teacher learning. Next to content focus, active learning, duration, collective participation, and coherence (Garet, Porter, Andrew, & Desimone, 2001; Desimone, 2009; Blank & de las Alas, 2010; Opfer & Pedder, 2011; Van Veen et al., 2012), several authors emphasize the extent to which teachers have opportunities to integrate a new methodology into their daily work, and the need for extensive practice, with possibilities for feedback to identify success and failure (Blank et al., 2008; Borko, 2004;

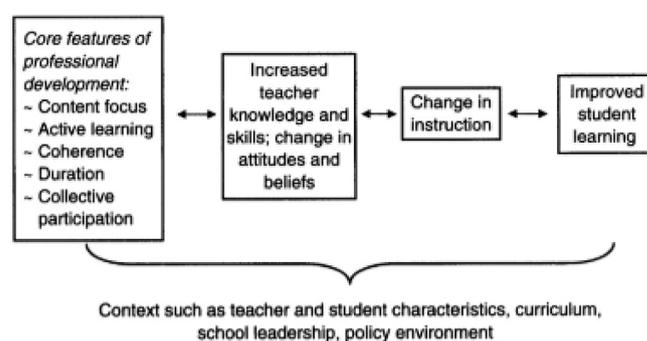


Fig. 1. Conceptual framework for studying the effects of professional development on teachers and students (Desimone, 2009, p.185).

Knapp, 2003; Opfer & Pedder, 2011; Osborne, Simon, Christodoulou, Howell-Richardson, & Richardson, 2013; Thurlings, Evers, & Vermeulen, 2015; Van Veen et al., 2012). In their self-determination theory Ryan and Deci (2000) and Deci and Ryan (2008) also stress the need for autonomy, next to competence and relatedness, to enhance motivation and effective performance. Furthermore, the availability and usefulness of materials and resources are mentioned as influential factors for the effectiveness of PDPs (Ball & Cohen, 1996; Cohen, Raudenbusch & Ball, 2003; Davis & Krajcik, 2005; Davis et al., 2017; Hill, Blazar, & Lynch, 2015; Opfer & Pedder, 2011; Callahan, Saye, & Brush, 2013; Remillard, 2005). In addition, some review studies put forward that some of the more effective programs appeared to be directly carried out by authors or their affiliated researchers, who were familiar with the work of teachers (Kennedy, 2016; Yoon, Duncan, Wen-Yu-Lee, Scarloss, & Shapley, 2007; Guskey & Yoon, 2009). However, lists of effective design features for PDPs are also criticized, mainly because the effect of these features on teacher or student learning often remains unclear (Guskey, 2003; Kennedy, 2016; Knapp, 2003; Van Veen et al., 2012).

Other researchers stress the importance of “educative” curriculum materials for successful PDPs, because carefully designed curriculum materials can support teachers as learners and contribute to teachers' professional practice and improvement of instruction (Ball & Cohen, 1996; Cohen, Raudenbusch, & Ball, 2003; Davis & Krajcik, 2005; Davis et al., 2017; Lampert, 2012). For instance, in a design experiment in social studies, educative web-based curriculum materials seemed to help teachers with the development of their professional teaching knowledge (Callahan et al., 2013). PDPs need to facilitate teachers in learning how to use curriculum materials with regard to content, aims, approaches and underlying ideas, whereas materials should be carefully framed with regard to the representations of content and pedagogy (Remillard, 2005). Davis and Krajcik (2005) developed a set of heuristics for educative curriculum materials in science teaching which can be useful in other fields as well. Next to design heuristics for scientific inquiry these heuristics consist of supporting teachers in engaging students in topic-specific phenomena; in using subject specific representations; in anticipating, understanding, and dealing with students' ideas about the subject; in engaging students in questions; and in the development of subject matter knowledge. Building on these heuristics Davis et al. (2017) mention important design principles for educative curriculum materials, such as that these should offer suggestions for adaptations of lessons that would take different amounts of time and meet a range of students' needs; provide teaching tools such as rubrics, examples of key scientific ideas, and student-friendly definitions of terms; highlight important content; emphasize the rationales for the

recommendations; and that these materials should be situated in teachers' practice. In a recent review study Kennedy (2016, p.11–12) identified four "methods" that appeared to be effective in supporting teachers in the implementation of new ideas in their daily practice, and could be included in the criteria for educative curriculum materials. *Prescriptions* consist of exact procedural guidance; *strategies* of teaching methods that teachers can choose to implement in specific situations; *insights* can help teachers to adapt their response in different situations, whereas a *body of knowledge* contains concepts and principles that teachers can use in their teaching practices (Kennedy, 2016). With the last three methods teachers may feel more autonomy in the way they use curriculum materials.

Based on characteristics of materials in literature on PDPs (Ball & Cohen, 1996; Davis & Krajcik, 2005; Davis et al., 2017; Kennedy, 2016; Remillard, 2005) we can conclude that, in the context of the present study, relevant educative curriculum materials seem to consist of:

- Background knowledge about subject matter knowledge, the objectives of the PDP, and knowledge of students' development and learning in the understanding of historical time (body of knowledge and insights);
- A collection of lesson formats and instructional materials for teachers with suggestions for adaptations (prescriptions and strategies);
- Materials to stimulate students' learning, such as timelines.

2.2. Teachers' knowledge, skills, attitudes and beliefs, about the understanding of historical time

In the previous paragraph we mentioned that increasing teachers' knowledge and skills and changing their attitudes and beliefs are important factors in PDPs (Borko, 2004; Cherrington & Thornton, 2013; Desimone, 2009; Knapp, 2003; Opfer & Pedder, 2011; Timperley, Wilson, Barrar, & Fung, 2007; Van Veen et al., 2012).

The importance of content knowledge for teachers' classroom practice is confirmed in multiple reviews and often referred to as pedagogical content knowledge (PCK). Although definitions of PCK diverge, they generally include knowledge of subject matter, knowledge of how to teach the subject, and knowledge of student learning processes regarding a specific subject (Shulman, 1986; Van Driel, Verloop, & De Vos, 1998; Van Veen et al., 2012). Some studies on PDPs in science and mathematics indicate that teachers' subject matter knowledge has a positive effect on students' achievements (Hill et al., 2015; Roth et al., 2011). For a PDP on the understanding of historical time teachers would need to refresh their knowledge about the historical eras and their characteristics, since elementary school teachers in the Netherlands, who teach all subjects, probably have superficial content knowledge of history (De Groot-Reuvekamp et al., 2014; Dutch Inspectorate of Education, 2015b).

