FACULTY OF BEHAVIOURAL SCIENCES

TEACHER ROLES AND PUPIL OUTCOMES

IN TECHNOLOGY-RICH EARLY LITERACY LEARNING

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UNIVERSITY OF TWENTE.

TEACHER ROLES AND PUPIL OUTCOMES IN TECHNOLOGY-RICH EARLY LITERACY LEARNING

Amina Cviko

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DISSERTATION

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born on the 20th of May, 1981

in Sarajevo, Bosnia and Herzegovina

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This dissertation has been approved by the promotors and assistant promotor

To my father

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Amina Cviko,
Enschede, 2013

CHAPTER 1
Introduction

This chapter introduces the dissertation about teacher roles in the design and implementation of technology-rich learning activities for early literacy. Following the research context, the factors examined in this study are described. In this way, the chapter explains why specific roles for teachers in the design and implementation of technology-rich curricular activities for early literacy were investigated. This chapter ends by stating the research questions and describing the research methodology.

1.1 THE DISSERTATION: A STUDY ABOUT TEACHER ROLES

This dissertation is concerned with three roles for teachers in enabling information and communications technology (ICT)-rich early literacy learning: executor-only, re-designer, co-designer. The executor-only role involved teachers in implementing ready-to-use ICT-rich early literacy activities. The re-designer role and the co-designer role each involved teachers in designing activities before implementing them. In the re-designer role, teachers collaboratively adapted ready-to-use activities and materials for their current curriculum. In the co-designer role, teachers collaboratively designed completely new learning activities and materials for their classes. The executor-only role requires teachers to invest time and effort in implementation, the re- and co-designer roles require teachers to invest their time and efforts in collaborative design as well as implementation.

The role differentiation is based on the premise that teachers' involvement in curriculum design can influence curriculum implementation, and in so doing, influence pupil learning outcomes. When the use of ICT is planned, structured and integrated effectively by teachers, an ICT-rich learning environment can contribute to pupil's literacy attainment (Higgins, 2003). Participation by teachers in curriculum design activities, such as engaging in aligning a new curriculum unit with existing curriculum and classroom activities can contribute to curriculum implementation (Penuel, Fishman, Yamaguchi, & Gallagher, 2007) and to improved student learning outcomes (Fishman, Marx, Best, & Tal, 2003). Also, teacher involvement in curriculum design can create a sense of co-ownership in teachers towards the curriculum (Fullan, 2003). The investments teachers are willing to make in implementing innovating curricula (e.g. as is the case with activities for ICT-rich learning) are particularly influenced by their perceptions concerning three elements of curriculum practicality: the effort required and the benefits gained i.e. cost-benefit ratio; how well innovation is specified i.e. instrumentality; and alignment with classroom needs i.e. congruence (Doyle & Ponder, 1978). Also, teacher perceptions about teaching/learning, ICT and subject matter can influence implementation of ICT-rich curricula (Niess, 2005; Tondeur, Valcke, & Van Braak, 2008b;).

Several assumptions underlie the studies reported in this dissertation about teacher roles in the design and implementation of ICT-rich learning activities. First, an active role in design of ICT-rich learning activities positively influences classroom implementation. Second, teacher perceptions about teaching/learning, ICT, early literacy influence implementation of ICT-rich learning activities. Third, curriculum implementation influences pupil learning outcomes.

Teacher involvement in curriculum development can foster curriculum implementation (Carl, 2005; Fullan, 2003;). Specifically, teachers participating in designing together curricular activities (e.g. opportunities for classroom activities) can contribute to improved classroom practice (Garet, Porter, Desimone, Birman, & Yoon, 2001). Yet such work can be conducted in many ways. Teacher involvement in curriculum design can take various forms, necessitating different tasks and effort while creating and using activities and materials. Different forms of teacher involvement in curriculum design can have a differential impact on teachers' sense of co-ownership, perceptions about the practicality of curriculum activities, and curriculum implementation and attainment. The problem underlying this study is the need for understanding various forms of teacher involvement in designing ICT-rich learning activities and how they contribute to implementation of ICT-rich learning and pupil learning outcomes. This study focuses on forms of active involvement in curriculum design (roles) and the question of whether a particular one is optimal for teachers and pupils.

Specific forms of active involvement during design are shaped by the aforementioned teacher roles (executor-only, re-designer, co-designer). These roles, together with teacher perceptions, are likely to influence how teachers integrate ICT-rich learning in their classrooms. For this study, effectiveness of ICT-rich learning environment (ICT-rich learning activities PictoPal) is defined in terms of pupil learning outcomes. With the aim of discovering the comparative benefits and drawbacks of each role, the study examined teacher perceptions, classroom implementation and pupil learning outcomes, in and across each role. The research question guiding the study was:

"Which teacher role (executor-only, re-designer, or co-designer) contributes most to the effectiveness of an ICT-rich learning environment for early literacy?"

The research question was addressed in four sub-studies. Three studies focused on a particular teacher role (executor-only, re-designer, or co-designer) and a cross-case study focused on the comparative differences across the three teacher roles. Taken together, this study examines the impact of teacher roles on implementation of ICT-rich activities and pupil learning outcomes in the context of early literacy learning.

1.2 CONTEXTUALIZING THE STUDY

1.2.1 Early literacy development of young children

The importance of early literacy has been long-established by research and endorsed by experts. Literacy skills involve the ability to communicate by means of reading and writing (Verhoeven & Aarnoutse, 1999). Children need literacy skills to successfully participate in their educational careers and society. In the Netherlands, primary school education promotes literacy acquisition in children aged 4-12 years. During the first two years of Dutch primary education, 4-6-year-olds develop early literacy skills. Early literacy refers to development of oral language (speaking, listening), written language (reading and writing, often in combination with pictures and scribbling), and conceptual skills (Cooper, 1993). The Dutch reference framework identifies four language domains for primary education (1) Verbal language skills: conversation skills, listening and speaking; (2) Reading skills; (3) Writing skills; and (4) Concepts (Expertisecentrum Nederlands, 2010). Each of these language domains are represented in the national attainment targets for kindergarten literacy: (1) functional reading and writing (2) functions of written language (3) relationship between spoken and written language, (4) language awareness, (5) book orientation, (6) technical reading and writing, (7) reading comprehension and writing, (8) story concepts and (9) alphabetical principle (phoneme-grapheme link).

The formulation of the attainment targets for literacy and language education aims to support teachers in developing their early literacy curricula (Verhoeven & Aarnoutse, 1999). This implies that early literacy curricula should address a broad array of early literacy skills. According to Justice and Pullen (2003) teachers should view early literacy as an integrated package of areas of skills and focus equally on written and oral behaviours in young children, including, for instance, understanding the function and form of print and the relationship between oral and written language. Over-emphasis on one aspect of early literacy skill can limit teachers' views of the broader picture (Elster, 2010). According to McKenney, Bradley, and Boschman (2012), a narrowed view about early literacy may lead to curricula which over-emphasize pre-reading skills (e.g. letter-sound linkage and technical reading), and under-emphasize writing abilities, and conceptual development. According to Snow (2006), the essence of operating literately is not simply the operation of the various components, but the process of constructing meaning; she argues that instruction should not focus on the components without linking them to the central purpose. From their observations of early literacy classroom practices, Neuman and Roskos (2005) suggest that generally young children are subjected to a narrow, limited curriculum, for instance targeted to basic sounds and letter skills. Snow (2006) identified a concern that children at risk are likely to be provided pre-reading skills focused instruction that fails to emphasize meaning, as a result of a limited view about early literacy. Justice and Pullen (2003) recommend early literacy activities that address both written language and phonological awareness, including meaningful opportunities for knowledge attainment as well as explicit exposure to key concepts. Also, Neuman and Roskos (2005) recommend a supportive learning environment with a wide variety of reading and writing resources that actively build language and conceptual knowledge, and instruction that integrates meaningful learning with foundational skills.

1.2.2 Technology integration

The potential of ICT-applications to support early literacy development in children aged 4-6 has been demonstrated through prior research. For example by story books on the computer, which combine multimedia and interactive additions that support aspects of literacy (De Jong & Bus, 2003). When integrated with other activities, ICT has the potential to support children in learning key concepts and the functions of language (McKenney & Voogt, 2009). Segers and Verhoeven (2005) found that language games can stimulate early literacy skills in children, however because children engage in interacting with peers about their computer use, the authors suggested that the link between computer activities and classroom activities should be considered as a factor influencing pupil early literacy learning outcomes. Experts agree that teachers should address early literacy in developmentally appropriate ways, integrating technology to support the meaningful learning (International Reading Association, 2009).

Technology integration refers to incorporating technology in meaningful and authentic ways into the curriculum and day-to-day practices to support early literacy development of young children (McManis & Gunnewig, 2012). Nowadays, technology is present in everyday lives of young children. For instance, youngsters now regularly observe someone produce an on-screen text to convey a message for a communicative purpose. Technology-integrated activities in early literacy development can prepare children for using technology as a communication tool, for instance by writing with technology (Merchant, 2007). Niederhauser and Lindstrom (2006) found that technology-using kindergarten teachers perceive interactive activities with technology as a communication tool to yield good or successful implementation.

Primary schools have invested in applications of ICT, such as computers and educational software for teachers and pupils to promote effectiveness of teaching and pupil learning outcomes (Higgins, 2003). Research shows that ICT-integration into existing classroom practice by teachers is challenging (Turbill, 2001), and that teachers struggle to use computers in their classrooms effectively (Gimbert & Cristol, 2004; Merchant, 2007). According to Merchant (2007), little research answers teachers' questions on how to integrate ICT as a tool effectively. Technology-rich activities can be effective in kindergarten classes, only if teachers use technology in developmentally appropriate ways, offering pupils engagement that is fitting in terms of age, culture and individual needs (Parette, Quesenberry & Blum, 2010). While technology integration offers multiple opportunities to address a wide range of early literacy learning goals, doing so places high demands on teachers.

1.2.3 PictoPal

Through integrated computer- and classroom activities children can learn the functions of written language in meaningful ways. PictoPal refers to ICT-rich on- and off-computer activities for early literacy. PictoPal consists of eight on- and off-computer activities and focuses on supporting four national interim attainment target goals for early literacy: (1) functional reading and writing, (2) functions of written language, (3) relationship between spoken and written language, and (4) linguistic awareness. An example of a PictoPal on-computer activity is that children compose and print a list of ingredients using software featuring written and spoken words, and pictograms. Off-computer children then engage in a play activity to 'buy' the ingredients listed on the printed page (e.g. in the store corner of the classroom) in order to cook a dinner (e.g. in the kitchen area of the classroom). Figure 1.1 shows an example of an on-and off-computer activity in which children engage in writing a recipe and following it.

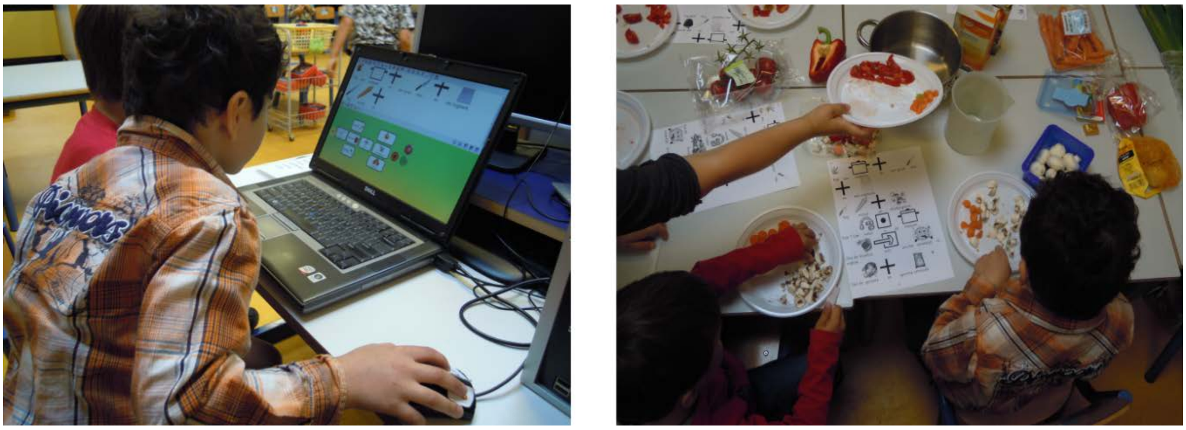

Figure 1.1 On-computer activity: Writing a recipe (left), Off-computer activity: Using the recipe to cook (right)

In using PictoPal, teachers focus on integrating activities to convey the purposes of language in a meaningful way and engage children in exploring the functions of written language themselves. In this way, teachers actively address interim goals concerning the functions of language. When teachers implement PictoPal on- and off-computer activities in integrated fashion, PictoPal can stimulate early literacy development in children and contribute to reaching the interim goals (McKenney & Voogt, 2009). Greater effects on pupil learning outcomes were found when teachers implemented PictoPal on computer activities together with other activities, than when teachers implemented PictoPal on computer activities only (Verseput, 2008a). The three teacher roles (executor-only, re-designer, co-designer) aim to support pupils' early literacy development by stimulating teachers in the integration of on- and off-computer learning activities.

1.3 THEORETICAL FRAMEWORK

1.3.1 Teacher involvement in curriculum design

Development of early literacy can be supported through technology-integrated curricula, yet the overall influence of technology on children's literacy development is determined by the teacher (Labbo & Reinking, 2003). It is the teachers who embrace, resist or try-out technology as a tool to support teaching and learning. Also, to successfully implement ICT-rich activities, teachers need to understand how to use teaching strategies with technology, why technology is important to young children and also show ability to use the technology and apply it in the classroom (Parette et al., 2010).

In the present study, an active role of teachers in designing ICT-rich learning activities is assumed to positively influence classroom implementation. Successful curriculum implementation further implies teachers to be actively involved in collaborative curriculum development (Carl, 2009). This section discusses key issues related to engaging teachers in collaborative curriculum design.

First, active participation in collaborative development of learning activities and materials can foster understanding of the curriculum (Crow & Pounder, 2000) and create a sense of co-ownership among participants (Fullan, 2003). Teacher involvement in collaborative design of curriculum materials can foster implementation of technology integrated curricula as well. Penuel, Fishman et al. (2007) found that teacher engagement in planning for implementation was significant for promoting implementation. Teachers need to be informed enactors of ICT-integrated curricula in order to implement curricula successfully. Collaborative curriculum development by teachers should feature hands-on opportunities and examples of technology-integrated lessons to support teachers to successfully integrate technology (Keengwe & Onchwari, 2009). Collaboration in teams and subsequent continuous support in early stages of implementation could help teachers understand to effectively implement curriculum materials in classrooms (Parette et al., 2010).

Second, co-ownership towards a new curriculum is considered an important factor for curriculum implementation because it seems to drive curriculum use and sustained curriculum change/reform (Fullan, 2011). According to Carl (2005, 2009) the teacher role as implementer of a curriculum, developed by curriculum specialists is detrimental to the teacher experience of taking ownership of a curriculum. Through involvement in curriculum development, teachers may experience ownership of the developed curriculum (Carl, 2009; Fullan, 2003; Kirk & MacDonald, 2001). Teachers' commitment, which can be seen as an indicator of teachers' sense of ownership towards new curriculum, has been shown to significantly account for variance in degree of curriculum use in the context of innovative curricula (Abrami, Poulsen, & Chambers, 2004).

Third, curriculum practicality is an important factor determining if teachers will implement an innovation. Involvement in design could influence teacher perceptions of practicality of the design, which in turn could influence curriculum implementation. Curriculum practicality involves three aspects: (1) how well a curriculum is specified, (2) how congruent a curriculum is with classroom, and (3) the ratio of effort required to benefits gained (Doyle & Ponder, 1978). This stance has also been corroborated through recent studies. Teachers' perceptions of costs, successful implementation, and the value of a curriculum determine for a part the actual curriculum use (Abrami et al., 2004). Also, a fit with existing classroom practice can be of influence on effective implementation (Abrami et al., 2004). De Grove, Bourgonjon, and Van Looy (2012) found that teacher perceptions of technology fitting the current curriculum are linked with teacher perceived intention to use technology. Teachers weigh off their investment in curriculum innovation in relation to the potential and actual benefits gained from it (Doyle & Ponder, 1978). When involving teachers in implementation of innovative curricula, teachers are often faced with considerations about how feasible a curriculum is to implement in their classrooms. To conclude, teacher involvement in curriculum design is assumed to be positively related to successful implementation of technology-integrated curriculum materials. In case of ICT-rich activities for early literacy, successful implementation refers to integration of on- and off-computer learning activities to support early literacy learning.

Teacher involvement during design could presumably be affected by teacher perceptions about their roles. Teachers who are able to adopt a particular role could be expected to perform well in that role. One's knowledge of the nature of a role in a team and the situation when a particular role should be adopted, is related to team member performance (Mumford, Van Iddekinge, Morgeson, & Campion, 2008). The following section addresses additional teacher perceptions that could influence design and implementation.

1.3.2 Teacher perceptions influence implementation

Teacher perceptions about teaching/learning, ICT, and early literacy are assumed in this study to influence curriculum implementation. Teacher perceptions are defined in this study as perspectives, experiences and personal feelings of teachers. Several studies showed that teachers' views on teaching/learning and ICT influence the way ICT-rich curricula are implemented (Tondeur et al., 2008b; Niess, 2005). Positive teacher perceptions of technology's influence on student achievement and classroom activities relate positively to technology integration (Inan & Lowther, 2010). What teachers perceive as appropriate for early literacy development in children may affect early literacy instruction (Neuman & Roskos, 2005). In case of ICT-rich activities for early literacy, the views teachers hold about technology, teaching/learning and the content of early literacy may affect how they implement technology-integrated activities for early literacy. It is plausible that teacher perceptions about teaching/learning, ICT, and early literacy also affect how ICT-integrated activities are designed. Consequently, designing activities can be positively or negatively shaped by perceptions teachers hold about teaching, learning, technology and early literacy.

1.3.3 Implementation and pupil learning outcomes

Pupil learning outcomes are commonly used as an indicator of effectiveness of a curriculum (Fishman et al., 2003). How teachers implement a curriculum influences pupil learning (Landry, Swank, Anthony, & Assel, 2011), and both the quantity of activities and the quality of implementation may explain pupil learning differences (Landry et al., 2011). The link between implementation of technology-integrated curricula and student learning outcomes is not always straightforward. Cheung and Slavin (2012) explored studies about implementation of ICT-rich literacy curricula and pupil learning outcomes. They reported that: poor implementation ratings were related to no effects in pupil outcomes; studies with medium and high implementation ratings were related to significant positive effects on pupil outcomes. However, Cheung and Slavin (2012) caution against attributing poor effects on pupil outcomes to poor implementation, because authors of these studies would be likely to ascribe no effects to poor implementation.