Research into students' learning processes on the understanding of historical time shows that teachers hold outdated beliefs related to the Piagetian stage theory about the learning of clock and calendar time being conditional for the learning of historical time and that the teaching of history therefore cannot start before the age of 9 (Barton & Levstik, 1996; Wilschut, 2012). However, according to empirical studies the development of historical time *also* is a learning process that starts at a young age (Blyth, 1978; West, 1981; VanSledright & Brophy, 1992; Harnett, 1993; Brophy, VanSledright, & Bredin, 1993; Barton & Levstik, 1996; Wood & Holden, 1997; Foster, Hoge, & Rosch, 1999; Vella, 2001; Hodkinson, 2003; Solé, 2009). Therefore, teachers will need to gain insights into students'

development in learning about understanding of historical time. Based on literature (De Groot-Reuvekamp, Ros, Van Boxtel, & Oort, 2017; Barton & Levstik, 1996; Harnett, 1993; Hoge & Foster, 2002; Levstik & Pappas, 1987) three stages can be distinguished in this development: emergent, initial and continued understanding of historical time, in which students develop their understanding on several aspects. For instance, the use of the vocabulary of historical time develops from the use of relative time phrases such as "long ago" to the use of dates and names of historical periods.

As to the pedagogy of the teaching of historical time, teachers will need to develop their skills in engaging students in learning activities to enhance their understanding of historical time that match the stages of development of their students. The next paragraph will elaborate on the change in teachers' instructional behavior.

2.3. Change in instruction - the instructional behavior for the teaching of historical time aimed at

The intention of a PDP is that teachers use their new knowledge, skills and beliefs to improve their instructional practices. This should result in improved student learning. Instruction can be defined as "interactions among teachers and students around content, in environments", in which resources should focus on the definition of instructional ends and means (Cohen, Raudenbusch and Ball, 2003, p. 122). For the teaching of historical time this means that teachers need to pay attention in their instructional behavior to the objectives for the understanding of historical time. These objectives include that students have to apply the vocabulary of time; sequence pictures of objects, situations, events and persons in chronological order; use the timeline; identify characteristics of historical eras, and compare eras with each other and with the present (Barton & Levstik, 1996; Department for Education, 2013; Dutch Ministry of Education, Culture and Sciences, 2006; Harnett, 1993; Hoge & Foster, 2002; Levstik & Pappas, 1987).

About educative curriculum materials that can contribute to achieving these objectives, educational literature suggests that timelines can support students in developing their understanding of time, because they visualize the chronological overview of historical eras (Cooper, 2012; Dawson, 2004; Hoodless, 1996; Stow & Haydn, 2000). A small body of empirical studies confirms the assertion that timelines are effective (Hodkinson, 2003; Masterman & Rogers, 2002). Furthermore, attached pictures can give an impression of a "sense of period" (Blow, Lee, & Shemilt, 2012; Dawson, 2004). Some studies have shown that teaching with pictures and stories is helpful to stimulate students' use of the vocabulary of time and their reasoning about chronological sequence and characteristic features of historical eras (De Groot-Reuvekamp et al., 2014; Barton & Levstik, 1996; Harnett, 1993; Hoge & Foster, 2002; Hoodless, 2002; Levstik & Pappas, 1987).

We can conclude that the instructional behavior aimed at in lessons on the understanding of historical time implies that teachers engage their students in activities that focus on the objectives while using timelines, pictures and stories. Teachers can, for example, encourage their students to use dates and names of eras; to sequence historical pictures on a timeline, and to identify and compare characteristic features of eras in stories and pictures. For Dutch elementary schools the use of curriculum materials in history lessons is not common practice, since most teachers follow textbooks for history, starting from grade 5 or 6 at about the age of 9 (Dutch Inspectorate of Education, 2015a; Wagenaar et al., 2010). For most teachers in the lower grades the teaching about historical time means that they have to develop the instructional behavior aimed at, since history in these grades usually does not feature in the curriculum.

2.4. The PDP in the present study

The PDP in the present study consisted of two 4-h training sessions, followed by a curriculum intervention with Timewise. During the training teachers explored the educative curriculum materials, which comprised background information for teachers and materials to stimulate students' learning (Ball & Cohen, 1996; Davis & Krajcik, 2005; Davis et al., 2017; Kennedy, 2016; Remillard, 2005).

The materials included:

- a. Materials for teachers to apply in their teaching, such as lesson plans, and PowerPoint presentations;
- b. Materials to stimulate student learning, such as timelines, stories, pictures, video clips and exercises on a website;
- c. Background information on subject matter knowledge of the characteristic features of the ten eras of the Dutch curriculum, which was added in a convenient overview in the instruction manual;
- d. Background information about students' development in the understanding of historical time and about teaching according to the objectives and stages in the developmental model (De Groot-Reuvekamp, Ros, Van Boxtel, & Oort, 2017).

All materials were practical and user-friendly, and needed little time for preparation. On the other hand, we provided for subject matter and pedagogical content knowledge, because teachers will more likely apply the suggested strategies in their lessons, if they understand the rationale behind the lesson plans (Davis & Krajcik, 2005; Davis et al., 2017). Furthermore, the materials were attractive for students to work with.

In the first training session the objectives of the understanding of historical time were discussed, along with students' development in the stages of emergent, initial and continued understanding of historical time (De Groot-Reuvekamp, Ros, Van Boxtel, & Oort, 2017). Beliefs about students first having to master clock and calendar time before they can learn about historical time, were compared to more recent insights into students' development in the understanding of historical time, and the age at which teaching and learning of historical time can start (Barton & Levstik, 1996; Harnett, 1993; Hodkinson, 2003; Hoge & Foster, 2002; Levstik & Pappas, 1987; Wilschut, 2012). The trainer introduced strategies that appeared to be effective according to literature (paragraph 2.3), such as teaching with timelines to visualize the chronological overview of eras, and using stories, pictures and videos to stimulate the development of a "sense of period". Subsequently, the trainer presented prescriptions for the implementation of Timewise, which included lesson plans for weekly Timewise lessons of about 30 min, preferably to take place at a fixed time in the week during a period of five months. The lesson plans consisted of three introductory lessons, with fixed formats, about the characteristics of the eras of the Dutch history curriculum, followed by flexible formats for twelve to fifteen weekly lessons on separate eras. The aim of the introductory lessons was to introduce and clarify the names and characteristics of the eras on the timeline, for which PowerPoint presentations for instruction were included. In small groups the teachers discussed the prescriptions of the introductory lessons and their planning of the Timewise lessons for the next five months. Teachers could decide themselves whether they planned the Timewise lessons instead of or next to regular history lessons.

The second training session focused on the materials to stimulate students' learning, such as the storybook and digital pictures and links to educational videos for the interactive whiteboard (IWB) and a large classroom timeline, which was especially developed for the PDP. There was one version for grade 2 on the

level of initial understanding with six eras and one version for grade 5 on the level of continued understanding, with ten eras. All materials and resources were made available through a website, which also contained digital timelines, on which pictures could be sequenced on the interactive IWB. Teachers could select appropriate teaching methods and learning activities (strategies) linked to the objectives. Examples were discussed, such as: asking students to present a short review of the previous lesson; attachment of pictures to the classroom timeline; introduction of the new topic through reading a story and/or showing a video; classroom discussion about characteristic features of an era and comparisons with other eras and the present; exercises with the digital timeline; election of a picture to be attached to the timeline as a start of the following lesson. The teachers discussed, in small groups, about their choices for suitable strategies to achieve the objectives in their own classroom practice.

3. Aims of the present study

The main research question in this study is: "Which components of the PDP for improving elementary school students' understanding of historical time were relevant for the success of the PDP?" To answer this question, the components of Desimone (2009) offer a useful framework. This leads to the following sub-questions:

1. How did teachers perceive the support of educative curriculum materials provided by the PDP?
2. Which changes in their beliefs and attitudes, and gains in knowledge and skills did teachers perceive?
3. To what extent did teachers implement the instructional behavior aimed at in the classroom?
4. Which student learning gains were realized by the teachers?

4. Design and method

The present study further explores the findings from an earlier effect study, which showed a medium effect of the Timewise approach of .44 for grade 2, and .54 for grade 5 on students' scores in the post-test, compared to the pre-test on the understanding of historical time (De Groot-Reuvekamp, Ros, & Van Boxtel, 2017). However, this study offered no insights into how or why learning gains differed between teachers, nor how the PDP contributed to the success of Timewise. A mixed-method design was applied in which qualitative methods are complementary to quantitative methods. Mixed-method designs are advocated in literature for purposes of triangulation, development, complementarity and confrontation (Greene, Caracelli, & Graham, 1989; Moss & Haertel, 2016).

Fig. 2 presents an overview of the instruments used, during different phases of the PDP.

The PDP started with two training sessions of 4 h each, followed by the implementation of the Timewise approach during five months, a time span that according to literature would be effective (Desimone, 2009). The first author, an experienced teacher trainer who coaches (student) teachers, provided the training. At the start of the training teachers filled in questionnaire 1 on beliefs. After the training they answered questionnaire 2 on the support of educative curriculum materials. In the week before and the week after the implementation all students took the pre- and post-test on the understanding of historical time. Just after the implementation all teachers answered questionnaire 3 on support of educative curriculum materials. We interviewed all teachers and observed them during one of the Timewise-lessons. One year later the teachers

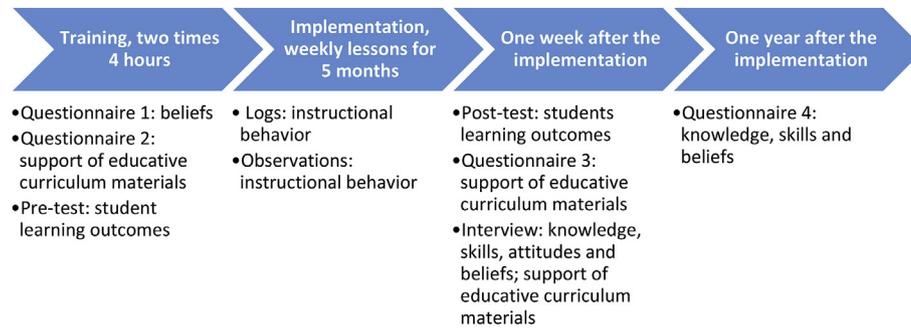


Fig. 2. Timeline of the PDP with the instruments that were used to answer the research questions.

answered questionnaire 4 on their knowledge, skills and beliefs before and since the PDP.

4.1. Participants

Between February and July 2015 eight teachers from grade 2 (ages 7–8) and eight teachers from grade 5 (ages 10–11) participated in this study. They taught in eight schools in towns and cities that belong to a partnership with a teacher training institute, in the South East of the Netherlands. The teachers had between 2 and 40 years of experience ($M = 17.13$, $SD = 14.44$); fourteen were female and two male (Table 1), which corresponds to the situation in the Netherlands where the majority of the teachers is female. The names in Table 1 are aliases.

189 students (89 boys and 100 girls) in grade 2 and 207 students (96 boys and 111 girls) in grade 5 were taught with the Timewise approach. Overall, the mean percentage of students with parents with a lower educational level (elementary school or basic vocational education) was lower than the national average of 10.9% (Dutch Inspectorate of Education, 2015a). However, in two grade-2 classes this percentage was higher: 16.7% in school 2 in Alice's class, and 50.0% in school 7 in Olivia's class.

The teachers' school directors asked them to participate in this study. All teachers had positive motives, either because they had a personal interest in history or because they wanted to improve their teaching, except for Andy in school 4, who participated just because his director asked him to. Five teachers (Jill, Olivia, Mary, Alice and Mabel) wanted to learn specifically how they could teach history in their grade-2 classes, and two grade-5 teachers (Vanessa and Rachel) participated because they were not satisfied with their current program for history.