In studies involving teachers in curriculum development, varying results have been found with regard to the effects of implementation on pupil learning outcomes. A study of Lowther, Inan, Ross, and Strahl (2012) showed no significant differences in achievement between students whose teachers were involved in a program on how to use technology and implementation of technology integration and controls (teachers not involved). But, a study of Landry et al., (2011) involving teachers in implementation of a research-based curriculum accompanied with professional development activities showed improvement in children's early literacy skills. Also, a study of Block, Campbell, Ninon, Williams, and Helgert (2007) involving teachers in a program on how to use technology, found positive effects on pupil early literacy outcomes.

Based on these findings the connection between curriculum implementation and pupil learning outcomes is not so straightforward. Apparently, a clear notion of what implementation entails is necessary to better understand the relationship. This study explores how teacher roles in design and implementation contribute to effectiveness of ICT-rich activities (pupil learning outcomes). For this study, effectiveness of PictoPal (the specific ICT-rich learning activities) is defined in terms of pupil learning outcomes. Effective implementation of ICT-rich activities and materials is thus viewed as a necessary condition for positively affecting pupils' early literacy learning outcomes, though it does not guarantee positive results.

1.3.4 Teacher roles in curriculum design and implementation

As previously mentioned, this study involves teachers in three different roles: executor-only, re-designer and co-designer of PictoPal, and sets out to examine the effects of each role on the implementation of PictoPal and resulting pupil learning. In this section, each role is defined and justified.

The executor-only role involves teachers in implementing ready-made ICT-rich early literacy learning activities. The role of executor-only is a role teachers (most) commonly take, when they enact curricula designed by others (e.g. as in textbooks). Remillard (1999) showed that teachers engage in planning and fine-tuning activities according to the views teachers hold about teaching and learning in their classes. While not active in design, the role of executor-only does require that individual teachers engage in planning for implementation, as well as actual implementation.

The re-designer role involves teams of teachers in a purposeful act of adjusting ICT-rich activities and materials, to align with (and/or replace) the current curriculum used in their classes. Also, the re-designer role involves teachers in subsequent implementation. Redesigning ICT-rich learning activities in a team allows for sharing understanding of what must be revised, based on what teachers view important and feasible in their classes. The re-designer role for teachers implies that participation in re-design is assumed to positively affect implementation. This is because the collaborative re-design could create teacher understanding and co-ownership while also enhancing teachers perceptions about curriculum practicality and their role.

The co-designer role involves teams of teachers in designing and implementing ICT-rich activities for early literacy. According to Penuel, Roschelle, and Shechtman (2007), co-design engages teachers in considering how materials fit their actual classrooms. The role as co-designer enables teachers to reflect on classroom relevance and create opportunities for success (Kenny & McDaniel, 2011). In this role, teachers can explore new curriculum materials by creating technology-supported learning experiences for their pupils and planning for implementation together with their colleagues (Keengwe & Onchwari, 2009). Co-design engages teachers in formulating goals and decision-making (Penuel, Roschelle & Shechtman, 2007). As with re-design, co-design can foster understanding, co-ownership in teachers, curriculum practicality perceptions and explication of their role, all of which could support the actual use of the resulting materials. The main aim of this study is to demonstrate differential effects on curriculum implementation and on pupils' learning outcomes given varied roles during teacher involvement in designing ICT-rich materials and activities for early literacy.

1.4 THE PRESENT STUDY

1.4.1 Teacher roles and learning outcomes: Operational definition

The present research focused on involvement of kindergarten teachers in curriculum (design and) implementation of PictoPal activities in three different roles: executor-only, re-designer, and co-designer. In this study, implementation of PictoPal refers to integrating a series of eight on- and off-computer activities (further referred to as PictoPal activities) in the classroom. The role in which a teacher engages in implementing a series of ready-made PictoPal activities, is referred here to as executor-only role. In the re-designer role, a teacher is part of a team of teachers re-designing existing PictoPal activities to fit their current curriculum and engages in implementation of the re-designed activities. Co-designing engages teachers in collaborative design of new PictoPal activities, fitting their current curriculum as well as implementing the activities.

Pupil learning outcomes in this study refer to specific early literacy learning outcomes. Pupil learning outcomes indicate effectiveness of the PictoPal activities as implemented by teachers in three different roles.

1.4.2 Research questions

The present study aims to understand how each role influences implementation of PictoPal activities and subsequent pupil learning outcomes. In the long run, the findings from this study can help understand how teachers might ideally be supported in technology integration in kindergarten classes in general; and specifically, the findings will help to provide teachers with appropriate materials, opportunities and support for the implementation of PictoPal. The main research question was: *Which teacher role (executor-only, re-designer, or co-designer) contributes most to the effectiveness of an ICT-rich learning environment for early literacy?*

To answer the main research question of this dissertation, four sub-studies were performed. The first study focused on the executor-only teacher role. Teachers in this implemented ready-made PictoPal activities. The research question was: *How do teacher perceptions of teaching/learning, technology and innovation impact integration of a technology-rich curriculum for emergent literacy and in turn, how does teacher technology integration of the curriculum impact pupil learning?* Teachers were interviewed about their perceptions on teaching/learning, ICT, innovation, early literacy, their role, and curriculum practicality. Observations were undertaken of technology integration within PictoPal. Pupils learning outcomes were tested prior to PictoPal-implementation and afterwards.

The second study explored the re-designer role, and involved teachers in redesign and implementation of PictoPal. The research question was: *What does teacher involvement in re-designing ICT-rich learning activities imply for implementation and learning outcomes?* Teachers were interviewed about their perceptions with regard to teaching/learning, ICT, early literacy, re-designer role, co-ownership, and curriculum practicality. Teachers were interviewed about their perceptions about collaborative re-design. In each class of the re-designing teachers, observations were conducted on integration of the on- and off-computer activities. Pupils' early literacy learning outcomes were examined before and after implementation.

The third study focused on the co-designer role. This study involved teachers in co-design and implementation of new PictoPal activities. The research question was: *When teachers are involved in co-designing ICT-rich activities, what does that imply for curriculum implementation and pupil learning outcomes?* Teachers were interviewed about their perceptions with regard to teaching/learning, ICT, early literacy, co-designer role, co-ownership, curriculum practicality. Also, teachers were interviewed about their co-design team. Integration was observed in each class of teachers as co-designers. Pupil early literacy learning outcomes were examined before and after implementation of co-designed PictoPal activities.

The fourth sub-study focused on the comparative value of each role for implementation and pupil learning outcomes. The research question was: *Which teacher role (executor-only, re-designer and co-designer) contributes most to the effectiveness of technology-rich learning activities for early literacy and why?* The teacher roles were regarded as cases and compared on the basis of PictoPal integration, and pupil learning outcomes. Also, cases were compared with regard to teacher perspectives concerning their role, curriculum practicality, and co-ownership.

1.4.3 Research methodology

A case-study approach, defined as empirical inquiry for investigating phenomena in real-life contexts (Yin, 2003) was applied in the four sub-studies. A case-study approach was regarded as suitable for examining three different teacher roles in their actual classroom practice. Each teacher role was studied in a separate sub-study. In three sub-studies each focusing on a particular teacher role, a classroom with a teacher formed a separate case. In these sub-studies, a within-case analysis was used to represent each case separately, followed by a cross-case analysis to compare cases with regard to a common set of measures. A fourth sub-study was conducted to compare three teacher roles. In this sub-study, teachers with a particular teacher role were regarded as a case. A cross-case analysis was used to compare three different cases with each other on a common set of measures. Within each sub-study mixed methods were used.

The first sub-study about the executor-only role had four cases. These cases were examined with a common set of measures: teacher perceptions, integration, and pupil learning outcomes. For examining teacher perceptions, a teacher formed the unit of analysis. A classroom with a teacher formed the unit of analysis for examining technology integration and pupil learning outcomes.

In the second sub-study about the re-designer role, five cases were studied on the following measures: teacher perceptions, technology integration and pupil learning outcomes. For the measures technology integration and pupil learning outcomes the unit of analysis was a classroom with a teacher, while for examining teacher team perceptions about redesign, a team formed the unit of analysis.

In the third sub-study on co-designers, three cases were studied with regard to integration and pupil learning outcomes. Also, in this sub-study, a team was regarded as the unit of analysis for teacher team perceptions about co-design, while a classroom with a teacher formed the unit of analysis for examining integration and pupil learning outcomes.

In the fourth sub-study, a multiple case study was used (Yin, 2003) with three teacher roles (executor-only, re-designer, and co-designer) as separate cases. A cross-case analysis was employed to compare the three cases, which had previously been investigated in independent research studies (Miles & Huberman, 1994, Yin, 2003). The following criteria were used to assign subjects to one of the three cases: (1) no experience with design and implementation of PictoPal, (2) same timing of implementation, and (3) same types of implemented activities. A case (teacher role) formed the unit of analysis. The teacher roles as cases were compared on the following set of measures: teacher perceptions about their role, curriculum practicality, co-ownership, integration, and pupil learning. Data from the cases were analysed using data-displays and by identifying similarities and differences across cases. Quantitative techniques were used to analyse integration data and pupil learning data across cases.

1.5 STRUCTURE OF THE DISSERTATION

The next chapter, chapter 2, describes the first sub-study about teachers in the executor-only role. Teachers in this study implemented ready-to-use PictoPal activities. Thereafter, in chapter 3, the second sub-study on re-designers is reported. In this study, teachers re-designed PictoPal and implemented it in their classes. Then, the fourth chapter reports on the third sub-study about teachers as co-designers, collaboratively creating new PictoPal-activities and materials. The fifth chapter reports on the fourth sub-study about a cross-case analysis based on the executor-only, re-designer and co-designer teacher roles. In the final chapter, chapter six, the findings of this dissertation are discussed. Additionally, reflections on the study and recommendations for future research are provided.

CHAPTER 2*
Teachers enacting a technology-rich curriculum for emergent literacy

PictoPal is the name of a technology-rich curriculum with a focus on emergent literacy of Dutch kindergarteners. A case study design was used to examine teacher technology integration within PictoPal along with their perceptions about teaching/learning, technology and technology-based innovations. Observations were undertaken on pupils' engagement and teachers' technology integration within PictoPal. Interviews were used to examine teachers' perceptions. Pupils' emergent literacy learning was examined in a nonequivalent control quasi experimental design. Four kindergarten teachers and four classes (n = 95 pupils) participated in the use of PictoPal. The findings suggest that a high extent of technology integration is related to: a developmental approach to teaching/learning; positive attitudes and expectations towards technology-based innovations; and positive perceptions of support in stressful work conditions. Significant learning gains were found for the experimental group using PictoPal. High pupil learning gains were not related to a high extent of technology integration. Senior kindergarteners engaged to a higher extent with PictoPal than junior kindergarteners.

2.1 INTRODUCTION

Over the last decade, the importance of improving language education in Dutch primary schools, and especially kindergartens, has been given increased attention. The Dutch Ministry of Education, Culture, and Science (MoECS) has initiated the formulation of national emergent literacy attainment targets (Verhoeven &

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Aarnoutse, 1999). The formulation of the attainment targets aims to set the goals to be achieved, give teachers freedom in the design of their language curricula and responsibility for the achievement of their pupils (MoECS, 1997).

In those two years, kindergarten pupils develop emergent literacy skills. The goal of the present study is to better understand the factors that influence teacher technology integration within PictoPal, a technology-rich curriculum with on and off computer emergent literacy activities. The study aims also to explore potential connections between teachers' technology integration, pupils' engagement in technology-supported activities and pupil learning.

Emergent literacy education in kindergarten contributes not only to learning to read and write, which is taught conventionally in Grade 1, but also to a broader area of literacy development as, for example, knowledge about the nature of language, writing, verbal ability, and the ability to process information. Young children's experiences with literacy are mostly gained in daily activities and their interaction with peers and adults (Cooper, 1993), a process whereby children construct meaning. From Piaget's and Vygotsky's views on the role of play in the development of children's literacy, symbolic (or dramatic) play drives the child's symbol-making competence (Pellegrini & Galda, 1993). From Piaget's perspective on learning, children practice during play individually and also in interaction with peers. A Vygotskian perspective emphasizes the adult (teacher)-child context with adults (teachers) stimulating social cooperation and interaction in learning, within a child's zone of proximal development. Both perspectives on the role of play in literacy provide a theoretical orientation for research involving child's emergent literacy development, which can be guided by teachers and supported by technology (e.g. Cassell, 2004; McKenney & Voogt, 2009).

In recent years, many Dutch kindergartens have invested in technology to support the curriculum. Various studies have shown positive effects of technology in supporting learning in emergent literacy development (e.g. De Jong & Bus, 2004; McKenney & Voogt, 2009; Segers & Verhoeven, 2002, 2005; Van Scoter, 2008;). Meaningful literacy learning through engagement in literacy experiences and integration of technology in the classrooms with 4 to 6 old children has also been endorsed by the National Association for the Education of Young Children (NAEYC) and the International Reading Association (IRA) (NAEYC, 1996, 2009; Neuman & Roskos, 2005). Experts agree that technology use in kindergartens should not be isolated but rather integrated with classroom routines and activities for a learning environment to offer meaningful experiences for children (e.g. Clements, Nastasi, & Swaminathan, 1993; Amante, 2007). Literacy learning is facilitated when children learn to use language for authentic purposes. Supported by technology, this could include writing a letter to a relative and posting a letter in a play corner (cf. Amante, 2007; McKenney & Voogt, 2009; Siraj-Blatchford & Whitebread, 2003).

The assumption underlying this study is that the effectiveness of a technology-rich curriculum depends on how teachers integrate technology-supported learning with the interactions with peers and adults during classroom learning. Teachers play a central role in bridging the gap between: (a) the potential of technology to support learning as indicated by research; and (b) teachers' own choices about pedagogy and classroom practices. However, many primary school teachers struggle to integrate technology in the classroom (Ertmer, 2005; Tondeur, Van Braak, & Valcke, 2007; Turbill, 2001). One of the obstacles may be resistance to innovations due to their educational beliefs about teaching practice and technology (Zhao, Pugh, Sheldon, & Byers, 2002). Another powerful factor is how well or poorly software is aligned with the classroom curriculum (Whittier, 2005).

2.2 TEACHER FACTORS AFFECTING TECHNOLOGY INTEGRATION

The relationships between teacher perceptions, curriculum implementation and pupil learning are complex. Figure 2.1 shows the factors and relationships that were central in this study on the enactment of a technology-rich curriculum for early literacy. The remainder of this section describes the literature base that led to the conceptualization shown in Figure 2.1.

Research on the role of teachers as enactors of a new curriculum in the classroom indicates that teacher perceptions of a curriculum affect curriculum implementation (e.g. Abrami et al., 2004; Cronin-Jones, 1991). Teachers, who are provided with materials that portray the new curriculum, constantly adjust and adapt these curriculum materials to fit their teaching practice to the learning processes of their students (Grossman & Thompson, 2008; Remillard, 1999, 2000). Teachers as enactors of the curriculum construct the curriculum in their classrooms by adjusting and adapting it. Teacher's interpretations of the meaning and intents of the new curriculum can be regarded as a factor affecting actual implementation. Those interpretations might be related to teacher's perceptions and ideas about teaching/learning, technology and innovation (component B). The characteristics of a new curriculum (component C) influence teacher considerations about its practicality. Teachers might interpret the practicality of a curriculum differently and construct the enacted curriculum in a different way then was intended by its designers (component C); and this may or may not affect pupils' learning outcomes.

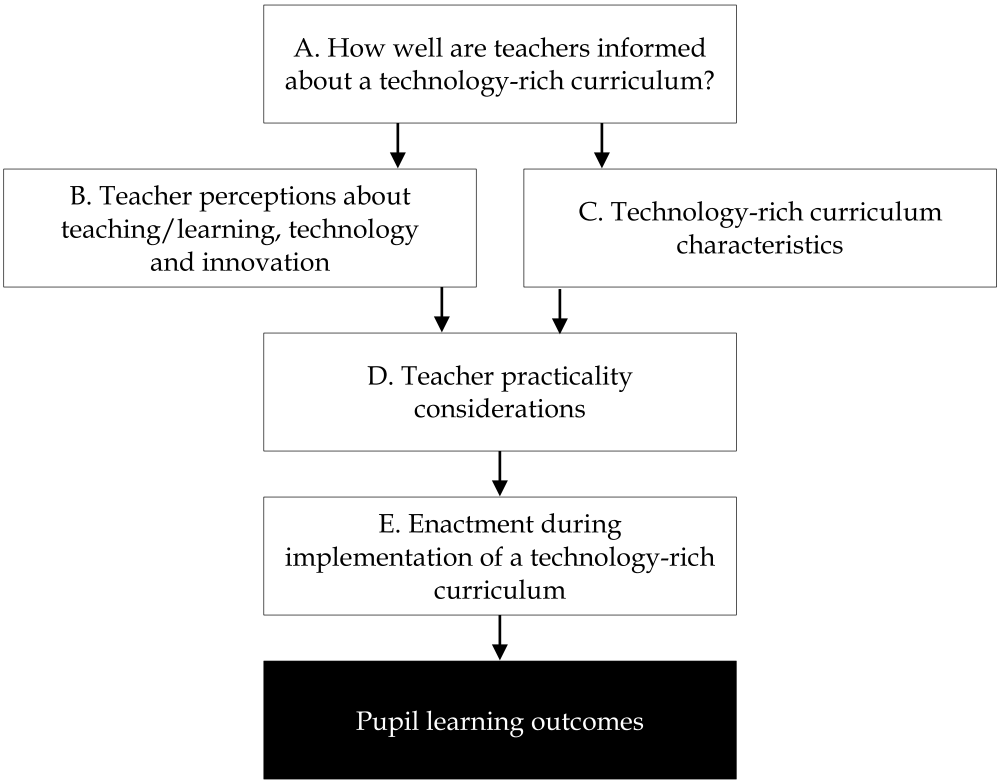

Figure 2.1 Important influences on pupil learning

Teacher perceptions concerning teaching/learning, technology and innovation (component B) influence enactment of a curriculum involving technology (component E) (Ertmer, 2005; Inan & Lowther, 2009; Tondeur et al., 2008b; Tondeur, Van Keer, Van Braak, & Valcke, 2008c; Zhao et al., 2002). Teacher perceptions on teaching/learning, technology and innovation can originate from existing beliefs about pedagogy. For example, Hermans, Tondeur, Van Braak, and Valcke (2008) found that teacher beliefs affect integrated classroom use of technology in primary schools. Teachers who hold constructivist beliefs reflecting a pupil-centered approach to teaching and learning, have a positive effect on integrated classroom use of technology, whereas teachers holding teacher-centered approaches to teaching and learning negatively influence integrated technology-use in the classroom. Also, Niederhauser and Stoddart (2001) found that teachers' pedagogical perspectives relate to the types of software used in classrooms. Specifically, K-2 teachers with a computer-centered approach to teaching favor use of skill-based software for young children.

Next to teachers' beliefs, the factors computer experience and attitudes are found to influence teachers' integrated use of technology (Hermans et al., 2008). Hermans et al. (2008) also found that the integration of technology in the classroom depends on the particular school context, suggesting that a particular school context can be regarded as a setting in which teachers' beliefs are shared. Teachers working in the same school tend to share similar beliefs about teaching and learning practices. Thus teacher's beliefs and the school context can influence integration of technology in his or her classroom practice. Successful implementation of innovations also depends on a teacher's decision-making based on his or her perceptions of what is practical and possible in a classroom setting (component D) (Doyle & Ponder, 1978; Ertmer, 1999).