The grade-2 teachers added the Timewise approach to their curriculum, since they did not teach history in their regular curriculum. Six grade-5 teachers added Timewise to their program next to regular history lessons. Two grade-5 teachers, Vanessa and Maureen, replaced the regular history lessons with the Timewise approach. Five teachers in grade 5 taught history through textbooks. Vanessa did not use her textbook anymore, because it had become outdated. Eve and Rachel taught history within integrated themes for social studies. Two grade-2 teachers (Jill and Olivia) also worked with themes for social studies, which did not include topics on historical eras, however. This represents the situation in the Netherlands, where for grade 1 and 2 (ages 6 to 8) history hardly features in the curriculum of most schools, and a majority of the schools teaches history through textbooks in grades 3 to 6 (ages 8 to 12). About 20% of all schools teach history as a part of social studies often integrated with civics, geography and science (Dutch Inspectorate of Education, 2015a; Wagenaar et al., 2010).

4.2. Instruments

Questionnaires: We administered four questionnaires to answer sub-questions 1 and 2. Questionnaire 1 contained three positive statements and one negative statement on beliefs on the teaching of historical time with a four-point scale. Questionnaire 2 contained closed and open questions on teachers' satisfaction about the educative curriculum materials that were presented and discussed in the training. In questionnaire 3 teachers could give their opinion on how the materials of the PDP were supportive in the implementation of Timewise. In questionnaire 4 teachers could indicate their feelings of competence before and since the PDP on ten statements about knowledge of and skills in teaching the

Table 1
Overview of participating schools, teachers and students.

School	Grade 2				Grade 5					
	Teacher characteristics			N students	% Low ed. parents	Teacher characteristics			N students	% Low ed. parents
	Name	Age	Expe-rience			Name	Age	Experience		
1	Mabel	25	4	21	4.8	Vanessa	26	4	30	0
2	Alice	60	36	24	16.7	Maureen	33	12	28	7.2
3	Maud	52	30	25	4					
4	Andy	59	38	24	4.2	Rose	62	40	27	0
5	Jill	34	11	41*	0	George	61	39	28	0
6	Claire	46	7	20	0	Eve	26	2	22	0
	Mary	34	10	22	0	Rachel	44	6	27	0
7	Olivia	31	8	14	50					
8						Emmy	52	22	27	7.4
						Chantal	26	5	18	5.6
Total	8			189		8			207	

Note: *This class was separated in two groups that each were taught for 2.5 months with the Timewise approach.

understanding of historical time, on a three-point scale (0 = not competent; 1 = a little competent; 3 = fully competent). They also answered the four statements on beliefs from the first questionnaire.

Logs. The teachers kept weekly logs in which they reported on the topic and the duration of the lessons and the objectives that were paid attention to. We collected a total of 141 logs from about 200 lessons, with a range of 3–15 logs per teacher (Mean 8.8; SD 3.7).

Observations. We observed all teachers for 30–45 min for their instructional behavior during one of the Timewise lessons. We asked them to give a lesson that was representative of how they taught the Timewise approach. During the observation we rated the frequency in which the teacher focused on the objectives on the understanding of historical time (1 = not or only once; 2 = repeatedly), and whether the teacher did or did not engage students actively in learning activities on the objectives. All observations were videotaped with the teachers' consent.

Interviews. At the end of the PDP the first author conducted semi-structured interviews with all teachers to get more in-depth information about teachers' perceptions of the support of the materials of the PDP, and of changes in attitudes and beliefs, and gains in knowledge and skills (sub-questions 1 and 2). We asked questions about the use of the instruction manual and the timeline (prescriptions), the use of stories, pictures and videos (strategies), and new insights into the teaching of historical time. The interviews were audiotaped with the teachers' consent and there were member checks on the transcriptions.

Pre- and post-test. We measured students' learning gains through a pre-/post-test design (sub-question 4). This test had been developed in a previous study (De Groot-Reuvekamp, Ros, Van Boxtel, & Oort, 2017) and validated through consultation with experts, interviews with students, and a trial with 135 students, whereas a final version was conducted with 1457 students of grades 3–8 in seven schools. The test consisted of 26 (grade 2) and 32 (grade 5) multiple-choice items related to the five objectives of historical time. For grade 2 the questions dealt with emergent and initial understanding, for grade 5 with initial and continued understanding. An example of a grade-2 question on the objective of sequencing is a question in which students were given four pictures of buildings and had to tick the box for the correct chronological sequence (a Roman temple, a mediaeval castle, a town hall from the 17th century and a factory from the 19th century). An example for grade 5 on the objective of comparing characteristics of historical periods was a question in which students were given a picture of people working in a textile factory in 1870 for which they had to identify that steam power was new at this time. This test was used as a pre-test just before the start of the intervention and as a post-test one week after the intervention.

Cronbach's alphas for the pre and post-test were .64 and .72 for grade 2 ($n = 337/346$) and .60 and .67 for grade 5 ($n = 421/427$).

4.3. Data analysis

We conducted calculations of means on the items in the questionnaires for sub-question 1 and 2. Because of the small number of participating teachers, it was not possible to investigate whether differences between teachers were statistically significant. We coded the interviews in Atlas-ti, with codes for the educative curriculum materials and the four supportive methods (Kennedy, 2016). Examples of codes were: use of the instruction manual and use of the timeline (prescriptions); use of stories, pictures and videos (strategies); insights into the learning of historical time. We marked representative quotes.

To answer sub-question 3, we calculated percentages for the

number of Timewise lessons in which teachers focused on the objectives, as reported in teachers' logs. With respect to the observations the first researcher rated sixteen observations, and subsequently a teacher trainer from another faculty for teacher training rated four videos, using the same protocol. This resulted in a Cohen's Kappa of $\kappa = .77$. For each objective the percentages of teachers who repeatedly focused on the objective was calculated, as well as the percentages of teachers who actively engaged their students.

To answer sub-question 4 (learning gains in grade 2 and 5) we made an overview per teacher of the mean student learning gains, resulting from the pre- and the post-test.

5. Results

5.1. How did teachers perceive the support of educative curriculum materials provided by the PDP?

Immediately after completing the training, all teachers answered to closed questions in questionnaire 2 that they had received sufficient support to implement Timewise in their classrooms, and that they had gained sufficient insights into the Timewise approach. Eight teachers added remarks such as "Instructions were clear" and "We received excellent materials to work with".

Table 2 shows teachers' opinions on the usefulness of the educative curriculum materials during the implementation of Timewise (questionnaire 3). Teachers of both grade 2 and 5 were very satisfied with the lesson formats in the instruction manual and on the website, as well as with the theoretical background knowledge and the materials to stimulate students' learning. For the different curriculum materials, the average satisfaction scores were above 3.8 on a five-point-scale with highest averages on the usefulness of the large classroom timeline (4.75) and theoretical background knowledge (4.63) for teachers in grade 5. Teachers in grade 2 reported the highest average satisfaction on the videos (4.50).

In the interviews after the implementation all teachers reported to use the large classroom timeline and twelve teachers preferred this timeline over the digital timeline, because, as Vanessa (grade 5) said: "the classroom timeline is always visible, which is also useful to refer to during other lessons" to which Mabel (grade 2) added: "the digital timeline only represents a part of the timeline". Furthermore, all teachers confirmed their satisfaction with the instruction manual. Twelve teachers could easily integrate the Timewise approach into their daily practice. They appreciated that the preparation took relatively little time (between ten and 30 min per lesson) because, as Mabel explained: "the manual is very clear and pictures are also there, so I know exactly which pictures I can use". All teachers gave the Timewise lessons at a fixed time in the week, except for Emmy in grade 5, who gave the lessons at different moments. Afterwards she thought that this could have been confusing for the students. Teachers in combined classes and teachers who taught social studies with fixed themes (Jill and Olivia in grade 2 and Eve and Chantal in grade 5) expressed during the interviews that they found it difficult to fit the Timewise lessons into their weekly program.

Finally, eleven teachers mentioned that they became enthusiastic about the materials during the implementation of Timewise. Olivia (grade 2) said: "History has never been my favorite. But in this way, with these stories and so on, I really enjoyed giving the lessons, because the students were always very fascinated". Vanessa (grade 5) also enjoyed working with the Timewise materials, because: "I noticed that it kept the students busy throughout the day". Furthermore, several teachers mentioned that they were motivated by positive reactions from parents and by the fact that students

Table 2
Teachers' satisfaction about the support of educative curriculum materials (n = 16).

	Grade 2 (n = 8)		Grade 5 (n = 8)	
	Mean*	SD	Mean*	SD
1. Lesson formats in the instruction manual	4.38	.74	4.25	.71
2. Materials on the website (e.g. lesson formats and power points)	3.88	.64	4.37	.74
3. Digital materials for the IWB	3.50	.76	4.00	.76
4. The large classroom timeline	4.00	1.31	4.75	.46
5. The stories to read	4.38	.74	3.88	1.36
6. The pictures	4.25	.47	4.25	.46
7. The videos	4.50	.54	4.13	1.36
8. Theoretical background in instruction manual	3.88	.64	4.63	.52

Note: *Means of answers on a five-point scale from "very unsatisfied" to "very satisfied".

bought the story book or borrowed it from the library to read the stories at home.

5.2. Which changes in their beliefs and attitudes, and gains in knowledge and skills did teachers perceive?

At the start of and one year after the PDP the teachers responded on four statements about **beliefs** about students' development in and the teaching of the understanding of historical time. Two teachers are missing: one teacher passed away and one teacher did not fill in questionnaire 4. The first statement was based on older theories and therefore negative. Table 3 shows that teachers from grade 2 as well as grade 5 most obviously changed their beliefs on the statement about students from the age of 5 being able to put different pictures of everyday life in the correct chronological order (statement 2). Teachers in grade 2 as well as in grade 5, still agreed to some extent after the PDP, although less than before, that learning the vocabulary of daily time is conditional for learning the vocabulary of historical time.

In the interviews ten teachers explained that they had changed their beliefs about students' development in the understanding of historical time through the implementation of Timewise. Six grade-2 teachers experienced that their students could learn more about history than they would have expected, and four grade 5 teachers had similar experiences with regard to students' understanding of political and economic characteristics of historical eras and with change and continuity. Furthermore teachers became convinced of the importance of the classroom timeline, as for instance Mary (grade 2) experienced that her students could very well place pictures on the classroom timeline and Andy and Olivia (grade 2) who noticed that their students also made connections with the timeline in mathematics and language lessons. Grade-5 teachers mentioned similar experiences, as George explained: "I became

convinced that it works well to start with the classroom timeline", and Rose remarked: "The students reacted very positively, they now have a better understanding of the eras and of dates and centuries".

About changes in **attitudes** all teachers reported that they had more consciously paid attention to the objectives of the understanding of historical time. Seven teachers particularly mentioned the use of the timeline, and the chronological sequence of eras. As Vanessa (grade 5) explained: "I now realize how important chronological order is. We used to take out one era, which was quite nice, but you need to have the whole overview to see where the era belongs and how much time was before and after. You need the timeline".

In questionnaire 4, administered one year after the PDP, the teachers reported in ten statements how competent they felt about **knowledge and skills** before and since the PDP. Four teachers are missing, because of several reasons. Table 4 shows that before the PDP teachers felt not to a little competent in their knowledge of and skills for the teaching of historical time, whereas since the PDP all teachers felt competent. All teachers felt themselves fully competent in the use of the timeline in history lessons since the PDP; teachers of grade 2 reported most progress.

In the interviews seven teachers confirmed that the PDP had provided them with more knowledge and skills on how to use the timeline: Olivia and Andy (grade 2) and George, Emmy, Rose, Vanessa and Chantal (grade 5). In Chantal's words: "Before, we never had a large classroom timeline; this gives the children the opportunity to always look back, what it looked like and how it started". Finally, several teachers said that they had gained more content knowledge about the ten eras because of the PDP, as Chantal (grade 5) explained: "I now have a clearer overview of the historical eras. This had never been explained to me very inspiringly. I remembered only very little. I am now much more aware of what I am doing and I have learnt a lot myself".

Table 3
Teachers' beliefs about the teaching of the understanding of historical time before and one year after the PDP (N = 14).

Statements on the teaching of historical time*	Grade 2 (n = 7)		Grade 5 (n = 7)		Mean total N = 14	
	Start PDP	After 1 year	Start PDP	After 1 year	Start PDP	After 1 year
1. Learning the vocabulary of daily time (clock and calendar time) is conditional for learning the vocabulary of historical time (the past, long ago, dates, etc).**	4.00 (.00)	3.29 (.95)	3.71 (.49)	3.43 (.54)	1.14 (.36)	1.64 (.75)
2. Students from the age of 5 are able to put pictures of everyday life in different historical periods in the correct chronological order.	2.00 (1.00)	3.29 (.76)	2.57 (1.13)	3.29 (.49)	2.29 (1.07)	3.29 (.61)
3. Students in grade 5 (ages 10/11) should be able to place the ten historical eras in the correct chronological order.	3.29 (.76)	3.86 (.38)	3.57 (.54)	3.86 (.38)	3.43 (.65)	3.86 (.36)
4. In each classroom there should be a large class timeline.	2.86 (1.07)	3.00 (.82)	3.14 (1.07)	3.71 (.49)	3.00 (1.04)	3.36 (.75)

Notes:

*Means of answers on a four-point scale from totally disagree to totally agree. SD between brackets.