Furthermore, previous research on the teacher as enactor of curriculum has shown that innovations around the integration of technology were most likely to succeed when: (a) the teachers were informed how to implement the innovation (component A) (how to use the technologies and how the innovation might support their teaching practice); (b) when the distance between innovative and existing teacher practices were small; and (c) when teachers could take small steps during the implementation of technology (Zhao et al., 2002). Also, the success of the implementation of technology innovation is determined by teachers' computer proficiency, knowledge about technology enabling conditions for teaching, the support offered to teachers (Inan & Lowther, 2009; Koehler & Mishra, 2008; Zhao et al., 2002), teacher willingness to learn from innovations; and their work conditions (Könings, Brand-Gruwel, & Van Merriënboer, 2006). Support to teachers (e.g. from administration, and availability of resources) seems to influence teachers' perception of technology, which in turn influences teachers' technology integration in classroom practice.

While literature points to the importance of teacher perceptions as influential on technology integration, little is known about *how* teacher perceptions on education, technology and innovations (component B) impact teacher technology integration and even less is known about if and how technology integration (component E) influences pupil learning outcomes. This study focuses on exploring (1) how kindergarten teacher perceptions on education, innovations and technology (component B) relate to teacher technology integration (component E); and (2) how teacher technology integration (component E) affects pupils learning. Further specification of the kindergarten teacher role in enacting a technology rich curriculum can help us understand how kindergarten teachers, with specific pedagogical perspectives, enact technology-based activities, and what implications can be drawn for the design of technology rich tools and curricula for emergent literacy.

Based on the framework given above, the PictoPal study reported here set out to examine kindergarten teachers' perceptions on teaching/learning, technology and innovations, their technology integration and pupil engagement and learning. Core constructs relating to the three variables of teacher perceptions about teaching/learning, technology and innovation are presented in Table 2.1.

Table 2.1 *Description of variables as indicators for teachers' perceptions on teaching/learning, technology and innovation*

Variable	**Variable description**
Vision on teaching/learning	What constitutes good teaching; Roles of teachers and learners
Attitudes towards computers (technology) and experience with computers	Personal feelings about computer use; Experience with technology in the kindergarten classroom; General technology experience
Attitudes and expectations towards technology innovations	Perceptions on technology innovations in kindergarten classrooms; Expectations for an technology-rich learning environment
Skills to implement the technology innovation	Self-reported skills needed to implement a technology-rich learning environment in the kindergarten classroom
Willingness to learn	Perceptions on innovations as opportunities for learning
Work conditions	Experience with (time) pressure in curriculum; support offered to teachers

The central question guiding this study was: How do teacher perceptions of teaching/learning, technology and innovation impact integration of a technology-rich curriculum for emergent literacy and in turn, how does teacher technology integration of the curriculum impact pupil learning? To answer this research question, four sub-questions were formulated:

- Teacher perceptions: What are teachers' perceptions of teaching/learning, technology and innovations?
- Technology integration: To what extent do teachers integrate computer activities and classroom activities within a technology-rich curriculum?
- Pupil engagement: To what extent do pupils engage in on computer activities within the technology-rich curriculum?
- Pupil learning: What are pupil learning outcomes when teachers enact a technology-rich curriculum?

2.3 PICTOPAL, A TECHNOLOGY-RICH CURRICULUM FOR EMERGENT LITERACY

PictoPal is a technology-rich curriculum for emergent literacy with learning activities both on the computer and off the computer. PictoPal activities are designed to teach children about the communicative functions of written language. This important emergent literacy aspect is currently at risk of being usurped by the strong focus in the Dutch kindergarten curriculum on practicing technical (pre-) reading skills such as phonemic awareness, resulting in a potential gap in the curriculum. Not only is this area under emphasized in materials for learners, but few teaching materials are available to offer guidance on pedagogically appropriate strategies for teaching about the communicative functions of written language. PictoPal was created to address gaps in common early language curricula by focusing on a selection of the national attainment goals for emergent literacy: (1) functional reading and writing (writing and reading with a purpose); (2) function of written language (learning that written language as means of communication); (3) relationship between spoken and written language; and (4) language consciousness. The kindergarten teachers participating in this study identified the need for addressing these aspects of emergent literacy. They therefore expressed appreciation for the PictoPal focus and committed to a three years collaboration on incorporation of PictoPal in the kindergarten language curriculum.

A central tenet underlying PictoPal is the notion that children have an intrinsic drive to engage with the world around them (McKenney & Voogt, 2009). PictoPal invites children to engage with written and spoken language, and to create their own written products. PictoPal focuses on forming linguistic concepts regarding the nature and function of written language by providing children with the opportunity to write their own texts and use their printed products in meaningful contexts (McKenney & Voogt, 2009). The focus on meaning-making and use of written products is expressed through computer activities linked to off-computer activities. An example of an on-computer activity and an off- computer activity is given in Figures 2.2 and 2.3. In Figure 2.2, children are co-creating the script for a weather forecast. In Figure 2.3, they are 'broadcasting' the weather forecast to their classmates.

Figure 2.2 On-computer activity: Composing the weather forecast

Figure 2.3 Off-computer activity: Presenting the weather forecast

Computer activities were designed using Clicker® software. Clicker® is a visual word processor with voice output. As seen in Figure 2.2, the lower portion of the word processor consists of a grid with cells containing words and images; and the upper portion is a writing window. Clicking on the cells allows children to put words and images in the writing window and to hear the words spoken aloud. In addition, children can print their resulting written products. In this way, children's texts can be used in classroom activities in an authentic way. The connection between the computer activities and the classroom activities is made by teachers. Teachers create opportunities for children to use their written products in the classroom by introducing, organizing and arranging classroom applications (McKenney & Voogt, 2009). A teacher manual supports the teacher with suggestions for the classroom activities. Table 2.2 gives examples of specific pedagogical strategies used in PictoPal to address national interim targets.

Table 2.2 *Sample pedagogical strategies used in PictoPal*

National emergent literacy interim goals	Sample pedagogical strategies used to meet different goals in PictoPal
Relationship between spoken and written language	1.1 Children listen to spoken words by clicking on written words with the right mouse button 1.2 When children (left mouse button) click on written words or pictograms, that word is 'written' in their own document (the computer types for them) 1.3 Children 'read' their printed products out loud
Language consciousness; words and sentences convey meaning	2.1 Children connect printed words to meaning by having pictograms placed above words. 2.2 Children review the meaning of what they have created when the computer 'reads' text back to them a. The computer reads each sentence when a period is entered. b. The computer reads any highlighted text (from one word to a whole document).
Functional writing; communicative purposes of reading and writing	3.1 Each lesson is introduced by an activity that gives attention to the text genre and its purpose (stories are for entertainment; lists are to keep track of things, etc) 3.2 Children 'use' printed products in authentic ways (e.g. letters are mailed; recipes are cooked, etc.)

2.4 METHODOLOGY

2.4.1 Study design

A case study design has been employed to investigate teacher technology integration within the technology-rich PictoPal curriculum. In this study, we applied a multiple data collection approach (Patton, 2002) using a mix of quantitative and qualitative methods. The effects on integration and pupil learning were examined with quantitative data complimented with qualitative data on teacher perceptions to help explain those effects.

In this study, four cases (four kindergarten classrooms with four teachers) were studied with a common set of measures of (1) teachers' perceptions; (2) pupils' engagement in activities; (3) teachers' integration of on- and off-computer activities; and (4) pupils' emergent literacy proficiency. A comparative method was adopted, which involves representing each case separately and comparing them with each other (Patton, 2002). To represent the relationships within the four cases, qualitative data on teachers' perceptions were used to interpret the quantitative data obtained for teachers' integration of on- and off-computer activities. Data on pupils' engagement and teachers' integration were used to interpret the data obtained for pupils' emergent literacy proficiency. In addition, comparisons of the four cases on the four measures were undertaken to reveal differential impact of the PictoPal curriculum on pupils' emergent literacy proficiency. Finally, a nonequivalent control group design was used to compare emergent literacy proficiency among pupils in the case study classes to a control group in which children were not exposed to PictoPal. In the study, the classroom teacher forms the unit of analysis for the teacher perspective variables, while the unit of analysis for the variables 'pupil engagement' and 'technology integration' and 'pupil learning outcomes' is formed by a kindergarten class.

2.4.2 Context

One primary school in a medium size town in the eastern part of the Netherlands participated in the study. This school consisted of three different campuses. The educational approach of the school can be described as adaptive teaching, which implies that pupils are encouraged to learn and work independently and that teachers strive to tailor education to individual pupil needs. In the kindergarten classrooms, teachers spend approximately one hour a day specifically teaching literacy, using a language curriculum which has been adopted in many Dutch schools. This curriculum offers theme-based language activities for play corners and teacher guided classroom discussions. Additionally, an accompanying software program ("Treasure Chest") is offered, which relates to the learning goals, but not to the specific themes of the curriculum. The kindergarteners usually work 10 minutes a week with this software, individually and in pairs. The kindergarteners work on eight computers (two of them in the classroom and six of them placed outside the classroom). Teachers are supported when needed by two technology coordinators, concerned with updating and maintaining functionality of both hardware and software. The school principal provides support to teachers by offering opportunities for participating in in-service training and participating in teacher team discussions on kindergarten education.

2.4.3 Participants

The case study focused on the implementation of the PictoPal curriculum by four kindergarten teachers in one of this school's three campuses. The school suggested involving the four kindergarten teachers from one campus to participate in the study. When asked about the attention on communicative functions of written language in kindergarten emergent literacy curriculum, teachers from all campuses felt that there is a gap in the curriculum and expressed the need to address it, preferably with PictoPal. Teachers of the two other campuses originally wanted to explore PictoPal, but agreed to function as a control group during the study. They intended to start using PictoPal as soon as the research was finished. The four teachers forming the experimental group are native Dutch and are representative of average Dutch kindergarten teachers. Also, most pupils participating in this study come from (upper) middle class native Dutch neighborhoods.

In the kindergarten classrooms of the other two campuses, the teachers used "Treasure Chest" as their language arts curriculum. These kindergarten classes served as a control group for this study. The group working with PictoPal consisted of 95 children (n = 95), mean age 65 months old (64 boys, and 51 girls). Kindergarteners from the other two campuses consisted of 73 children (n = 73), mean age 65 months (45 boys and 28 girls). To investigate the learning outcomes of pupils working with PictoPal, a nonequivalent control group design was used. All 168 pupils were pre- and post-tested on emergent literacy. The similarity of the groups concerning language skills was determined by scores on a national language test for kindergarten pupils. PictoPal was implemented in two junior kindergarten classrooms (1a and 1b) and two senior kindergarten classrooms (2a and 2b). The junior kindergarten classes consisted of pupils aged 4-5 years and the senior kindergarten classes had pupils aged 5-6 years. Table 2.3 presents an overview of the distribution of pupils in the four classrooms. Four female teachers were involved in the implementation of PictoPal in their classroom.

Table 2.3 *Teaching experiences (in years), number of pupils, gender and mean age (in months) of pupils at the start of PictoPal per classroom*

	Years of experience	***n***	**Boys**	**Girls**	**Mean age**
Junior classroom 1a, teacher Alice	20	19	11	8	57
Junior classroom 1b, teacher Carol	10	24	13	11	58
Senior classroom 2a, teacher Diana	12	27	13	14	70
Senior classroom 2b, teacher Fiona	33	25	14	11	71

2.4.4 Instruments

Interviews

Data were collected on six constructs related to the three variables of teacher perceptions about teaching/learning, technology and innovation, as well as the teachers' current teaching context. A semi-structured interview scheme was used, which consisted of questions regarding the context of teaching in the kindergarten and questions related to (1) teaching/learning (e.g. visions about teaching/learning); (2) technology (e.g. attitudes, experiences and expectations regarding technology use); and (3) innovation (e.g. skills to implement PictoPal, willingness to learn, and work conditions). An example of the questions related to attitudes towards computers is: "How would you describe your feelings about using technology in your classroom?"

Observation checklist

The Integration Checklist (Verseput, 2008b) was used to structure observation of pupil engagement during on-computer activities and teachers' integration of PictoPal, including both on- and off-computer activities. The Integration Checklist consists of 8 items measuring the extent of engagement and 12 items measuring the extent of integration of on- and off-computer activities. The 8 items measure the extent of pupil engagement in computer activities related to following topics (one item each): (1) group work; (2) collaborative work; (3) helping peers; (4) pupil activity; (5) individual work (6) requesting support (7) conversing about the process; and (8) conversing about the product. An example of item 8 is: "Pupils talk about the printed texts they created during their computer activity."

Items (one per topic) measuring the extent of integration of on- and off-computer activities relate to the topics: (1) involving pupils; (2) initiating listening; (3) initiating speaking; (4) initiating writing; (5) initiating reading; (6) play with writings; (7) initiating activity; (8) initiating collaboration; (9) initiating individual work; (10) providing support; (11) initiating talk about the process; and (12) initiating talk about the product. An example of item 12 is: "The teacher creates the opportunity for pupils to talk about their products."

The items were measured on a 3-point scale, with 0 indicating the target behavior is absent, 0.5 indicating some extent of the target behavior is observable, and 1 indicating a great extent of the target behavior is observable. The inter-rater reliability for the raters, who observed and rated pupils engagement and teacher integration within two activities, was found to be Cohen's kappa = 0.67 (p <.0.001), 95% CI (0.375 - 0.966), indicating a substantial agreement.

Emergent literacy test

To measure pupil emergent literacy proficiency, the emergent literacy test for 4-5 year olds (McKenney & Voogt, 2006) was used. The test was administered prior to the implementation of PictoPal and after the eight-week period in which pupils worked with PictoPal. The test consists of 14 items measuring the sub-set of emergent literacy skills related to the functions of written language, also including functional reading and writing, and connecting spoken and written language. An example item is the following task, aimed to determine if a child knows what writing is: (1) The researcher sets out color pencils, a pen, paper, scissors, a coloring page, a book, a spoon, a postcard and a grocery list; (2) the researcher presents the items to the child with an open arm gesture and says, "Can you pretend that you are writing something?" The item is scored as correct if the child takes either a pencil or a pen and a sheet of paper, and does or imitates the act of writing.

The items were scored on a two-point scale (2 = correct; 1 = not correct). Cronbach's alpha was 0.76 on the pre-test and 0.87 on the post-test. The pre-test scores on the emergent literacy test correlated significantly with the pupils' scores on the national language proficiency test (rpb = .52, p < .05). The correlation between the two tests suggests that the emergent literacy test for 4-6 year olds measures linguistic skills in children. The national language proficiency test measures two aspects related to conceptual consciousness of language: passive vocabulary; and listening (Van Kuyk & Kamphuis, 2001). This test also measures some aspects of emergent literacy (meta-linguistic consciousness) which are: sound and rhyme; writing orientation; hearing the first and last word in a sentence; and synthesizing sounds. The specific aspects of emergent literacy measured by the two tests do not overlap, but both measure elements described in the national interim goals for emergent literacy.

2.4.5 Data analysis

For this study, we adopted a qualitative comparative method involving examination of cases separately along common variables, followed by a cross-case analysis (Miles & Huberman, 1994; Patton, 2002). The data on teachers' perceptions were content analyzed within each case to understand the particular cases by summarizing teachers' interview responses into groups, attaching a content code to each teacher's response reflecting the core of the response. The comparison of perceptions across the four cases involved scanning the responses for commonalities and shared perceptions, thereby mitigating the risk of forcing cases into the same categories (Miles & Huberman, 1994). Each teacher's perceptions were then compared to the data on her technology integration. The qualitative data analysis was conducted by two researchers: one researcher grouped and coded the interview responses; twice, the other researcher critically reviewed the content and meaning of the teacher response analysis conducted by the first researcher.

The data on teacher technology integration was analyzed using analysis of variance (ANOVA) to test the hypothesis that there were no differences on technology integration between the four cases. On the basis of the data distribution on technology integration, the means of the four cases were assigned a group label reflecting the extent of PictoPal technology integration expressed as low, medium or high. The same three labels were used to characterize extents of pupil engagement during on-computer activities. The relative position of the means for both sets of data were determined by assigning the scores below the 33.3rd percentile into 'low' group, the scores above or equivalent to the 66.7th percentile to a 'high' group, and the scores below the 66.7th percentile but at or above the 33.3rd percentile to the 'medium' group. Regression analysis was used to examine how the extents of teacher integration and the extent of pupil engagement were predicted by the length of time they worked within PictoPal. Following analysis of the data on the technology integration and pupil engagement, teachers' perceptions and their technology integration were compared qualitatively, by representing each case as a combination of relationships between perceptions and technology integration.

Pupil learning was analyzed using analysis of covariance (ANCOVA). We tested the hypothesis that the means of the emergent literacy pre- and post-test score differences did not differ between the control and the quasi-experimental group when adjusted for the pupils' scores on the national language test. Following the analysis, the extent of the integration of on- and off-computer activities and pupils' engagement in computer activities was qualitatively compared with the results on pupils' learning outcomes in order to be able to explain differences in pupil learning outcomes by teacher technology integration. In a cross-case analysis we tried to explain teacher technology integration by teachers' perceptions.

2.4.6 Procedure

The implementation of PictoPal started with a one-day workshop provided to teachers by the researchers as an introduction to PictoPal. The aim of the workshop was to create dialog with teachers about the content of the curriculum material (computer activities and classroom activities) and the practical organization of PictoPal. The curriculum material was a PictoPal module centering on the theme of springtime. It consisted of eight activities all linked to the central theme of spring, structured to expose children to different text types (lists, report/forecast, instructions, stories, letters, poems and invitations). At the same time, the off-computer applications were designed to bring the functions of the different text types to life in meaningful ways for the children. Figures 2.1 and 2.2 show the on- and off-computer activities associated with 'writing' and 'broadcasting' the weather forecast.

Prior to the implementation of PictoPal, interviews were conducted with four teachers on their perceptions of teaching/learning, technology and innovation. The interviews lasted approximately one hour per teacher. All interviews were audio taped and transcribed verbatim. The resulting phrases were coded. Also, prior to PictoPal implementation all pupils (n = 168) were pretested using the previously described emergent literacy test (McKenney & Voogt, 2006). In addition, pupils' scores on the national language proficiency test were gathered.

For the duration of the PictoPal implementation (eight weeks), teachers implemented three inter-linked activities a week: an introductory activity, on-computer activity, and off-computer activity. All teachers executed the eight introductory- and off-computer activities. Guidance of kindergarteners during on-computer activities was provided by pupils from the sixth grade. The time in which pupils engaged in on-computer activities ranged between 10 minutes for the first three activities to 15 minutes for the seventh and eighth computer activity. For each PictoPal on-computer activity in each class different pupils were chosen to form a pair to work together. During 10 – 15 minutes of each on-computer activity we observed one pair of pupils from each of the four classes. The observation data gathered during eight on-computer activities was based on 16 pupils per class, which is representative for the four classes with 18 – 26 pupils. One researcher and one research assistant gathered 32 observations on engagement of pupils during all eight on-computer activities from four classes.