**The first statement is negative, because it is based on older theories.

Table 4

Mean results of teachers with regard to their feeling of competence in knowledge and skills for teaching the understanding of historical time, before and since the PDP (n = 12).

Knowledge and skills*	Grade 2 (n = 5)**		Grade 5 (n = 7)**	
	Before	Since	Before	Since
1. Engage students to use the vocabulary of time.	2.20 (.45)	2.80 (.45)	2.43 (.54)	2.86 (.38)
2. Engage students to work with chronological sequences.	2.00 (.00)	2.60 (.55)	2.00 (.58)	3.00 (.00)
3. Use the classroom timeline during history lessons	1.80 (.84)	3.00 (.00)	2.14 (.90)	3.00 (.00)
4. Use the classroom timeline during other lessons	1.20 (.45)	2.20 (.45)	1.71 (.76)	2.57 (.54)
5. Use the digital timeline during history lessons	1.00 (.00)	2.00 (.71)	1.14 (.38)	2.00 (.00)
6. Engage students in identifying characteristic features.	2.00 (.00)	2.60 (.55)	1.71 (.49)	2.71 (.49)
7. Engage students in identifying continuity and change.	2.00 (.00)	2.80 (.45)	1.43 (.54)	2.29 (.49)
8. Find and use pictures that visualize characteristics of an era.	2.20 (.45)	2.80 (.45)	1.71 (.49)	2.43 (.54)
9. Find and use videos that visualize characteristics of an era.	2.00 (.71)	2.67 (.52)	2.29 (.76)	2.71 (.49)
10. Find and use stories that visualize characteristics of an era.	1.67 (.82)	2.33 (.52)	2.00 (.58)	2.86 (.38)

Note: *1 = Means of answers on a three-point scale: 1 = not competent; 2 = a little competent; 3 = fully competent. SD between brackets.

5.3. To what extent did teachers implement the instructional behavior aimed at?

The observations showed that, although we offered the teachers the opportunity to select teaching methods and learning activities, they used the educative curriculum materials according to the suggestions in the training. All teachers generally followed the lesson format described in the instruction manual. Most teachers started a lesson with a short review of the previous lesson. Emmy (grade 5) for instance asked her students to write down what they remembered of the previous lesson about the era of Monks and Knights. All teachers engaged their students in using the names of eras and in grade 5 also in the use of dates. Furthermore, all teachers used the classroom timeline: often at the start, like Claire, who started and ended her lesson about castles in the Middle Ages with referring to the timeline and having the students attach a picture of a castle to the classroom timeline. All teachers read a story from the storybook and showed a short video. This was followed by a classroom discussion about characteristics of the era, in which they used the exemplary questions in the instruction manual and encouraged students to make comparisons with other eras and with the present.

Differences in the use of the materials consisted predominantly of the length of the video fragments; sometimes teachers chose to show the whole video instead of just the advised fragment.

The observations were confirmed in the logs and the scores on teachers paying attention to the objectives and actively engaging students during the observed lessons.

Table 5 shows that teachers logged that they had focused on all five objectives in most of the lessons. All teachers in grade 2 and grade 5 reported that they had used the classroom timeline in every Timewise lesson. On the basis of data from the observed lessons, Table 5 also shows that more than three quarters of the teachers repeatedly paid attention to the objectives, except for the objective

of “working with chronological sequences”, to which only 38% of the teachers repeatedly paid attention, in grade 2 as well as grade 5. About active student engagement in the observed lesson, Table 5 shows the highest percentages on the objective of “the use of the vocabulary of historical time” and the lowest on “working with chronological sequences” and “identifying continuity and change”.

Table 6 presents teachers’ individual instructional behavior as measured in logs and observations. For grade 2, the results with respect to the attention paid to the objectives in the logs more or less corresponded to the observations. Most teachers repeatedly paid attention to the objectives in 75%–100% of their Timewise lessons. Only Claire and Mary reported lower percentages in their logs.

For grade 5, all teachers, with the exception of Maureen, reported in their logs to have paid attention to the objectives in all Timewise lessons. The observations confirmed that most grade-5 teachers repeatedly paid attention to the objectives, in which they actively engaged their students. Only Eve and George hardly engaged their students in activities to reach the objectives.

5.4. Which student learning gains were realized by the teachers?

Table 7 shows the mean student learning gains per teacher, as calculated from the differences between the pre- and post-test on the understanding of historical time. The overall mean learning gains were 3.96 for grade 2 and 3.94 for grade 5. Paired sample *t*-tests (two-tailed) showed that for all teachers, except for Eve (grade 5), the learning gains were significant (Table 7).

In grade 2, the students of three teachers with the lowest learning gains (Jill, Olivia and Claire) showed lower scores on the pre-test than the students of the other grade-2 teachers. Claire and Olivia also reported in their logs (Table 6) that they had paid less attention to the objectives, whereas Jill reported having paid 100% attention to the objectives. The two teachers with the highest

Table 5

Instructional behavior as reported in 141 logs and observed in one lesson in percentages (n = 16).

Objectives Engage students to:	Grade 2 (n = 8)			Grade 5 (n = 8)		
	Logs*	Observed behavior**		Logs*	Observed behavior**	
		Lessons	Focus on objectives		Student engagement	Lessons
1. Use the vocabulary of time	95 (9.24)	88	63	100 (.00)	100	50
2. Work with chronological sequences	78 (36.44)	38	13	99 (3.90)	38	13
3. Use the classroom timeline	100 (.00)	75	50	100 (.00)	75	50
4. Identify characteristic features of historical eras	92 (10.92)	88	38	100 (.00)	100	63
5. Identify continuity and change	78 (33.34)	88	13	97 (7.78)	88	38

Notes:

*Logs report percentages of Timewise lessons in which teachers focus on this objective. SD between brackets.

**Observations report percentages of teachers who repeatedly focused on the objective and who actively engaged students in learning activities with regard to the objective in the observed lesson.

Table 6
Individual teachers' instructional behavior in observations and logs (n = 16).
- Objectives: mean of the scores on the 5 objectives for the extent to which teachers focused on the objectives (1 = not or only once; 2 = repeatedly).
- Students' engagement: mean of the scores to what extent teachers actively engaged students in reaching the objectives (1 = no engagement; 2 = active engagement).

Instructional behavior Grade 2				Instructional behavior Grade 5			
Teachers	*Observations		**Logs	Teachers	*Observations		**Logs
	Objectives	Student Engagement	Objectives		Objectives	Student Engagement	Objectives
Jill	1.6	1.2	100	Eve	1.4	1.0	100
Claire	1.6	1.2	70	George	1.6	1.0	100
Olivia	1.8	1.4	76	Emmy	1.8	1.6	100
Maud	1.8	1.2	97	Rose	1.8	1.6	100
Andy	1.8	1.2	99	Vanessa	1.8	1.6	100
Alice	1.8	1.6	100	Rachel	1.8	1.4	100
Mabel	1.8	1.6	100	Chantal	2.0	1.6	100
Mary	2.0	1.4	68	Maureen	2.0	1.6	93

Notes:

*Observations:

**Logs: Mean percentages of Timewise lessons in which teachers focused on the five objectives.

Table 7
Mean student learning gains resulting from the difference between pre- and post-test and the time teachers spent on Timewise and regular history lessons (n = 16).

Teacher	Grade	Mean Pre-test*	Mean Post-test*	Mean Learning gain	Standard Deviation	Sign.	Time on Timewise**	Time on history next to Timewise**
Jill	2	12.90	15.33	2.43	4,07	,001	30	0
Olivia	2	11.00	14.08	3.18	3,31	,010	30	0
Claire	2	12.17	15.56	3.39	3,40	,001	20	0
Maud	2	15.00	18.90	3.91	3,83	,000	45	0
Mary	2	14.86	18.95	4.10	2,79	,000	45	0
Andy	2	14.50	19.08	4.58	3,39	,000	30	0
Alice	2	15.08	20.04	4.96	2,66	,000	35	0
Mabel	2	14.76	19.90	5.14	3,50	,000	35	0
Eve	5	19.05	19.68	0.63	4,15	,516	20	15
George	5	20.71	23.39	2.68	3,70	,001	40	45
Emmy	5	18.85	22.11	3.26	3,82	,000	40	45
Rose	5	20.11	24.33	4.22	3,39	,000	40	30
Vanessa	5	17.04	21.89	4.86	4,21	,000	50	0
Rachel	5	16.19	21.08	4.89	3,18	,000	40	15
Chantal	5	20.11	25.28	5.17	2,75	,000	35	45
Maureen	5	17.90	23.70	5.80	3,18	,000	45	0

*The test for grade 2 consisted of 26 items and for grade 5 of 32 items.

**time per week in minutes.

student learning gains (Mabel and Alice) also showed the highest results on their instructional behavior in the observation (Table 6). In grade 5, Eve's students hardly made any progress. The two teachers with the highest student learning gains in grade 5 (Chantal and Maureen) showed the highest results on their instructional behavior in the observation (Table 6).

Table 7 also shows that teachers who spent more time on history, because they gave regular history lessons in addition to Timewise, did not necessarily reach higher learning gains. In grade 2, teachers did not give extra history lessons in addition to Timewise lessons. However, teachers who spent 45 min on Timewise (Maud and Mary) did not reach higher learning gains than teachers who spent 35 min (Alice and Mabel). In grade 5 most teachers spent extra time on history, because they gave Timewise lessons alongside their regular history lessons. Two grade-5 teachers (George and Emmy) spent more time on history lessons (85 min in total) than most other teachers, but their learning gains were below average. The two grade-5 teachers who did not give regular history lessons in addition to Timewise (Vanessa and Maureen) reached learning gains above average.

6. Discussion

The present study examined which components of a PDP on improving elementary school students' understanding of historical

time were relevant for the success of the PDP, which resulted in a significant improvement of learning outcomes of students in grade 2 and 5.

We based the design, implementation and evaluation of the PDP on the "theory of improvement" (Desimone, 2009; Van Veen et al., 2012; Wayne et al., 2008), which is represented in the model for PDPs in Fig. 1 (Desimone, 2009). Apart from design features of this model, such as content focus, active learning, and coherence, design features of the PDP in our study were based on theory about educative curriculum materials (Ball & Cohen, 1996; Davis & Krajcik, 2005; Davis et al., 2017; Remillard, 2005). Findings showed that teachers highly valued the educative curriculum materials of the PDP, which consisted of background information for teachers, and materials to stimulate students' learning. It seems that teachers' motivation to work with the curriculum materials played an important role in the success of this PDP. From the beginning of the training teachers were enthusiastic about the quality of the materials. During the implementation their motivation grew, because they experienced that the Timewise approach was meaningful for their students. Furthermore, we gave teachers autonomy to apply the materials as they thought suitable for their situation. This also enhanced their motivation and their feelings of competency, which is in line with the self-determination theory (Deci & Ryan, 2008; Ryan & Deci, 2000).

Nevertheless, the PDP did not match requirements of a

minimum of 20 h of contact time, (Desimone, 2009; Opfer & Pedder, 2011; Van Veen et al., 2012). Considering the small amount of time that was devoted to the training (8 h), the effects of Timewise on students' learning gains were remarkable. This might be explained by the focus of the training, which was predominantly on the explanation and exploration of the educative curriculum materials, which teachers could apply in their classrooms fairly quickly after the training. While using these materials, teachers could actively engage their students in activities on the objectives on the understanding of historical time, in which the timeline supported them in particular. During the implementation teachers weekly sent a log to the researchers and they knew that they would be observed and interviewed. These measurements might additionally have contributed to teachers' motivation to implement Timewise according to the prescriptions and strategies (Kennedy, 2016) that were provided in the training.