The pupils' on-computer activities were followed by off-computer activities in which pupils used the prints of their computer-generated texts. Also, for the duration of the PictoPal implementation, the eight off-computer activities were observed in all four kindergarten classrooms. Observations focused on teacher integration of the on- and off-computer activities. Each observation lasted approximately 20 minutes. The data on integration of on- and off-computer activities constituted 32 observations of eight integrated activities taught by teachers in four kindergarten classrooms. After PictoPal implementation, all pupils (n = 168) were post-tested with the same emergent literacy test as was used in the pre-test.

2.5 RESULTS

The results are presented in the order of research questions to address (1) teacher perceptions (2) teacher technology integration, (3) pupil engagement and (4) pupil learning.

2.5.1 Teacher perceptions

In a cross case analysis we compared the perceptions of the teachers on the six variables. The results are presented in Table 2.4.

The results of the cross-case analysis on teachers' perceptions (Table 2.4) showed that the four teachers differed somewhat in their perceptions about teaching. Particularly Diana expressed having a more developmental approach to teaching expressing her view on teaching as 'helping children by bringing them a step further in their language development by letting them experience language in an enjoyable and a playful way, and also helping children in their social-emotional, motor, and cognitive development.

While the other teachers emphasized facilitative approach to teaching, for example Carol who expressed her view on teaching: 'Well, anyway creating a stable environment to let children feel secure. And from there, they can learn. Of course, from there on, it will be incrementally expanded.'

Table 2.4 *Cross-case analysis of teachers' perceptions*

Variable	Classroom 1a Alice	Classroom 1b Carol	Classroom 2a Diana	Classroom 2b Fiona
Teacher perceptions on teaching/learning	*Adaptive teaching	*Adaptive teaching *Viewing safe environment as condition for learning	*Developmental teaching	*Adaptive teaching *Viewing safe environment as condition for learning
Attitudes towards and experience with computers	*Positive attitudes towards computers *Positive experiences own use	*Positive experiences own use *Difficulty of computer programs influence computer use in the class	*Positive attitudes towards computers *Use of computers as a tool supporting learning *Need for professional development on how to deal with computers as a tool	*Positive attitudes towards computers *Positive experiences own use
Attitudes towards and expectations of technology-based innovations	*Positive attitude towards technology-based innovations *Investment of effort during implementation	*Positive, but technology-based innovations are not the main goal for kindergarten. *Investment of effort during implementation *Expectation of successful implementation of PictoPal	*Positive attitudes towards technology-based innovations *Expectation of successful implementation of PictoPal	*Positive, but technology-based innovations can only work if the teacher knows the innovation before implementation *Investment of effort during implementation *Expectation of successful implementation of PictoPal
Skills to implement the technology innovation	*Confidence in being competent to implement PictoPal	*Confidence in being competent to implement PictoPal; does not feel at ease with printers	*Confidence in being competent to implement PictoPal	*Confidence in being competent to implement PictoPal

Table 2.4 *Cross-case analysis of teachers' perceptions (Continued)*

Variable	Classroom 1a Alice	Classroom 1b Carol	Classroom 2a Diana	Classroom 2b Fiona
Willingness to learn	*Wants to learn from PictoPal *Learning at own workplace by implementing the innovation	*Wants to learn from PictoPal *Learning at own workplace by implementing the innovation	*Wants to learn from PictoPal *Learning at own workplace by implementing the innovation	*Wants to learn from PictoPal *Learning about innovations in courses outside the school and from workshops of the technology coordinators
Work conditions	*Time pressure in teaching	*Time pressure in teaching	*Time pressure in teaching *Experiencing to receive support on time pressure from principal	*No time pressure in teaching *Experiencing support on technology applications by the technology coordinators

With respect to their attitudes towards computers, all four teachers were rather positive, but Carol seemed to be a little bit more reserved about the use of computers for teaching kindergarteners explaining that

> *'It depends on the software used. In general children like it, but if software appears to be difficult then you [as a teacher] have to offer a lot of help, which is sometimes very difficult'.*

When we asked teachers about their attitudes towards technology-based innovations, Carol seemed to be somewhat reserved. All four teachers were fairly positive about PictoPal as an innovation, although Alice, Carol and Fiona expected to invest time in the implementation of PictoPal. The four teachers felt confident that they have the skills to implement PictoPal and want to learn from the experience. Only Fiona did not feel the pressure of time when teaching the kindergarten curriculum, the other three teachers experienced time pressure to teach the kindergarten curriculum. Diana reported that she experienced support from the principal with regard to time pressure.

2.5.2 Teacher integration of on- and off-computer activities

Integration of on- and off -computer activities of four teachers was compared in order to reveal any differential impact of teacher integration on pupils' emergent literacy proficiency. An ANOVA with integration of on- and off-computer activities as a dependent variable and classroom with 4 levels as independent variable showed a difference for level F (3, 28) = 3.035, $p < .05$, $\eta^2 = .25$. The senior kindergarten teacher from classroom 2a integrated on- and off-computer activities to a significantly higher extent M = 7.06, SD = 2.24 than the teacher teaching in the junior kindergarten classroom 1b M = 3.63, SD = 1.87. Teachers of the senior kindergarten classes (2a and 2b) M = 6.19, SD = 2.74 integrated the on- and off- computer activities to a significantly higher extent compared to teachers of the junior kindergarten classes (1a and1b) M = 4.28, SD = 1.91, $t(30) = 2.28$, $p = .03$, $d = .83$. Table 2.5 summarizes the means and standard deviations found for teacher integration of on- and off-computer activities.

The distribution of the observation data, shown in Figure 2.4 illustrates how teachers scored on the 12 items measuring the integration of the on- and off-computer activities. In Figure 2.5, the extent of integration is shown during the time that teachers worked with PictoPal.

Diana (2a) did not score lower than other teachers on integration items, except on initiating speaking. Alice (1a) and Carol (1b) scored very low on initiating conversations about the process of off-computer activities and initiating collaboration. Carol (1b) and Fiona (2b) scored low on involving pupils in activities.

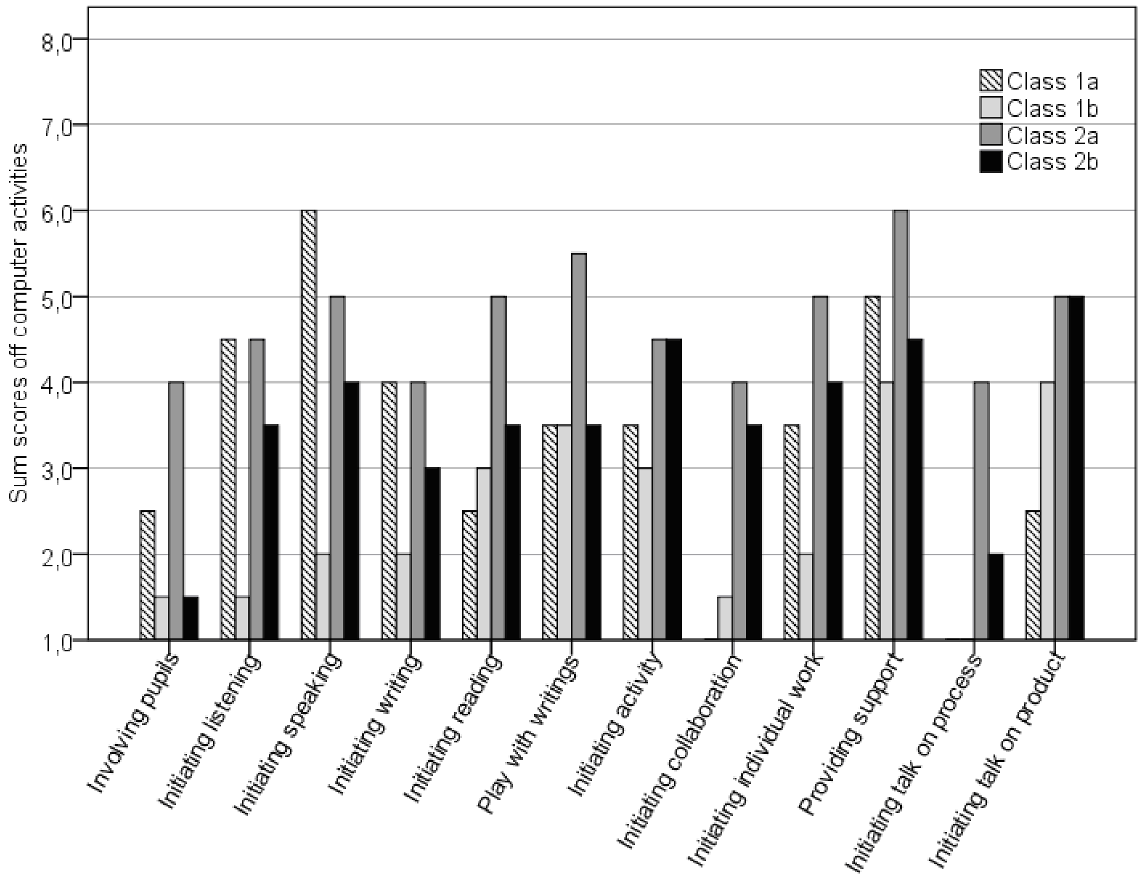

Figure 2.4 Distribution of observation data on the items of the integration of the on- and off-computer activities

A significant proportion of variance in integration can be explained by the time Carol (1b), Diana (2a), and Fiona (2b) worked within PictoPal, respectively $R^2 = .74$, $F\ (1, 6) = 16.96$, $p < .05$; $R^2 = .54$, $F\ (1, 6) = 7.03$, $p < .05$, and $R^2 = .75$, $F\ (1, 6) = 17.50$, $p < .05$. Although the extent of Alice's (1a) integration increases over time, no significant correlation was found between her time working within PictoPal and the extent of integration.

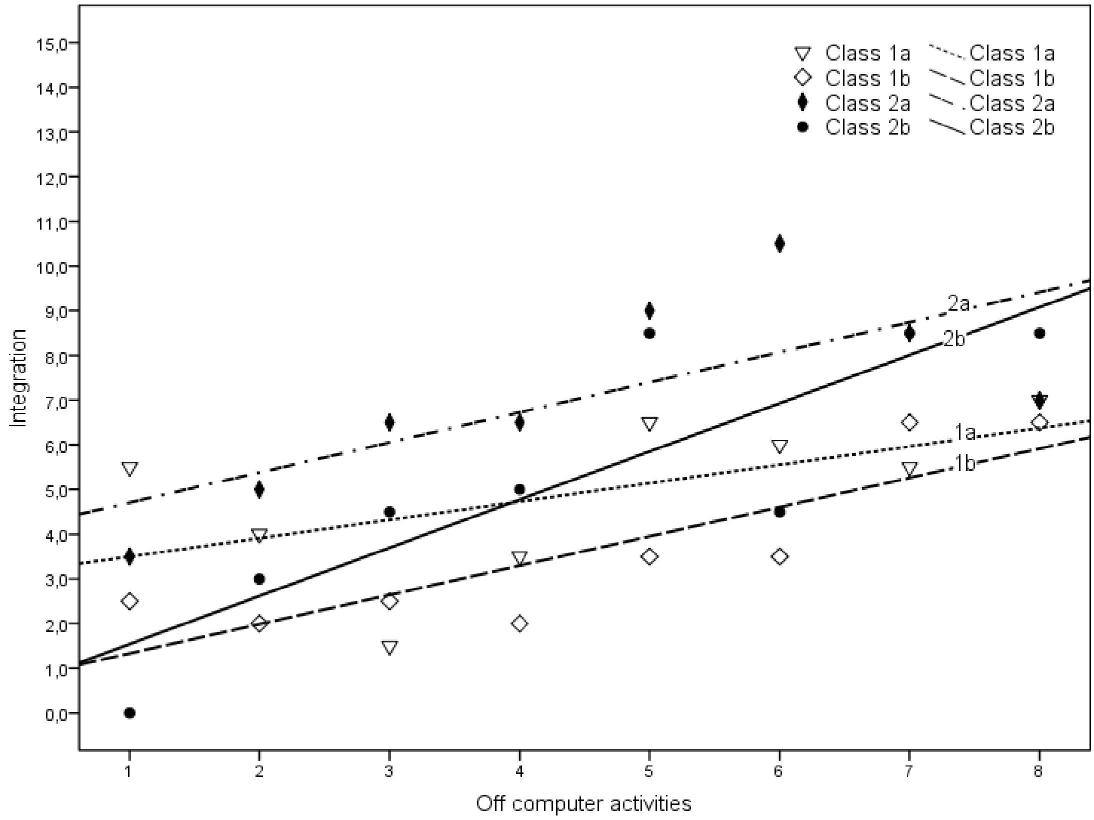

Figure 2.5 The integration of the on- and off-computer activities in each class during 8 on- and off-computer activities

2.5.3 Pupil engagement in on-computer activities

An ANOVA with engagement in computer activities as a dependent variable and classroom with 4 levels (class 1a, class 1b, class 2a and class 2b) as an independent variable showed a significant difference for the level F (3, 28) = 3.511, $p < .05$, $\eta^2 = .27$. Senior class pupils (2b) $M = 5.50$, $SD = 1.46$ were significantly higher engaged in computer activities than the junior class pupils 1b $M = 3.56$, $SD = 1.27$. Senior class pupils (2a and 2b) $M = 6.19$, $SD = 2.74$ engaged to a higher extent in computer activities than junior class pupils (1a and 1b), $t(30) = 2.88$, $p = .01$, $d = 1.29$. Table 2.5 summarizes the means and standard deviations found for pupil engagement.

Table 2.5 *Means and standard deviations of pupil engagement in on-computer activities and teachers' integrated teaching of on– and off-computer activities*

	Junior kindergarten classrooms		**Senior kindergarten classrooms**	
	Classroom 1a (Alice)	*Classroom 1b (Carol)*	*Classroom 2a (Diana)*	*Classroom 2b (Fiona)*
Engagement in on- computer activities (n = 8)	3.81 (1.22) L	3.56 (1.27) L	4.56 (1.29) M	5.50 (1.46) H
Integrated teaching on- and off-computer activities (n = 8)	4.94 (1.82) M	3.63 (1.86) L	7.06 (2.24) H	5.31 (3.06) M

Note: Pupil engagement on computer maximum score 8; Integrated on- and off-computer activities maximum score 12; L = low; M = medium; H = high, are indicators of the relative position of means in the observed range of scores.

The distribution of the observation scores on the separate items of pupil engagement in on-computer activities is shown in Figure 2.6. As Figure 2.6 illustrates, the differences in pupil engagement per classroom appear to be around collaboration, helping peers, conversing on process and conversing on product during the computer activities.

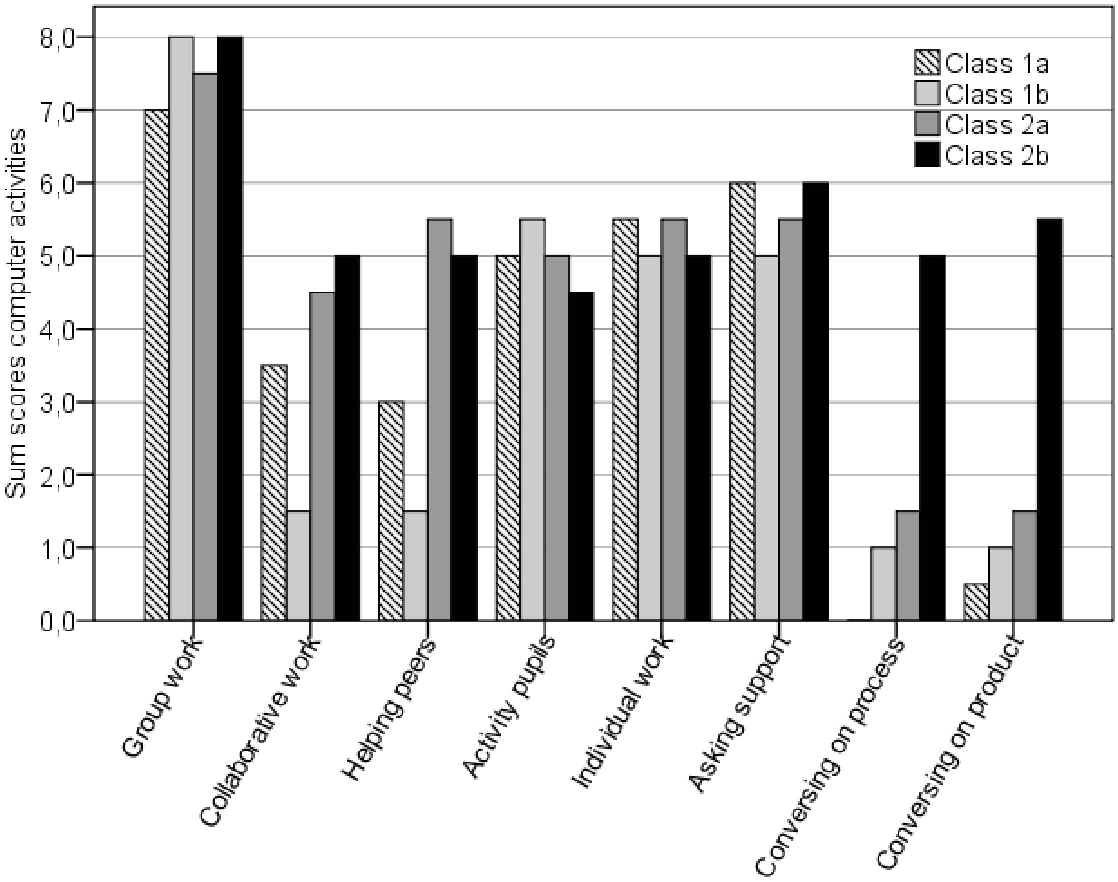

Figure 2.6 Distribution of observation data on the items of pupil engagement in computer activities

In Figure 2.7, the extent of pupil engagement is shown over the time that pupils of the four classrooms worked within PictoPal. The successive on-computer activities explained a significant proportion of variance in pupils engagement scores for classes 1a, 1b, 2a and 2b, respectively $R^2 = .72$, $F\ (1, 6) = 15.17$, $p < .05$; $R^2 = .49$, $F\ (1, 6) = 5.85$, $p < .05$; $R^2 = .83$, $F\ (1, 6) = 29.96$, $p < .05$ and $R^2 = .91$, $F\ (1, 6) = 64.00$, $p < .05$.

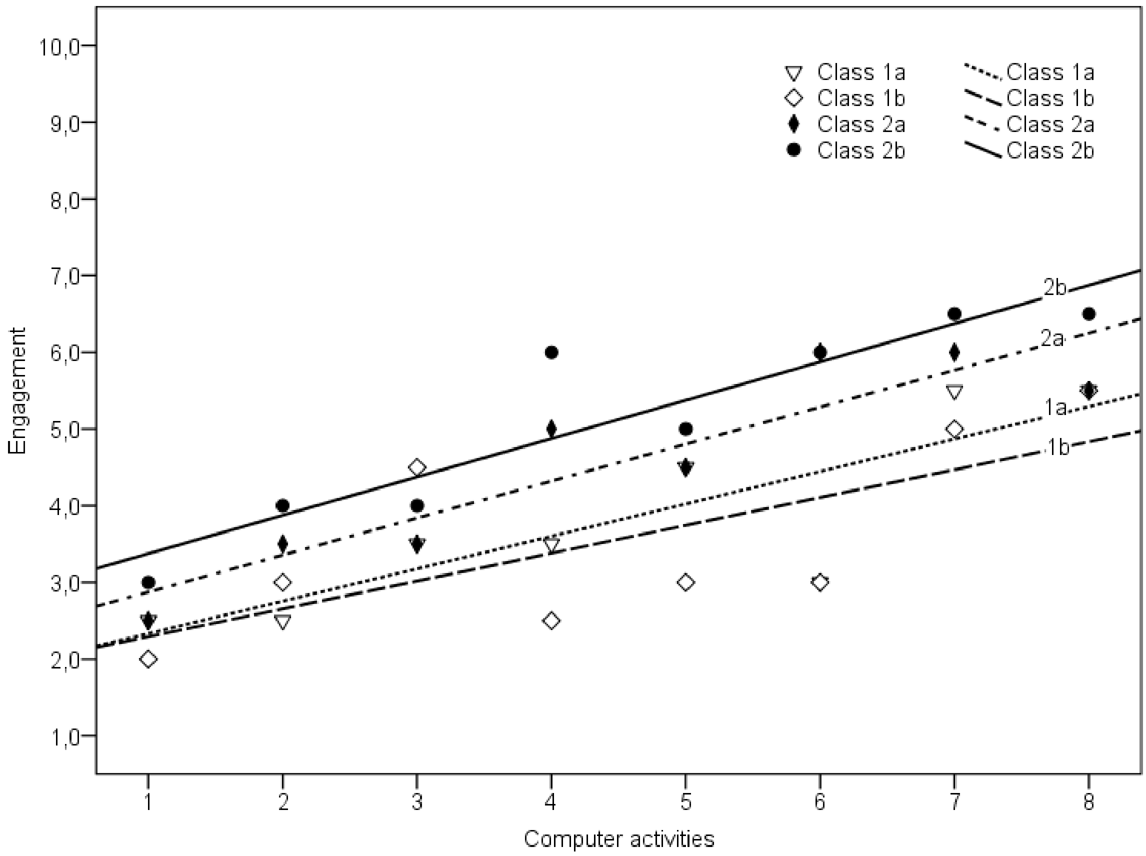

Figure 2.7 Pupil engagement in each class during the 8 computer activities

2.5.4 Pupil learning

Table 2.6 shows the means, standard deviations in the pre-and post-test for the experimental and control group, and also the learning gains and effect sizes of the learning gains (Cohen's d) for both groups. An ANCOVA with pre-post differences as dependent variable and group (experimental and control group) as independent variable, and national test language proficiency as a covariate showed a significant difference for group on emergent literacy F (1, 159) = 14. 508, p < .05, η^2 = .08. The learning gains of the pupils in the experimental group M = 2.93, SD = 2.23, n = 91 were significantly higher than the learning gains of the pupils in the control group M = 1.63, SD = 2.74, n = 71.

Table 2.6 *Means and standard deviations of pupil the pre-and post-data, and the learning gains with effect sizes for the experimental and control group*

	Pre test			Post test		Learning gain		Effect size (Cohen's *d*)	
	n	*M* (*SD*)	*M* (*SD*) [a]	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*M* (*SD*) [a]	*d*	*d* [a]
Experimental group	95	8.78 (2.77)	8.52 (2.63)	91	11.69 (1.85)	91	2.93 (2.23)	3.02 (2.48)	1.24	1.19
Control Group	72	8.36 (3.25)	8.70 (2.63)	71	9.92 (2.45)	71	1.63 (2.74)	1.53 (2.44)	0.54	0.48

Note: [a] Emergent literacy pretest scores and learning gain adjusted for national language test scores.

2.5.5 Emergent literacy proficiency of pupils learning with PictoPal

An ANCOVA with pre-post differences as dependent variable, class (1a, 1b, 2a, and 2b) as an independent variable, and scores on the national language test as a covariate showed a difference for class F (3, 86) = 2.946, p < .05, η^2 = .09. The learning gains of 1a pupils M = 3.81, SD = 2.28, n = 18 and the learning gains of 1b pupils M = 3.72, SD = 2.21, n = 23 were higher than the learning gains of 2b pupils M = 2.09, SD = 2.15, n = 24. Table 2.7 shows the means, standard deviations in the pre- and post-test for the classes, and also the learning gains and effect sizes of the learning gains (Cohen's *d*).

Table 2.7 *Means, standard deviations of the pre- and post-data, and the learning gains with effect sizes for the four PictoPal-classes*

	Pre test			Post test		Learning gain			Effect size Cohen's *d*	
	n	*M* (*SD*)	*M* (*SD*)[a]	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*M* (*SD*) [a]	*d*	*d* [a]
Class 1a Alice	19	7.37 (2.39)	7.72 (2.63)	18	11.11 (1.97)	18	3.83 (2.04)	3.81 (2.28)	1.76	1.49
Class 1b Carol	24	7.29 (2.58)	7.50 (2.53)	23	10.87 (1.77)	23	3.73 (2.20)	3.72 (2.21)	1.65	1.57
Class 2a Diana	27	10.19 (2.30)	9.85 (2.69)	26	12.54 (1.45)	26	2.38 (2.14)	2.41 (2.34)	1.24	1.26
Class 2b Fiona	25	9.76 (2.57)	9.66 (2.47)	24	12.00 (1.84)	24	2.08 (2.08)	2.09 (2.15)	1.02	1.09

As shown in Table 2.7 large effect sizes were obtained for the learning gains of pupils from the four classes. The learning gains of junior classes 1a and 1b were found to differ significantly from the learning gain of pupils from senior class 2b.

This difference might be explained as a result of a ceiling effect for the measurement of learning in classes 2a and 2b. Although the distributions of the pre- and posttest scores were approximately normal for classes 2a and 2b, the distributions showed that 30% of pupils from 2a and 32% from 2b scored the maximum test score (14) compared to respectively 0% and 12% on the pretest. In comparison to junior pupils from 1a (n = 18) and 1b (n = 23) with respectively 5% and 4% of pupils with the maximum score on post test, a relatively much higher percentage of pupils from classes 2a and 2b scored the maximum score. This indicates that senior classes' pupils might have been able to score higher on the post test than the maximum tested score. The ceiling effect might have limited the measurement of the true posttest score and learning gains of pupils from classes 2a and 2b.

2.6 CONCLUSIONS AND DISCUSSION

This study sought to explore the influence of teachers' perceptions of teaching/learning, technology and innovation on their technology integration of a technology-rich curriculum for emergent literacy and, in turn, the effects of integration on pupil learning outcomes. The findings of this study suggest that teacher perceptions about teaching/learning, technology and innovations can be related to the way in which teachers enacted the PictoPal. A developmental approach to teaching, perceiving technology as a tool for supporting learning, very positive expectations towards implementation of innovations, confidence in technology skills and perceiving support being provided by the principal in the face of work pressure are related to a high extent of technology integration. The findings in this study show that the teacher with a developmental approach to teaching perceived herself as a helper for pupils to construct meaning also integrated off computer activities to a higher extent than those who viewed themselves as facilitators who set conditions for learning. This finding is reminiscent of findings in a study by Hermans et al. (2008) which indicated that constructivist beliefs to learning favor technology integration. The developmental approach to teaching found in this study can be described as taking the role of helper and participating in childrens' activities (play) with computer generated products to encourage and enhance pupil use of literary products and related language. Although the teacher's developmental perspective on curriculum corresponded to substantial technology integration, the extent of integration did not necessarily influence pupil learning gains. Interestingly, the study shows that a facilitative approach to teaching along with a moderate extent of technology integration still led to significant pupil learning gains.

The facilitative role taken by teachers is different and can be described as minimal (verbal) involvement in children's' activity (play), providing children with the tasks and tools to elicit autonomous activity (play).

Also, the finding that positive attitudes towards technology favorably influence technology integration reflects the findings of Hermans et al. (2008). Positive expectations about the success of implementation, that is expecting implementation to occur with some degree of investment of effort and time and expecting a congruency between pupils' skills and the innovative learning environment, were found in this study to relate to high technology integration. Concerns about technology skills related to low technology integration. Feeling daunted by the amount of effort needed for technology integration related to a mediocre integration. Since all teachers used the same intervention, it would appear that not an absolute measure of practicality, but a teacher's perception of how practical (or not) an innovation is (cf. Doyle & Ponder, 1978) seems to have played an important role in influencing how these kindergarten teachers enacted the innovation.

Since all teachers perceived themselves as eager to learn about how to implement innovations and viewed PictoPal as an opportunity for learning, the 'willingness to learn' factor identified by Könings et al. (2006), had no differential impact on technology integration in this study. Technology integration seems to be influenced by teacher perceptions of principals' organizational support in the face of stressful working conditions such as time pressure. This finding is in congruence with the finding in the study of Inan and Lowther (2009) that perceived support provided by a principal positively influences teachers' technology integration. The finding in this study that kindergarten teachers working in the same school do not necessarily share the same perceptions on teaching/learning contradicts the previously suggested relation between shared set of educational beliefs in particular school context as reported by Hermans et al. (2008).

The findings on pupil engagement indicate that pupils from senior classes do engage more in activities than pupils from junior classes. The difference on computer behavior found between junior and senior kindergarteners can be explained with developmentally related language use among senior dyads. Senior kindergarteners' language use during engagement in computer play activity is richer in vocabulary and more socially-oriented compared to junior kindergarteners. Also, senior kindergarteners are more familiar with each other as they have already spent one kindergarten year interacting with each other. A potential implication for on-computer activities involving junior kindergarteners is to combine children familiar with each other to stimulate peer interaction about computer literacy activity and subsequent symbolic play in off-computer activity (Pellegrini & Galda, 1993). The finding that junior and senior kindergartener engagement during on-computer activities increases over time indicates that junior kindergartener's skills to work within and enjoy PictoPal also grow during PictoPal implementation. A cross cases it appears that senior kindergarteners were helping each other more and engaged more in collaboration among peers during computer activities than junior kindergarteners. A possible explanation for this difference could be that senior kindergarteners are familiar with each other and that their teachers encourage cooperation in their classes. The junior kindergarteners spent more time and attention on actively engaging in the literacy activity on computer during the eight weeks, which could possibly explain why junior kindergarteners learning gains were higher than those of senior kindergarteners.

The finding that integration of on- and off-computer activities increases over time suggests that teacher integration of the activities improves during the first few weeks of PictoPal implementation. This finding along with the finding that the extent of pupil engagement increases during first weeks, implies that sustained and effective implementation of PictoPal can be reached, even if a teacher enacting PictoPal holds a facilitative (as opposed to developmental) approach to teaching and integrates technology initially to a low extent. Findings also indicate that the high pupil learning gains cannot be related to the high extent of technology integration of on- and off-computer activities. An explanation can be a ceiling effect for the measurement of learning in classes 2a and 2b.

All studies have limitations. One is particularly notable in this study: testing emergent literacy. From the pre- and post-testing data, it appeared that a ceiling effect might have impaired the measurement of emergent literacy learning gains for the senior kindergarteners. Surprisingly, relatively more senior kindergarteners scored the maximum emergent literacy test score on a post test, compared to the scoring of the maximum score on the pre-test. The ceiling effect in the sample of senior kindergarteners needs to be acknowledged and addressed in future research. Future research could also examine teachers working in different kindergarten contexts for example kindergarten teachers teaching non-native Dutch kindergarteners, and teachers using other language curricula than do teachers in this study. Also, future research could examine if the findings pertaining to developmental and non-developmental approach to teaching hold true for kindergarten teachers with these teaching approaches. While this study focused on teachers enacting a curriculum they were provided with, a next study could examine what happens when teachers construct together curriculum and enact it in classes. Collaboration between teachers on an innovative design is claimed by Fullan (2003) to create a sense of ownership and commitment to an innovative effort and a sustained use of an innovative curriculum. Future research could focus on effects of involving teachers in a supported joint creation of a curriculum for emergent literacy.

CHAPTER 3†

The teacher as re-designer of technology integrated activities for an early literacy curriculum

Though popular among children outside of school, Dutch teachers often struggle to offer technology integrated activities in the kindergarten classroom. Because involving teachers in development of technology integrated activities can support their implementation, this study examines teachers in the role of re-designing such activities. Two case studies (Year 1 and Year 2) were undertaken in two consecutive years involving six teachers in re-design. Interviews were held to examine teacher team perceptions about their role as re-designers. Implementation of the re-designed activities was observed in five classes. A non-equivalent control quasi-experimental design was used to investigate pupil learning outcomes (Year 1: n = 102; Year 2: n = 119). Pupils in experimental groups outperformed pupils in control groups on early literacy. While the extent of integration increased as implementation continued, this could not explain the differences found in learning gains.

3.1 INTRODUCTION

Technology integration forms a challenge for many teachers. This is often difficult due to unclear teacher-student roles, which affect teacher perceptions concerning the relevance and benefits of technology integration for their classrooms (Ertmer, 2005). Also, teacher struggles to integrate technology in classrooms are commonly exacerbated by lack of planning time (Bauer & Kenton, 2005), and/or an active role in determining the importance of technology integration (Keengwe & Onchwari, 2009).

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The absence of teacher involvement in decision making regarding technology integrated curricula causes a gap between expected and actual curriculum implementation (Tondeur et al., 2007). Observations like this have prompted a shift from perceiving teachers as merely receivers of technology tools to perceiving them as active participants in re-designing curriculum to integrate technology (Parette, Quesenberry, & Blum, 2010). When determining the impact of ICT-activities on student learning, such activities cannot not be isolated from other activities in a learning environment (Kennewell, 2001; Lim, 2002).

An active role in which teachers, together with colleagues, plan for implementation and create ICT-activities for pupils can possibly be fruitful for actual implementation (Keengwe & Onchwari, 2009; Riel & Becker, 2008). Teacher involvement in design creates a sense of ownership and commitment to a curriculum (cf. Fullan, 2003). One way to involve teachers in curriculum development, while accounting for limited teacher time available, is involving teachers in collaborative *re*-design of existing materials. The re-designer role enables teachers to address challenges and possibilities in ICT-integration and have a clear voice in design while investing modest time and effort. As discussed in the following section, the role of re-designer may be fruitful for fostering the sense of ownership which can contribute to integrating ICT-activities in the classroom.

3.1.1 Teacher role as re-designer

Re-designing has parallels with something teachers do on a daily basis: adaptation. However, we use the term re-design in our case to emphasize the proactive work of adaptive planning, in contrast to making changes on the fly (which could also constitute adaptation). When re-designing, teachers examine and reflect on existing activities and materials; set goals for re-design; discuss and change activities to meet the re-design goals; and discuss how to implement the re-designed activities. Kenny and McDaniel (2011) found that teacher involvement in exploration of technology positively affected teacher's judgments and expectations about the value of technology. Through hands-on opportunities involving actual integrated lessons, teachers can begin to identify the relevance and learn about successful implementation of ICT-activities (Keengwe & Onchwari, 2009). While Kenny and McDaniel (2011) note that identifying relevance and envisioning scenarios for implementation are preconditions for teacher motivation to integrate technology, they also suggest that successful implementation of ICT-activities correlates with teachers views about what is *feasible*, and not necessarily with positive views about technology.

Teacher feasibility concerns have been well-examined. Doyle and Ponder (1978) refer to this issue as 'the practicality ethic' and identify three salient components. First, teachers consider how well specified an innovation is. Second, teachers consider the relation between the effort they invest (costs) and the benefits of the innovation for their classroom. And third, teachers consider how congruent the innovation is with their convictions, classroom setting and specific students. Through participation in development, teachers naturally attend to these issues, thus directly increasing the practicality of an innovation. In addition, involvement in development may foster teacher ownership of the developed innovation (Kirk & MacDonald, 2001), which could also positively influence their sense of feasibility/practicality. Finally, designing ICT-activities can help primary school teachers reflect on and develop their own ideas about their teaching (Angeli & Valanides, 2009).

Re-designing ICT-activities in a team allows for sharing understanding of what must be revised, based on what teachers view feasible in their classes and what effort is needed for implementation. Team-based development can result in teachers' taking co-ownership of the innovation. However, the team-outcome is also influenced by the team-based process, for example, team functioning (Tillema & van der Westhuizen, 2006), design skills and expertise, team leadership, team size and time (Crow & Pounder, 2000).

Involving teams of teachers in developing ICT-activities may help teachers gain understanding about the curriculum at hand (Koehler & Mishra, 2005), and shape a shared belief about the innovation, as one's own views may also be guided by the views of teachers as a group (Kenny & McDaniel, 2011). According to Penuel, Roschelle and Shechtman (2007), teacher teams can work with developers to create an implementable innovation in which technology is used in order to meet a common educational goal. The present study was undertaken to understand better the role of teacher as re-designer. It involved teachers in a team to re-design PictoPal and examined their perceptions about co-ownership, curriculum quality and practicality as well as their perceptions on team re-design. In addition implementation of the re-designed activities was examined along with pupil learning.

3.1.2 Context of this study: Re-designing PictoPal activities

In this study, teachers re-design and use PictoPal activities. PictoPal is a learning environment designed to stimulate early literacy development through meaningfully integrated on-and off computer activities. In line with good practice concerning technology use with young children, PictoPal activities are integrated in everyday activities, and not separate (cf. Sheridan & Pramling Samuelson, 2003). PictoPal focuses on four Dutch national attainment goals for early literacy (1) functional reading and writing (2) function of written language (3) relationship between spoken and written language and (4) language consciousness. One set of PictoPal learning activities consists of eight on-computer activities to compose and construct small texts, each with a corresponding off-computer application activity in which the printed text is used for fully authentic purposes (e.g. a weather forecast is given to the class) or semi-authentic purposes (e.g. as essential props in role-play, [cf. Brooker, 2003]).

In the on-computer activity shown in Figure 3.1, children compose letters; and in the off-computer activity shown in Figure 3.2, children mail their letters. PictoPal activities can be changed by teachers who wish to attune them to specific learner needs and/or curricular goals. In this study, teachers re-designed an existing set of PictoPal activities related to springtime to fit with winter themes. Besides the thematic change, teachers wanted the re-designed materials to explicitly stimulate independent work while also building on pupil prior knowledge and vocabulary.