Throughout the implementation of Timewise, students' achievements appeared to have led to changes in teachers' beliefs and attitudes, especially on the importance of using the classroom timeline. On the other hand, the belief that learning clock and calendar time is conditional for learning about historical time, appeared to be rather persistent. As previous studies have indicated, this might have been caused by teachers presuming that the understanding of dates is a requirement for the understanding of historical time, whereas these studies also showed that young students are able to understand historical time without using dates (Barton & Levstik, 1996; Harnett, 1993; Hoge & Foster, 2002; Levstik & Pappas, 1987). Findings about increasing teachers' knowledge and skills showed that one year after the PDP all teachers still felt competent in their knowledge and skills in the teaching of historical time, particularly in the use of the classroom timeline, which in several empirical studies has proven to be effective in enhancing students' understanding of historical time (Hodkinson, 2003; Masterman & Rogers, 2002; Prangmsma, Van Boxtel, & Kanselaar, 2008).

With regard to the positive effects of Timewise, it could be argued that learning gains might have improved because of the extra time teachers spent on history, since six grade-5 teachers gave extra history lessons, which were part of their regular textbook program (Table 7), in addition to the Timewise lessons. In the analyses in our previous study, we found a small but significant effect for the time teachers spent on Timewise and history lessons (.03 for grade 2 and .02 for grade 5). However, even when taking this effect into account, the effect of Timewise on students' understanding of historical time remained significant (De Groot-Reuvekamp, Ros, & Van Boxtel, 2017). Apparently, time was not the most important factor to explain students' learning gains. Moreover, two grade-5 teachers (Vanessa and Maureen) who did not give extra history lessons in addition to Timewise, reached student learning gains above average (Table 7). This could be explained by the fact that both teachers scored high on repeatedly paying attention to the objectives and actively engaging their students (Table 6).

A factor that might additionally have contributed to the positive effect is that the PDP was carried out by the first author, a researcher who is familiar with the work of teachers. In their review studies Yoon et al. (2007) and Kennedy (2016) found this as a positive effect for successful PDPs. On the other hand, we are aware that the involvement of researchers in a PDP could lower the objectivity of the research, since it is the researcher who asks the questions, conceptualizes the study and interprets the data (Peshkin, 1988, 2000). Although we realize that subjectivity never can be excluded, we tried to diminish this as much as possible, by using a mixed-method approach, whose strength lies in the combination of quantitative and qualitative data. The more objective

data consisted of the results of the pre- and post-test, and of questionnaires. For the analysis of the observations, we included inter-rater reliability. For the interpretation of the interviews, we tried to diminish subjectivity by discussing the analysis between the co-authors.

We will conclude this section with some limitations of the present study. Firstly, the sample of teachers was rather small and not randomly selected. A drawback of the small sample was that it was difficult to apply statistical analyses to investigate whether differences between teachers' behavior and students' learning outcomes were statistically significant. Future more large-scale research could enable measurements of statistical significance through which more robust results can be reached to draw conclusions on what works in PDPs. A second limitation concerns the data collection that for the largest part relied on teachers' self-reports in logs, questionnaires and interviews. Although a combination of questionnaires, interviews and observations is recommended as a valid form of measurement to investigate effects of PDPs (Desimone, 2009), we observed only one lesson per teacher. Despite our asking the teachers to give a representative lesson, their behavior could have been different from other Timewise lessons. On the other hand, the findings from different data collections in this study largely were in line with one another, which contributed to the validity of the findings. Finally, the present study focused on participation of teachers of grades 2 and 5. Future research might broaden the focus to other grades and investigate the effects of a PDP with coaching and collective participation of whole school teams. Another avenue for future research would be to investigate the effect of replacing textbook lessons by Timewise.

7. Conclusion

Whereas most studies on PDPs focus on changes in teachers' behavior, the present study included all components of Desimone's (2009) framework for PDPs, and it confirmed that the interplay between *design features, changes of teachers' attitudes and beliefs, increased knowledge and skills and change in instruction* leads to improved *student learning outcomes*.

The positive effects of Timewise on students' learning gains were remarkable, moreover since relatively little time (8 h) was devoted to the actual training of teachers. The focus of this training was on educative curriculum materials, which consisted of materials for teachers to apply in their teaching; background information on subject matter knowledge and on students' development in the learning of historical time; and materials to stimulate students' learning. The clear explanation of the Timewise materials during the training seemed to have enabled the teachers to implement Timewise according to the prescriptions and strategies. These findings contribute to the review study of Kennedy (2016) that supportive methods can be effective in enabling teachers to implement a new teaching approach in their classroom. Furthermore, findings correspond with conclusions of earlier studies that educative curriculum materials are an important factor for the success of PDPs (Ball & Cohen, 1996; Cohen et al., 2003; Davis & Krajcik, 2005; Davis et al., 2017; Lampert, 2012).

Additionally, the present study builds on the self-determination theory (Deci & Ryan, 2008; Ryan & Deci, 2000), which emphasizes the need of autonomy and competence to enhance motivation. Although the teachers in this study volunteered to participate, mostly because of a personal interest in the subject of history, their intrinsic motivation seemed to have grown during the implementation of Timewise. This increase in motivation may have been caused by their enthusiasm for the practical and user-friendly materials, which in turn stimulated enthusiastic reactions of students. Moreover, the curriculum materials offered teachers the

autonomy to give Timewise lessons in addition to or instead of regular history lessons, and choices in teaching methods and learning activities. On the other hand, the Timewise approach had a clear structure, consisting of lesson formats in which the objectives were clearly formulated, based on the operationalization in the developmental model of De Groot-Reuvekamp, Ros, Van Boxtel, & Oort (2017) and De Groot-Reuvekamp, Ros, & Van Boxtel, (2017). This structure, next to the possibility of always being able to consult the materials for background information, may have supported teachers' feeling of competence.

Finally, the implementation of Timewise offered teachers experiences that appeared to have changed their beliefs and attitudes about (young) students being able to learn about historical time. Findings showed that student learning gains were higher for those teachers who repeatedly engaged their students in learning activities on the objectives, such as applying the vocabulary of time, identifying characteristic features of eras and working with the timeline. One year later, teachers still felt competent about their knowledge and skills in the teaching of historical time.

Summarizing, recommendations from the PDP in the present study would be that it is important to provide teachers with attractive and user-friendly educative curriculum materials and clear prescriptions and strategies, within a structure that supports their feelings of competence and gives room for autonomy.

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