Figure 3.1 On-computer activity: Composing invitation letter

Figure 3.2 Off-computer activity: Children mailing the letters

3.2 METHOD

A case study method (Yin, 2003) was used to study teacher perceptions and implementation of their re-designed PictoPal activities. A pre-test post-test quasi-experimental design was used to examine the impact of the re-designed activities on pupils' early literacy learning outcomes. The question guiding this study was: *What does teacher involvement in re-designing technology integrated activities, imply for implementation and learning outcomes?*

The findings of this study are presented following these sub-questions:

1. What are teacher team perceptions about collaborative re-design of technology integrated activities for an early literacy curriculum?
2. What are teacher perceptions about their role as re-designer and their co-ownership?
3. What are teacher perceptions about quality and practicality of the re-designed activities?
4. How do teachers implement the re-designed activities?
5. What are pupil learning outcomes?

3.2.1 Participants and intervention

This study was conducted in the Netherlands in one primary school with three campuses. In one campus, a team of kindergarten teachers (n = 6) re-designed PictoPal activities which were then implemented during eight weeks. The intervention took place twice during two years. The first time (Year 1) four teachers (Iris, Mira, Diana, and Fiona) re-designed PictoPal to fit the curriculum thematically. Two teachers, Iris and Mira, implemented the re-designed activities in their kindergarten classes. The other two teachers were not involved in implementation because they were no longer teaching kindergarten during that time. The second time (Year 2) four teachers (Alice, Jet, Diana, and Fiona) re-designed Year 1-PictoPal activities to simplify implementation by lowering the difficulty and thereby enabling pupils to work more independently. In Year 2, three teachers (Diana, Jet and Alice) implemented the re-designed activities. Fiona was not involved in implementation.

Prior to Year 1 two teachers (Diana and Fiona) experienced PictoPal-implementation during eight weeks (see also Cviko, McKenney, & Voogt, 2012), two teachers (Mira and Iris) had not experienced PictoPal. Table 3.1 shows an overview of participants in Year 1, their teaching experience in years and experiences with PictoPal prior to Year 1-re-design. Table 3.2 shows an overview of the Year 2-participants with their experiences in teaching with PictoPal. Both tables indicate how many pupils were in the classes of teachers implementing PictoPal and how many from the other two campuses participated in control groups. To study the impact of PictoPal on pupil learning, 102 pupils participated in Year 1 (experimental condition n = 49; control condition = 53) and 119 pupils in Year 2 (experimental condition n = 65; control condition = 54). Control group pupils and experimental group pupils come from one primary school, with three campuses in which teachers use same language curriculum. Also, teachers of the control and experimental groups have similar teaching experience and have common goals, pedagogy and assessment regarding language education in the kindergarten, which they align through frequent team meetings. National language test scores (administered shortly before the intervention), indicate that pupil language skills were comparable in the experimental and the control group. All pupils, whether in the experimental or control group, used computers on a regular basis for learning with educational software accompanying the language curriculum and for other subject areas. One set of on-computer and off-computer PictoPal activities was used in the experimental group; no treatment was given in the control group.

Table 3.1 *Participants in Year 1 (experimental condition)*

Teachers involved in re-design	Teaching experience	PictoPal experience prior to Year 1	Pupils per class (Exp.)
Fiona	33	Implementation prior to Year 1	NA
Diana	13	Implementation prior to Year 1	NA
Iris	2	None	24
Mira	3	None	25

Note: NA not applicable, because the teachers did not implement PictoPal.

Table 3.2 *Participants in Year 2 (experimental condition)*

Teachers involved in re-design	Teaching experience	PictoPal experience prior to Year 1 and Year 2	Pupils per class (Exp.)
Fiona	33	Implementation prior to Year 1 and re-design prior to Year 2	NA
Alice	23	Implementation prior to Year 1 and prior to Year 2	24
Diana	14	Implementation prior to Year 1 and re-design prior to Year 2	22
Jet	6	None	19

Note: NA not applicable, because the teachers did not implement PictoPal.

3.2.2 Procedure and instruments

Teachers agreed to come together to re-design activities linked to the theme of Winter. In each year (1 and 2, respectively), four teachers participated in re-design. In Year 1, the main revision was content. In Year 2, teachers' main aim was to render PictoPal (a) more suitable for the junior kindergarteners and (b) easier for children to use PictoPal independently. Both teams spent nine hours in total on re-design. In both years PictoPal was implemented during eight weeks.

Teachers were interviewed about working in a team, including how they perceived the team: functioning, value, activities, expertise, leadership, focus, and skills to re-design technology integrated activities. Also, teachers were interviewed about their re-designer role, Pictopal activity quality and practicality.

The implementation of PictoPal-activities was observed by two researchers using the Integration Checklist (Verseput, 2008b), which consists of 12 items measuring the extent of integration of the on- and off -computer activities. The items relate to (1) involving pupils, (2) initiating listening, (3) initiating speaking, (4) initiating writing, (5) initiating reading, (6) play with writings, (7) initiating activity, (8) initiating collaboration, (9) initiating individual work, (10) providing support, (11) initiating talk on process, and (12) initiating talk on product. An example item is: "The teacher creates the opportunity for pupils to talk about their products". Each observation of an activity took approximately 20 minutes. The items were scored on a 3-point scale with 0 indicating the target behaviour is absent, .5 indicating the behaviour is observable to some extent, and 1 indicating the target behaviour is observable to a great extent. The inter-rater reliability based on ratings of two raters indicated sufficient agreement Cohen's kappa = .71. Pupils were pre- and post-tested using an early literacy test for 4-5 year olds (McKenney & Voogt, 2006).

3.2.3 Data analysis

Interviews were first summarized per question and then responses between teachers were compared and contrasted. The observation data was analysed using analyses of variance (ANOVA) to examine the hypothesis that there was no difference in implementation between teachers. The similarity of the groups was determined by scores on a Dutch national language test for kindergarteners. Analyses of covariance (ANCOVA) was used to test the hypothesis that there were no differences in learning outcomes between the control and experimental groups as well as the hypothesis that there were no differences between the PictoPal-classes.

3.4 Results

3.4.1 Re-design

When asked about working in a team, teachers of both teams were positive. They valued the experience they had with classroom practices in kindergarten. Team 1 (Year 1) especially appreciated the exchange of ideas; while team 2 (Year 2) was more motivated by the perceived need to re-design the PictoPal activities. Team 2 teachers acknowledged the value of collaborating in a team to understand PictoPal thoroughly, which supported teacher decisions when later implementing the activities. Team activities were intense. Teachers of both teams felt sufficiently skilled to re-design the activities. Teachers shared their perceptions about a shared goal, focus and leadership in a team. In Table 3.3 team perceptions about re-design team Year 1 and -Year 2 are shown.

Table 3.3 *Team perceptions of Year 1 and Year 2 - re-design team*

	Year 1 team	**Year 2 team**
Working in a team/team functioning, and value of a team	*Positive, because have already worked as a kindergarten team on curricular decisions *Exchange of ideas and proposals adds to the value of a team	* Teachers complement each other in a re-design team, due to the existing working relations and cooperation *Positive. Re-design for differentiation was a necessary step
Team activities	*Call for creativity, working intensively on pupil-oriented content, structure and alignment with the audio and visual possibilities *Shared goal, confidence in the final product *Understanding re-design structure	*Clear, small framework, positive about team size: working in a small team *Teachers goals and principles were aligned, because of shared understanding of kindergarten class practice *Much time was spent on certain aspects, yet every time something useful came out of it
Team expertise	*Sufficient for the re-design because teachers differ in experience with teaching and adapting curriculum *No need for the presence of a language expert	*Same expertise, homogenous team, because all share experience with teaching kindergarten *Teachers had same approach, aimed at kindergarteners, several years of experience with kindergarteners

Table 3.3 *Team perceptions of Year 1 and Year 2 - re-design team (Continued)*

	Year 1 team	Year 2 team
Team leadership and focus in a team	*Shared due to equal teacher participation, joint setting of re-design objectives and plan	* Shared leadership, Fiona lead a team organisationally
Skills to re-design the on- and off-computer activities	*Skilled to adapt their kindergarten curriculum to the pupils of their classrooms, but felt that the adaptation of the activities was new for them	* Skilled to re-design

3.4.2 Re-designer role and co-ownership

When asked about their role as re-designer, teachers of the Year 1 team reported that, although the re-design purpose and procedure was explained, the process was new. They perceived their new understanding about re-design to be an enrichment of their skills. Teachers' understanding about re-design can be related to the choices teachers made on what to include as revisions; and the links between the re-designed activities and their existing language curriculum. In team discussions, teachers reasoned about their proposals in relation to the re-design goals (more emphasis on activities suitable for junior kindergarteners and enabling pupils to work more independently). Also, teachers discussed how the re-designed activities fit into existing curriculum thematically and how to connect them. Teachers reported taking responsibility for content, vocabulary, and difficulty level. These teacher perceptions can be related to the responsibility for re-design, which teachers were expected to take in their role as re-designer. Specifically, the perception relates to team discussion about how the proposed activities would elicit enthusiasm and meaningful engagement in kindergarteners.

Only Mira reported questioning herself during the re-design as to why she took on the responsibility. She explained that she dealt with doubts about her role:

"I have nothing against team work, on the contrary I am in favour of re-designing kindergarten activities as it is fun and fruitful for learning. I was not sure about the purpose of re-design… was the purpose to help curriculum makers adapt curriculum?"

From Mira's perspective the responsibility for re-design does not fit the task of a teacher. Fiona, Diana, Iris, Alice and Jet perceived re-designing technology integrated activities as being not a regular practice of teachers. Year 1 teachers compared their role as re-designer with the situation in which the kindergarten teacher team adapts the curriculum to the classroom composition and particular pupil needs. Year 1 teachers perceived the team product as co-owned, because of the joined responsibility for product re-design.

Year 2 teachers described their role as thinking along with a team. Teachers perceived themselves as contributors to a shared view about re-design goals, and ways to meet those goals. Alice felt that creative thinking is one of her strengths. She also knows what is possible with her kindergarteners, and felt able to offer realistic suggestions for re-design. Jet was particularly focused on elements attuned to the needs of junior kindergarteners, and evaluated suggested activities in light of how junior kindergarteners would execute them. Jet was especially concerned with feasibility, by considering if implementation would even be possible. In her view, the role of re-designer makes a teacher reflect about one's own actions, classroom organization, and practical knowledge. Jet felt that:

> "*Re-designing can be an endless task, at a certain moment you have to be content with the end product.*"

Teachers felt the commitment of the team was excellent, because teacher collaboration was found important, regardless of what the task at hand is. Year 2 teachers felt little co-ownership, because in their view they have only contributed ideas, which were written on paper during re-design and afterwards incorporated into pupil on- and off -computer activities.

3.4.3 Activity quality and practicality

When asked about activity quality, Year 1 teachers reported confidence about implementation, as the re-designed activities met the goals teachers intended and because the re-designed activities were written in teachers' guides with possible suggestions meant to support implementation. For teachers, this implied that the quality of the re-designed activities was good. Year 2 teachers felt they succeeded in the re-design, because the re-designed activities were appealing to kindergartners and were aligned with pupil world view. All teachers were confident about the quality of the team end product, but Jet, involved for the first time in re-design, felt the end product should be reviewed by an expert.

During re-design teachers questioned the practicality of PictoPal, on the other hand they saw during implementation that kindergarteners enjoyed working with the learning environment. In their view, kindergarteners should rather engage independently with PictoPal. Even though teachers re-designed activities in Year 2 to fit better to junior kindergarteners, teachers felt that children were able to conduct the activities completely independently. They concluded that PictoPal is more usable for gifted children, because then no adult guidance is needed.

When asked about their practicality considerations, Year 1 teachers felt they were intensively involved, but that the efforts put into collaborative re-design were in balance with the expected pay offs in their classrooms. Also, Year 2 teachers felt that efforts invested in re-design were sufficient for the expected pay offs in the classroom.

Jet found that the invested time was necessary to thoroughly re-design activities, so that both junior and senior kindergarteners could work on their own level. This means that re-design also involved teacher considerations about congruency with classroom/pupil needs: how congruent the activities are with the junior and senior kindergarteners level. Alice felt that:

"re-design was not a burden, although it was intensive and you needed to be fully concentrated. The benefit was knowing PictoPal, so that it is easier to implement."

3.4.4 Implementation

All five teachers involved in re-design implemented the on- and off -computer activities during eight weeks. The first off-computer activity was not implemented by Alice and Jet and the sixth off-computer activity was not implemented by Jet due to time constraints. Kindergarteners took home the products of the first and sixth on- computer activities (*1. List of favourite winter clothes and 6. A letter to a relative*).

Table 3.4 shows the overall integration mean scores over eight activities with standard deviations per class to describe the extent to which teachers integrated Year 1 or Year 2 activities with other elements of class work and instruction. We expected that teacher involvement in re-design would have an impact on the start of implementation, that the teachers involved would start with comparable levels of integration.

In the 1st week, teachers' extent of integration seemed to vary much more than in the 8th week. To reveal any differences between teachers in the overall extent of integration, an ANOVA was performed. This showed, however, no significant differences, probably due to standard deviations. Teachers scoring relatively low on integration (for instance Alice and Jet) had large standard deviations.

Table 3.4 *Teachers implementing PictoPal per year, their classes and numbers of pupils, and teacher integration of on-and off-computer activities overall means and standard deviations*

Teacher	**Classes and pupils (*n*)**	**Integration (*n* = 8) Mean *(SD)***
Year 1		
Iris	Junior class (24)	6.69 (1.44)
Mira	Junior class (25)	7.63 (2.03)
Year 2		
Jet	Junior class (19)	5.38 (4.38)
Diana	Senior class (22)	8.13 (1.30)
Alice	Senior class (24)	5.13 (3.10)

However, significant mean differences between teachers were observed on the integration items 'initiating writing' F (4, 32) = 5.898, $p < .05$, $\eta^2 = .42$ and 'play with writings' F (4, 32) = 4.059, $p < .05$, $\eta^2 = .34$. Figure 3.3 shows the distribution of the mean scores on twelve integration items for the five classes in which teachers and children were observed during eight off-computer activities. From the graph, it appears that in each class a quite similar integration mean score was reached. To reveal between-class differences in initiating writing, a post hoc test was performed. This showed that teacher Iris $M = .63$, $SD = .23$ was observed to encourage kindergarteners to write during applications of the printed computer products and that accordingly in her class children engaged in writing more than it was observed in class of Jet $M = .17$, $SD = .40$, Diana $M = .25$, $SD = .27$, and Alice $M = .43$, $SD = .36$. Also, Mira $M = .75$, $SD = .27$ scored significantly higher on initiating writing than Jet, Diana and Alice. Mira $M = .86$, $SD = .35$ and Diana $M = .94$, $SD = .18$ scored significantly higher on encouraging kindergarteners to play with writings they had previously produced on computers than Iris $M = .56$, $SD = .18$ and Alice $M = .50$, $SD = .29$. The teacher emphasis differed thus only when looking at specific items measuring integration of activities.

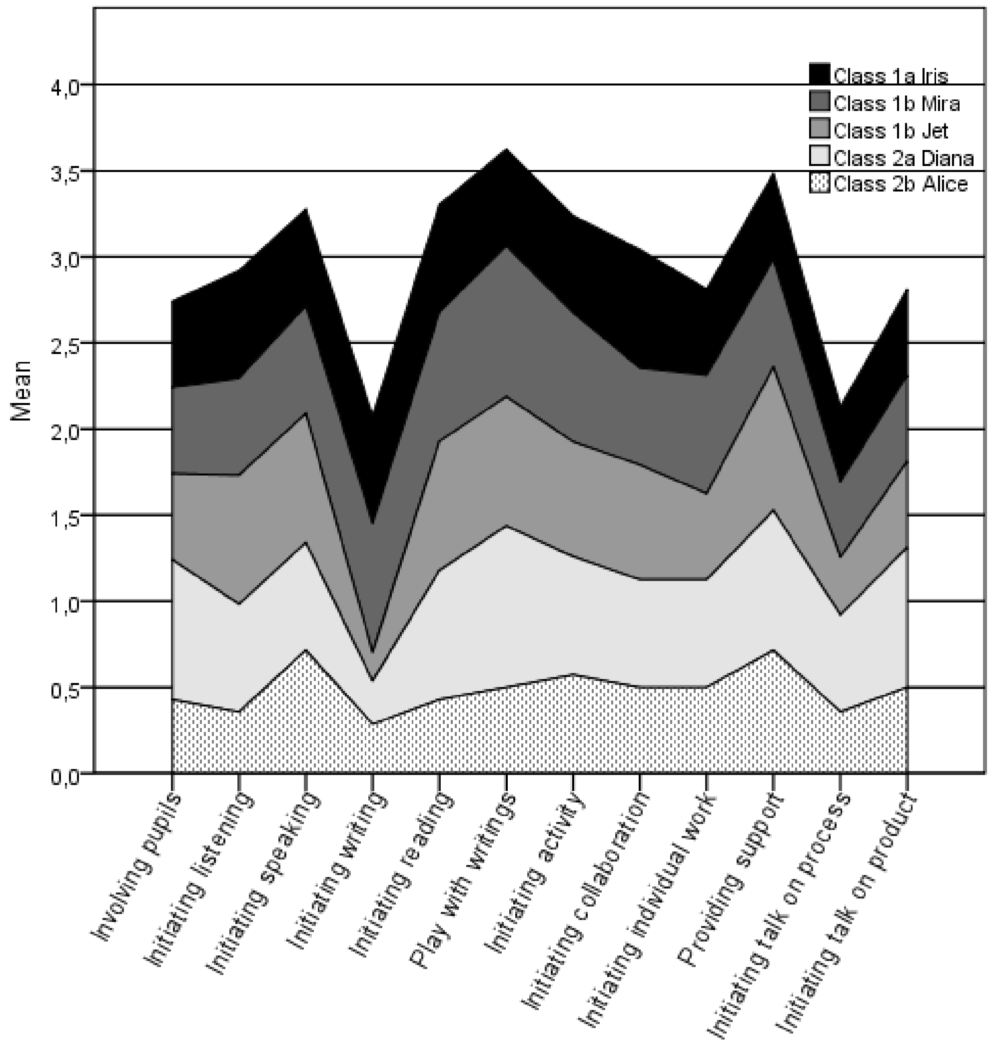

Figure 3.3 Distribution of mean scores per class on the items of integration of eight on- and off-computer activities

In Figure 3.4, the extent of integration is shown over the time of eight weeks that the five teachers implemented eight successive PictoPal-activities in their classrooms. To reveal how implementation changed over time, a regression analysis was performed. Although the extent of integration increased over the time of eight weeks Iris, Diana, Alice and Jet work with PictoPal, time was not a significant predictor for their integration. Only for Mira could a significant proportion of variance in implementation be explained by time $R^2 = .72$, $F\ (1, 6) = 15.25$, $p < .05$. For teachers Alice and Jet, a proportion of variance in integration explained by time was low and non-significant, respectively $R^2 = .51$ and $R^2 = .16$.

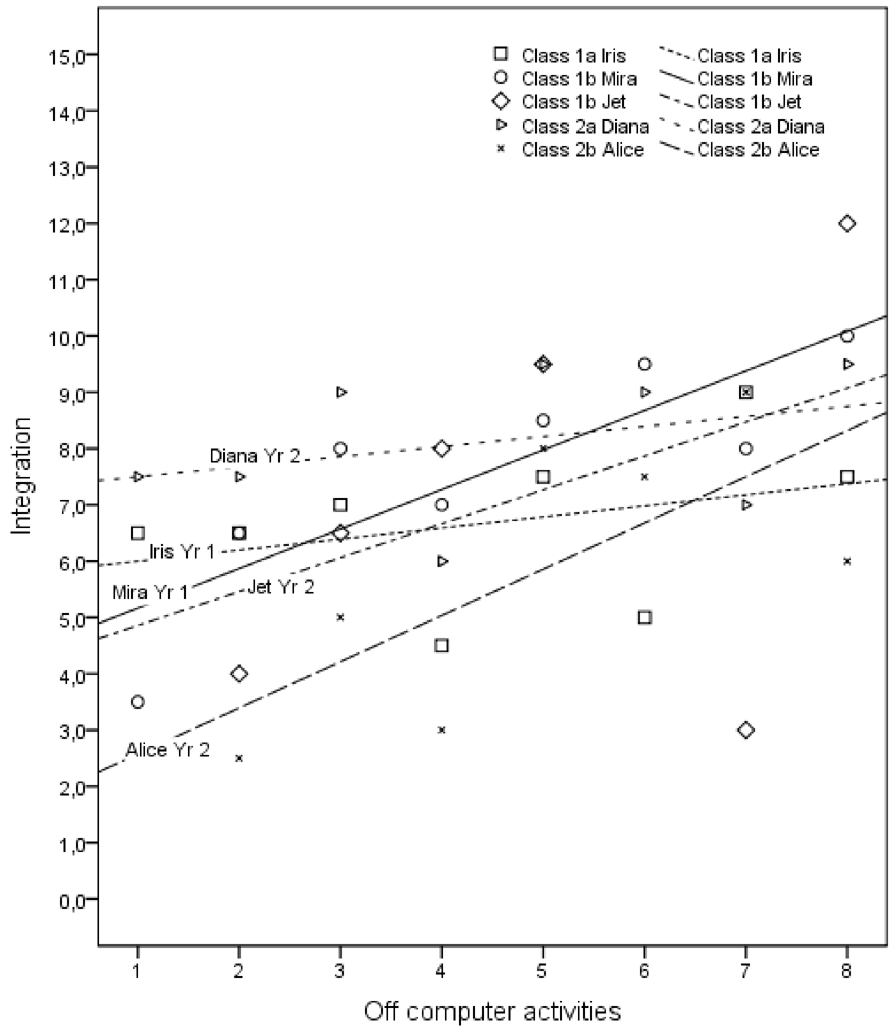

Figure 3.4 The integration of the eight off-computer activities in each class

However, as Jet did not implement activities 1 and 6, this result should be interpreted with caution. This teacher joined the school that year and was not acquainted with the language curriculum, which could explain her reported constraints for not implementing activities 1 and 6. The extent of integration by Alice and Jet varied much from week to week and was dependent of the activity they implemented. This could mean that Alice and Jet might have experimented during the eight weeks with how to implement PictoPal. Also, for Iris and Diana, the proportion of variance in integration explained by time was low and non-significant, respectively R^2 = .11 and R^2 = .11. This result could be explained by their relatively high integration means at the start of implementation, which appear to stay stable across activities. Iris and Diana started with relatively high means of integration and had low standard deviations and thus could not improve much. Diana (experienced with PictoPal re-design and implementation) and Alice (experienced in implementation only) seemed to evolve differently during Year 2 implementation. Diana appeared to start with a relatively high extent of integration and to maintain a certain extent throughout the activities (*SD* = 1.30); while Alice started relatively low and varied much in integration during implementation (*SD* = 3.10). The implementation findings identify little on how teacher involvement in re-design teams affected implementation or changes in extents of integration over time.

3.4.5 Pupil learning with PictoPal activities year 1 and year 2

Tables 3.5 and 3.6 show the number of pupils, the mean score and the standard deviation of the early literacy pre- and post-test of the experimental and control groups of Year 1 and Year 2.

Table 3.5 *Number of pupils, means, standard deviations and effect sizes of experimental and control group Year 1*

	Pre test		**Post test**		**Learning gain**		**Effect size**
	n	*M (SD)*[a]	*n*	*M (SD)*	*n*	*M (SD)*	Cohen's *d*
Experimental group	45	9.24 (3.12)	50	13.38 (3.50)	45	4.13 (3.09)*	1.25
Control group	54	11.26 (3.59)	45	13.00 (3.27)	50	1.96 (2.70)	.58

Note: *Significant at the alpha level of 0.05; [a] Adjusted for national language test scores.

To reveal impact of PictoPal Year 1 on pupil early literacy, an ANCOVA was conducted with Year 1 pre-post differences as dependent variable, group (Year 1 experimental and control group) as independent variable, and scores on the national language test as a covariate. This showed a significant difference for group F (1, 92) = 10.645, p < .05, η^2 = .10. The learning gains of pupils from the experimental group (pupils from classes of Iris and Mira) M = 4.13, SD = 2.70 were higher than the learning gains of pupils from the control group M = 1.96, SD = 2.70. An ANCOVA with Year 2 pre-post differences as dependent variable, group (Year 2 experimental and control group) as independent variable, and scores on the national language test as a covariate showed a significant difference for group F (1, 106) = 10.395, p < .05, η^2 = .09. The learning gains of pupils from the experimental group (pupils from classes of Jet, Diana and Alice) M = 2.96, SD = 2.92 were higher than the learning gains of pupils from the control group M = 1.10, SD = 3.65.

Table 3.6 *Number of pupils, means, standard deviations and effect sizes of experimental and control group Year 2*

	Pre test		**Post test**		**Learning gain**		**Effect size**
	n	*M (SD)*[a]	*n*	*M (SD)*	*n*	*M (SD)*	Cohen's *d*
Experimental group	58	12.36 (3.24)	58	15.40 (2.65)	57	2.96 (2.92)*	1.03
Control group	53	14.17 (2.94)	53	15.09 (3.13)	52	1.10 (3.65)	.30

Note: * Significant at the alpha level of 0.05; [a] Adjusted for national language test scores.

3.4.6 Pupil learning per classroom with PictoPal activities year 1 and year 2

Table 3.7 shows an overview of the number of pupils, the pre- and post-test mean scores, standard deviations and effect sizes per classroom. To reveal differences for classes an ANCOVA was performed with pre-post differences as dependent variable, Year 1- classes (classes of Iris and Mira) as an independent variable, and scores on the national language test as a covariate. This showed a significant difference for class F (1, 42) = 5.062, p < .05, η^2 = .11. The learning gains of pupils from the class of Iris M = 5.08, SD = 2.73, n = 24 were higher than the learning gains of pupils from the class of Mira M = 3.05, SD = 3.17, n = 21. An ANCOVA with pre-post differences as dependent variable, Year 2-classes (class of Jet, class of Diana, and class of Alice) as an independent variable, and scores on the national language test as a covariate showed a significant difference for class F (2, 53) = 5.455, p < .05, η^2 = .17. The learning gains of pupils from the class of Jet M = 4.88, SD = 2.39, n = 17 were higher than the learning gains of pupils from the classes of Diana M = 1.64, SD = 2.54, n = 22 and Alice M = 2.78, SD = 2.94, n = 18.

Table 3.7 *Number of pupils, means, standard deviations and effect sizes of teachers as re-designers classes*

		Pupil learning			
Teacher	**Class pupils** (*n*)	*Pre-test M (SD)* [a]	*Post-test M (SD)*	*Learning gain M (SD)*	*Cohen's d*
Year 1					
Iris	Junior class (24)	9.48 (2.65)	14.42 (3.59)	5.08 (2.73)*	1.57
Mira	Junior class (25)	9.14 (3.69)	11.84 (3.12)	3.05 (3.17)	.79
Year 2					
Jet	Junior class (19)	9.63 (2.24)	14.55 (2.42)	5.00 (2.38)*	2.11
Diana	Senior class (22)	13.77 (2.39)	15.17 (2.93)	1.64 (2.54)	.52
Alice	Senior class (24)	13.38 (3.25)	16.17 (2.41)	2.78 (2.94)	.98

Note: *Significant at the level 0.05; [a] Adjusted for national language test scores.

3.5 Discussion

This study aimed to gain a better understanding of the implications of teacher involvement in the re-design of technology integrated activities for implementation and pupil learning. For design of curricular experiences and teacher professional development the findings about teacher team perceptions imply that teachers collaboration is grounded in existing team functioning, shared team leadership, shared understanding of kindergarten practice, and common goals. Also, the finding that teachers were convinced of being skilled to re-design activities and have enough expertise in their team implies that the role as a re-designer is proximal to a daily teacher role, yet also suggests that teachers might overstate their actual skills to re-design ICT-integrated activities. Teacher appreciation for the small team size suggests re-design teams should remain small to foster focus and productivity. Also, when supporting re-design teams teacher experience with ICT-integrated activities could account for teacher perceptions about team activities.

When involving teachers in re-designing, the re-design activity should contain discussion about the role of re-designer, especially about how that the role carries responsibilities for content, activity purposes and alignment between content and goals. Also, researchers should explicitly explain the purpose(s) of the re-designer role.

Teacher considerations of re-designing in the light of their satisfaction with the team-product seems to be an important aspect for this role. Teachers could be supported in reflecting about how a re-designed product meets intended goals, how satisfied teachers are with the interim product and what time and effort it takes to reach the product teachers expect to be ready for implementation. Such interim reflection moments could help teachers monitor their re-design tasks and define how they will know if/when they are satisfied with the end product.

Teacher involvement in re-design seems to have a mixed effect on teacher perceptions about the role. The role of re-designer seems to provide teachers with an opportunity to collectively reach an understanding about the activities and to how to implement them. The role of re-designer allowed for informed judgment concerning the pupils for whom the activities are best suited. The value of the role of re-designer lies in collaboration on pupil learning and creating activities relevant for teachers. Being in the role of re-designer of PictoPal, adaptations required more (collaborative) work on coherency between structure, content, technology, planning and classroom practice compared to the work in the existing kindergarten team. In line with Lloyd and McRobbie (2005) and Levin and Wadmany (2006) this study suggests situating teacher understanding in a context and content of their regular classroom practice as a powerful act through which integration of ICT in classrooms can be supported. The relevance of the role as re-designer for teacher work could be sustained by providing collaborating teachers with support and opportunities in their schools that enable them to continue.

After this study, teachers continued implementation of both Year-1- and Year-2-activities in kindergarten classes. Also, teachers of one of the other campuses started to implement PictoPal activities, which can be an indication that the sense of co-ownership is shared throughout the school. The continuation indicated that teachers do feel co-owner of the re-designed activities and that sustainability can be expected in these schools campuses.

The finding that teachers in this study were positive about the practicality and quality of curriculum activities they had re-designed is in accordance with the finding that teacher judgments and expectations about technology-rich activities are affected by their involvement in exploration of technology (Kenny & McDaniel, 2011). However, this study indicates another factor influencing teacher considerations about the practicality of activities. Specifically, implementation of PictoPal- Year 1seemed to affect teachers practicality considerations concerning the level of guidance required by junior kindergarteners to work independently, because after implementation of Year 1, activities were re-designed to better suit junior kindergarteners needs and enable them to use PictoPal more independently. Also, teacher perceptions after Year 2 implementation in which they felt that PictoPal might be more suitable for talented pupils could suggests that prior to implementation, teachers expected to reach independent pupil performance, which was not met after actual implementation. From implementation findings it cannot be identified how teacher involvement in re-design teams could have affected integration or changes in extents of integration over time while they worked with PictoPal. Results showed that teachers did not differ on the overall integration. An explanation for this result could be the small sample size. A larger sample size could add to the strength of this conclusion. Teacher prior experience with the implementation of PictoPal did not have a differential impact on integration, as for instance Alice who had experience with

PictoPal implementation did not integrate better than other teachers. Teachers were found to be equally prepared to implement PictoPal, yet they progressed differently during the eight weeks of implementation. The finding that for one teacher the extent of integration during the eight weeks increases, implies individual differences in integration over time, namely that some teachers could be expected to be able to improve the extent of integration. Other teachers (Diana and Iris) started with high integration and could not improve much. Also, high versus low standard deviations of integration scores implies that teachers develop differently during the eight weeks. This study suggests that there might be different groups of teachers within the way they implement PictoPal: a teacher who improved integration (Mira), teachers who are stable over eight weeks (Iris and Diana), and those who vary considerably in their extent of integration across activities (Jet and Alice).

The shared understanding of the re-designed activities and the perception that re-design is beneficial for implementation could have contributed to the integration. Thanks to other team members, teachers might have experimented to find adequate ways to implement PictoPal in their practice. Fullan (2002) calls early difficulties of trying something new an ‘implementation dip’, which teachers can experience during initial implementation and suggests that continuous support during this time is important. Support from re-design team-members and experimentation with the innovation in existing practice could be a possible explanation for the finding that some teachers start with low extent of integration, subsequently vary across activities, yet do not considerably differ from colleagues. Teachers who improved integration considerably in the eight weeks could have had profit from the available support from re-design team members.

In all classes, medium or large effect sizes were reached for pupil learning gains. Only significantly higher learning gains were found for the junior pupils of Iris and Jet. Also for these junior classes large effect sizes were found. This could mean that junior classes profit more from PictoPal than senior classes do. The junior learning gains cannot easily be explained by the extent their teachers’ integration. There seems to be no relationship between the way teachers develop during implementation (during eight weeks) and the differences found in attainment. This is in line with the finding in the study of Cviko et al. (2012) that high integration means do not relate to high pupil learning gains. Both Year 1 and Year 2 activities yielded enhanced early literacy learning gains compared to the control groups.

The study suggests that when teachers are involved in re-design of activitites, pupils appear to learn well. Teachers in the experimental condition implemented all of the planned activities, but the extent of integration of the activates varied. For the teachers who varied substantially in their score across weeks (Mira, Alice and Jet), it might have been possible to find differences in integration means if the duration had been longer than eight weeks. Also, the study suggests that the teachers involved in re-design tend to grow differently during implementation, and that the differences in development are not explanatory for differences in pupils leaning gains. Differences in learning gains are more likely related to pupil factors than to the extent of integration. Active participation in re-design might have informed teaching early literacy, for instance enhanced awareness of and good practices related to language teaching and as such be considered as a professional development opportunity possibly contributing to changes in classroom practice. In order to control for this factor, a larger study could be needed. Also, additional observations of the degree and nature of early literacy learning opportunities teachers and parents offer, could be insightful for an explanation.

Since this study suggests that being involved in re-designing technology-rich activities can be fruitful for teacher experiences of co-ownership, a subsequent study could explore what kind of involvement appeals to teachers and encourages full responsibility for (re-)design. For example, the collaborative design of completely new activities could give teachers more freedom but also more responsibility. By experimenting with the role of co-designer, teachers might accept and develop this role alongside their existing role as classroom teacher (Carlgren, 1999). Teacher voice in curriculum development and teacher collaboration on designing new activities can result in an implementable innovation (Kirk & MacDonald, 2001; Penuel, Roschelle & Shechtman, 2007), sense of co-ownership of the innovation and sustained curriculum use (Fullan, 2003). This study demonstrates that the role of re-designer is a viable approach to teacher involvement which can yield an implementable innovation that is co-owned by the participants and used for a longer period of time.

CHAPTER 4‡

Teachers as co-designers of technology-rich learning media and activities for early literacy

Although kindergarten teachers often struggle with implementing technology, they are rarely involved in co-designing technology-rich learning media. This study involved teachers in the co-design of technology-rich learning media and sought to explore implementation and pupil learning outcomes. A case-study method was used to investigate: the co-design experiences of seven teachers; implementation in three kindergarten classes; and pupil learning outcomes. Interviews were used to study teacher perceptions about pedagogy, technology, early literacy, co-designer role, practicality and co-ownership. Process notes were made during design team meetings. Observations were made of implementation, and pupil learning was pre- and post-tested in non-equivalent control quasi-experimental design (n = 111). Findings indicate that teacher perceptions about pedagogy affect their co-design involvement. The extent of integration of on- and off-computer activities was similar between teachers. Significant pupil learning gains were found, thus indicating that the co-designed media and activities had positive effects on pupil learning outcomes.

4.1 INTRODUCTION

Although technology–integrated curricula can support early literacy in kindergarteners, often kindergarten teachers struggle to implement technology in developmentally appropriate ways (Parette et al. 2010). Involvement in development of classroom curricula gives teachers a voice in curriculum decision-making (Carl, 2009) and can enhance teacher understanding of the learning environment being created (Cochran-Smith & Lytle, 1999).

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‡ This chapter has been submitted as: Cviko, A., McKenney, S., & Voogt, J. (submitted). Teachers as co-designers of technology-integrated activities for an early literacy curriculum.

Teachers' perceptions about pedagogy, technology and curriculum content could influence co-design of curriculum activities. Also, teachers' perceptions about their role seem related to teachers' involvement in curriculum design. Involvement in development of classroom curricula could foster a sense of ownership (Fullan, 2003) and teachers' perceptions about curriculum practicality, which in turn could influence implementation. Toward understanding how implementation can be facilitated, the present study involves kindergarten teachers in the co-design and implementation of curricular media. The study set out to examine: how the teachers co-design media and related activities; view technology, pedagogy and early literacy; how teachers perceive the co-designer role; co-ownership; and curriculum practicality. Further, the present study examines implementation and pupil learning outcomes. The main focus of the study was on the role of teachers as co-designers of technology- integrated curriculum. First, the literature is reviewed to indicate factors influencing teachers' curriculum design and implementation. Thereafter, findings are presented and implication discussed.

4.2 FACTORS RELATED TO TEACHER ROLE 'CO-DESIGNER'

Teacher involvement in the design of curriculum activities could positively influence implementation, because they can discover the classroom relevance and create opportunities for success (Kenny & McDaniel, 2011). Teachers involved in co-designing technology-rich media report learning about: technology itself; teaching with technology; and curriculum content (Polly, 2011). Teachers' perceptions about pedagogy, technology and education have been found to be important determinants of successful implementation (Tondeur et al., 2008b). Since creating technology-rich media engages teachers in technology, pedagogy and content, teacher's perceptions may influence how teachers co-design a curriculum. Niess (2005) assumed that integration of knowledge about subject matter, technology, and teaching and learning supports teaching subject matter with technology. Involvement in design could encompass participation in decision-making and formulating goals (Penuel, Roschelle, & Shechtman, 2007) and 'hands on' opportunity for exploring the new curricular media (Keengwe & Onchwari, 2009) and creating new materials to fit one's own context. Design team products can be influenced by team functioning (Tillema & van der Westerhuizen, 2006), team activities and -leadership, team members' design skills, team size and the time spent in a team (Crow & Pounder, 2000). Teachers' co-design could influence teachers' role perceptions. Teachers are likely to engage in roles that go beyond specified role requirements, when they perceive team ability as high (Somech & Drach-Zahavy, 2000). A broader role repertoire allows team members to adapt their role to changing situations (Mumford et al., 2008). Reversely, teachers' role perceptions could influence teachers' co-design. One's knowledge of the nature of a role and the situation when a particular team role should be adopted is related to a team member performance (Mumford et al., 2008).

Through involvement in curriculum development, teachers may take ownership of the resulting products (Kirk & McDonald, 2001). Teachers' co-ownership of a new curricular media can be defined in terms of commitment, understanding the new curriculum and being skilled at it on the part of teachers (Fullan, 2003). Teachers' purposeful collaboration can enable teachers to know what other teachers do and foster transparency of practice and responsibility, which can foster teachers' ownership of educational practice (Fullan, 2011).

Also, teachers' co-design could influence teachers' perceptions about curriculum practicality. The practicality of an innovation wields powerful influence on curriculum implementation (Doyle & Ponder, 1978). In their view, practicality concerns: how well a curriculum is specified; the ratio of effort required to potential benefits; and how congruent the curriculum is with the needs of the classroom. How practical teachers perceive a curriculum for their practice and pupils (and thereby successful implementation) determines if they implement the curriculum at all (Abrami et al., 2004). McGrail (2005) found that teachers accepted technological change as long as they were convinced that they will see gains for students and teaching. Perceptions about value of an innovation, successful implementation, and costs explain about 43 % of the variance in curriculum use (Abrami et al., 2004).

Curriculum implementation can be described in terms of the quantity of the activities offered to pupils and in terms of quality - the manner in which teachers implement activities (Landry et al., 2011). In a study of Lowther et al. (2012) teachers involved in implementation of technology integration and in a training program focused on effective technology use, showed confidence that they knew how to meaningfully integrate technology use into lessons. Also, in a study of Landry et al. (2011), teachers involved in professional development activities showed great gains in use of early literacy teaching practices and classroom organisation.

Pupil learning outcomes are commonly used as indicators of the attained curriculum. In a study of Lowther et al. (2012), no significant differences were found in achievement between students whose teachers were involved in a technology use program and implementation of technology integration and controls, students whose teachers were not involved. Landry et al. (2011) found teachers' involvement in a program including professional development activities and curriculum implementation to result in greater children's development language and early literacy skills.

4.2.1 The purpose of the study and research questions

This study aims to understand how the co-designer role contributes to technology integration in kindergarten classes, and how that influences learning. The main research question was: When teachers are involved in co-designing technology-integrated activates for early literacy, what does that imply for curriculum implementation and pupil learning outcomes? This question was addressed through the following sub-questions:

1. What are teachers' views about pedagogy, technology and early literacy?
2. In what co-design activities do teachers engage?
3. What are teachers' perceptions about their co-design team?
4. What are teachers' perceptions about their role as co-designer?
5. What are teachers' perceptions about co-ownership of technology-integrated media and activities?
6. What are teachers' perceptions about practicality of technology-integrated media and activities?
7. How do teachers implement the technology-integrated media and activities?
8. What are the pupil learning outcomes?

4.3 METHODOLOGY

A case study, defined as an empirical inquiry for investigating phenomena in real-life contexts (Yin, 2003) was used to examine teachers co-design and the related teachers' perceptions, implementation and pupil learning outcomes. Within the case study, a non-equivalent group quasi-experimental design was used to examine early literacy outcomes of pupils learning with co-designed technology-integrated activities.

4.3.1 Context

PictoPal is a technology-supported intervention for early literacy. PictoPal is based on the national attainment targets: (1) Functional reading and writing; the functions of written language; the relationship between spoken and written language; and linguistic awareness. PictoPal consists of (a) on-computer activities through which pre-readers use words, sound and images to construct written texts; and (b) off-computer activities that prompt children to 'use' their printed documents for authentic purposes (McKenney & Voogt, 2009). Figure 4.1 shows an on-computer activity, in which children, compose a recipe for a vegetable soup (left) and an off-computer activity, in which children follow instructions on their printed recipe (right). In this way each on- and off-computer activity is integrated in a meaningful way.

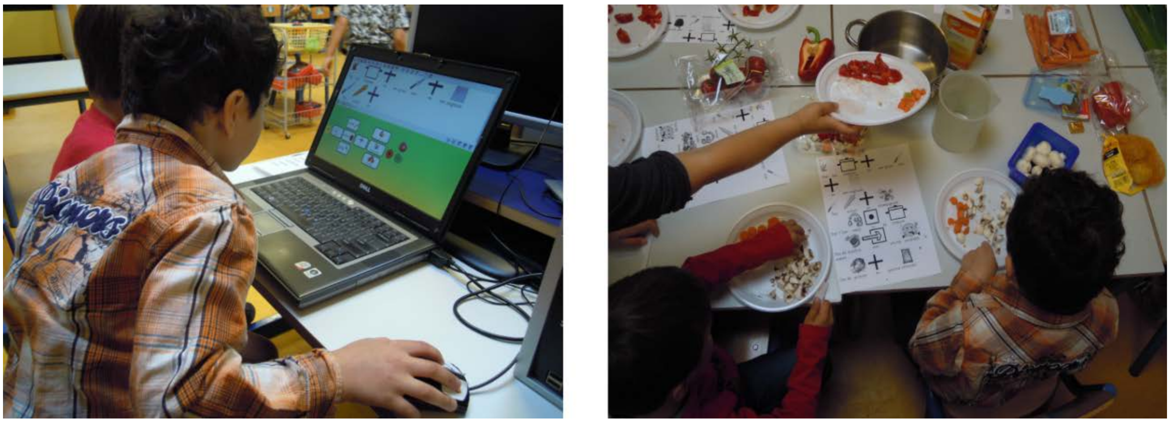

Figure 4.1 PictoPal on- and off-computer activity

PictoPal was introduced to teachers by presenting a demo version, and explaining its purpose, content, and features. Teachers were invited to discuss their views about early literacy and technology integration, and ideas about design and implementation of a new module. Teacher' designs written on paper were converted into computer activities and teacher manuals, which teachers used to guide their own implementation. The purpose of the co-design was to provide teachers with an opportunity to collaboratively create their own classroom intervention. The design task required teacher input for new content of eight on- and eight off-computer activities, aligning with the existing goals and structure of PictoPal. The goal of the co-designed activities was to engage pupils in computer-assisted writing and in subsequent purposeful applications of the written products. Specifically, teachers were challenged to:

1. Create new content (texts types, sentences, words and pictograms);
2. Gradually increase the difficulty level of on-computer activities;
3. Connect on-computer activities products with off-computer activities; and
4. Ensure thematic alignment within and between activities.

4.3.2 Participants

From four schools, five teachers and two student teachers (interns) were interested in PictoPal and co-designing media and activities. They worked in two teams, referred to here as the teacher-team and the intern-team. The teacher-team had four teachers, each teaching their own kindergarten class. Each teacher had approximately 20 years teaching experience. Carla (school 1) and Maria (school 2) co-designed and implemented PictoPal in their classes. After the second team meeting, Mary and Wilma (school 3) discontinued participation. The intern-team had one teacher (school 4), teaching her own class and two student teachers, who were not yet responsible for a class of their own. Teacher Jenny had 6 years of teaching experience, while interns Wendy and Laura had 6 months of teaching experience. Jenny implemented PictoPal in her class.

Pupils from three classes n = 44 (28 boys and 16 girls) participated in the experimental group and pupils from four classes n = 67 (18 boys and 49 girls) participated in the control group. The control classes were not taught at the same schools as the experimental classes. Those pupils came from another school in the same region. The experimental and control groups were comparable, because both groups used the standard language curriculum, but teachers enhanced or replaced standard activities with PictoPal-activities in the experimental group. Table 4.1 shows an overview of the distribution of pupils in the classrooms studied.

Table 4.1 *Number and gender of pupils at the start of PictoPal-implementation*

	n	Boys	Girls
Class 2a, Maria	8	6	2
Class 2b, Carla	16	10	6
Class 2c, Jenny	20	12	8

4.3.3 Data collection

After PictoPal-implementation, teachers were interviewed about pedagogy, technology and early literacy; involvement in co-design team, the co-designer role; co-ownership and practicality of PictoPal. The data collection involved two researchers. During co-design meetings, notes were taken and later analysed to describe team activities and the time teachers spent in a team. After the second co-design meeting, two teachers were interviewed about their reasons for discontinuation. Classroom implementation was observed using an integration checklist (Verseput, 2008b), focused on the extent to which teachers integrated on-and-off computer activities. During eight weeks of implementation, observations were held once a week in each class for about 20 minutes. The inter-rater reliability of two observers, who rated the integration during one activity was found to be Cohen's kappa = .63, (p < 0.001), 95% CI (.20 – 1.06), indicating an acceptable agreement (DeVellis, 1991). The test for early literacy was administered before and after implementation. Table 4.2 shows an overview of the instruments used is this study.

Table 4.2 *An overview of the instruments*

Method	Detail
Interview	An interview scheme guiding interviews was used to examine teachers' perceptions about teaching, technology, early literacy; teacher role; co-ownership and practicality. When elaboration was needed, teachers were asked to clarify their responses. An example questions is: 'What are your views on teaching young children?'
Team notes	Observations of teams of teachers co-designing the materials were made using minutes. The notes contained descriptions of team activities, team size and time spent in a team.
Integration checklist	Integration of on- and off-computer activities was observed using an checklist with 12 items (Verseput, 2008b). An example item is: 'The teacher lets pupils talk about the products of their activity.' The items were scored as 0 = absent; 0.5 = observable to some extent; 1 = observable to a great extent.
Early literacy test	An early literacy test for 4-5 year olds (McKenney & Voogt, 2006) consisting of 20 items was used to investigate pupil learning outcomes. An example item is: (1) the researcher sets out colour pencils, a pen, paper, scissors, a colouring page, a book, a spoon, a postcard and a grocery list; (2) the researcher presents the items to the child with an open arm gesture and says, *'Can you pretend that you are writing something?'* The test items were scored as 1 = correct and 0 = not correct.

The data from the interviews were analysed by summarizing responses. Teachers' responses regarding pedagogy, technology end early literacy were analysed by two researchers. Each step in the analysis was discussed until agreement was reached on categories (see Table 4.5). The observation data on integration was analysed using analyses of variance (ANOVA) and pupil early literacy outcomes using analysis of covariance (ANCOVA) and a paired sample T-test.

4.4 RESULTS

4.4.1 Perceptions about pedagogy, technology and early literacy

Findings showed that teachers hold a developmental or an experience approach to teaching. They were positive or critical about technology and viewed early literacy teaching important. Table 4.3 shows an overview of the teacher's views about pedagogy, technology and early literacy.

Table 4.3 *An overview of teachers' perceptions*

	Carla	Maria	Mary	Wilma	Jenny	Wendy	Laura
Pedagogy	Developmental	Developmental	Experience	Experience	Developmental	Developmental	Developmental
Technology	Positive	Positive	Negative	Neutral	Positive	Positive	Positive
Early literacy	Variety of activities	Variety of activities	Free texts activeties	Free texts activeties	Motivating activities	Activities for early literacy foundation	Variety of activities

A developmental approach can be characterized as stimulating child development by offering a tailored learning environment. For instance, according to Carla and Maria teaching should occur in the 'zone of proximal development'. For Jenny pupils should be intrinsically stimulated to understand concepts. In Wendy's view teachers should stimulate the social–emotional development of a child. Laura reported that pupils should be taught by creating a good educational climate and using various learning methods suitable for different pupils. The experience approach features teaching based on pupil experiences which was found to represent the views of Mary and Wilma. Their perspective was that children should be stimulated to discover their own world; for instance, a teacher can offer writing activities based on children's experience and volition to engage in writing.

As shown in Table 4.3 most teachers were positive about technology. Carla had no objection to allowing pupils to spend 20 minutes a day on a computer. In that way, they can learn literacy and math in a playful manner on their own level. Computers, in Maria's view, can offer visual materials to help clarify learning objects to children and are valuable for teaching and learning only if the content is thematically structured. Also, in Laura's view, computers are useful tools for teaching early literacy, because they enable faster feedback and allow for faster sentence composition and more convenient ways to link pictograms and words. The relative positive view on technology was contrasted by Wilma who reported having an aversion towards computers. In her view a computer is a 'dead box' which does not allow for direct dialog.

When asked about early literacy, all teachers found it important, yet the way it could be taught, varied slightly between them. In Maria's view, a rich language learning environment is needed to enable spontaneous child development and teaching early literacy must orient pupils towards written language, and learning to read and write. For Mary and Wilma, a dialog with children during writing activities was considered important. When considering all viewpoints about early literacy teaching, the fun factor (enthusiasm, motivation) should not be forgotten according to Jenny.

4.4.2 Co-design activities

The teacher-team (Carla, Maria, Wilma, and Mary) discussed their perceptions about early literacy and technology integration, during the first meeting. During the second meeting, they discussed how early literacy aspects can be brought into meaningful activities. After the second meeting, Carla and Maria agreed to co-design together a new PictoPal-module and Mary and Wilma discontinued their involvement. During the third meeting, Carla and Maria worked out their ideas on how to connect meanings of words to pictograms in ways pupils would understand. In total, nine hours were spent on PictoPal-design in this team.

Also, the intern-team (Jenny, Wendy, and Laura) invested nine hours in the meetings. The activities of the intern-team involved discussing and writing up ideas about design- and implementation. The team discussed the kindergarten classroom relevance of (1) thematically linked PictoPal-activities; (2) alignment with language curriculum, (3) vocabulary; (4) sentence structure, and (5) intonation and pronunciation of the audio-output.

4.4.3 Teachers' perceptions about team functioning, design- and leadership skills

From interviews about team functioning, Carla, Maria, Mary and Wilma appeared less positive about the first co-design meeting. According to Mary discussions of the national interim goals for early literacy were refreshing. However, because of the lengthy discussions, and not designing immediately, she felt the meeting was not successful. Also, Carla would rather have engaged in making materials immediately than in discussing concepts. On the subject of team functioning Carla and Maria reported that their team functioned well. When asked about design- and leadership skills, they acknowledged being familiar with designing lessons and having shared leadership in their team. Despite the unsuccessful view of the meeting, Mary felt that design can be an enrichment of own skills and Wilma felt that team members can complement each other.

With respect to the interim-team functioning, Jenny and the interns were positive. Jenny felt that all team members should be equally involved with co-design. According to her, skills to lead a team were important, she actively steered the team design, yet having little experience in designing. Laura and Wendy reported being skilled to design ICT-integrated lessons, but that their skills are still developing. Laura viewed leadership skills irrelevant: she participated from the perspective of pre-service training.

4.4.4 Perceptions about the co-designer role

According to Carla, the first and second team meeting could have been put together, to feel co-designer from the start. She explained she did not understand what PictoPal was all about during the first meeting, and that she merely provided knowledge about early literacy. During the second meeting, she explained that she gained clear idea of the purpose of PictoPal and felt co-designer. Also, Maria shared Carla's perception about taking the role of a co-designer. Maria felt enthusiastic that she took the role as co-designer and together with Carla had worked intensively on reaching a team outcome ready to be implemented in her class. From interviews, it appeared that motivation for team design faded for Mary, because she found that her view on pedagogy and design did not match. Wilma explained that if teachers' school background and design of curriculum activities fit one another, the outcome can be successful. Mary and Wilma appeared reserved about computers and shared the view that pupils should be offered little a priori structured, restricted choices. They viewed PictoPal as too structured and this obstacle was considered insurmountable, and a reason to discontinue the co-designer role.

In Jenny's view, she is able to adapt her teacher role to the co-designer role. When taking the role of co-designer, she expects an attitude reflected in active participation in discussion as well as understanding and accomplishing co-design outcome. Laura described her role as shaping, together with Wendy, the content of ICT-based activities suitable for kindergarteners.

4.4.5 Perceptions about co-ownership

Carla felt co-ownership of PictoPal. She introduced PictoPal to her colleagues and spread her enthusiasm to implement it. When asked about her experiences about co-ownership, Maria reported to feel committed, but that the word 'ownership' would be a big word to describe her experience. Mary expressed that she did not feel ownership, because she was connected to PictoPal. Also, Wilma felt no co-ownership toward the PictoPal design. Jenny felt co-owner of the design, because she gave an unique input and perceived her involvement in co-design and implementation of PictoPal as a good start toward technology integration in her class. Jenny emphasized her adaptation when preparing activities, in order to be able to implement it as she sees fit. Laura felt committed and Wendy a co-owner of PictoPal.

4.4.6 Perceptions about curriculum practicality

When asked about curriculum practicality, Carla perceived the efforts she put in the first co-design meeting not in balance with her expectations. She explained that she had expected direct involvement in design and a tangible team outcome after the first co-design meeting. She felt positive about the ratio of efforts put in the design and the reward experience of implementation, because the eight integrated activities were organized in a learning environment in her class as it was designed. For her, PictoPal matches the pupil needs. Maria expected PictoPal to have a positive impact on pupil learning, as concepts can be explained with pictograms and visual materials. Maria pointed to her curiosity about the learning outcomes. By knowing the benefits of the curriculum in terms of pupil learning she would be able to weigh off thoroughly her effort and the total benefits of the co-designed curriculum activities. In Maria's view, PictoPal samples showed her what she could do when designing new materials and were valuable for relating and adjusting the activities to the current language curriculum and the classroom conditions. For Mary and Wilma, the sample material of PictoPal was perceived as not fitting their current practice, in which they use free texts (expressing oneself by drawing). Wilma had concerns about the fun factor, in her view it is not clear if children would consider this format fun and therefor motivated to engage with PictoPal. Mary's efforts did not justify the expected benefit. She stated that she remained open for co-design and implementation, but only when she could do something with the co-designed product in her own practice. She felt her effort in design was not necessary because PictoPal did not fit her classroom practice.

Jenny recognized that changes to designed off-computer activities occur even during implementation, because not all activities can be exactly executed in daily practice as planned. Jenny perceived her invested efforts in the design in accordance with her expectation of the investment. She acknowledged the input and efforts of other team members, yet emphasized the importance of equally shared commitment of all members toward the design. In her view, without support, designing curricular media and activities individually would cost too much time, and would be impractical. Wendy reported that the kindergarteners should first understand concepts, before they engage in PictoPal-activities and then expected PictoPal to be beneficial for kindergarteners. For Laura, PictoPal was implementable in kindergarten on a stand-alone basis, but could also be integrated as a support tool for other subjects and lessons.

4.4.7 Curriculum implementation

Table 4.4 shows the mean integration scores of eight on- and -off computer activities and standard deviations per teacher and her classroom. Figure 4.2 shows a distribution of the mean observation score on the twelve integration items per teacher. To reveal any differences between teachers in the extent of integration, an ANOVA was performed. This showed no significant differences in integration between teachers.

Table 4.4 *Integration means and standard deviations*

	Jenny *M (SD)*	**Carla** *M (SD)*	**Maria** *M (SD)*
Overall integration of eight on- and off-computer activities (n = 8)	8.31 (1.75)	8.56 (0.78)	8.69 (1.71)

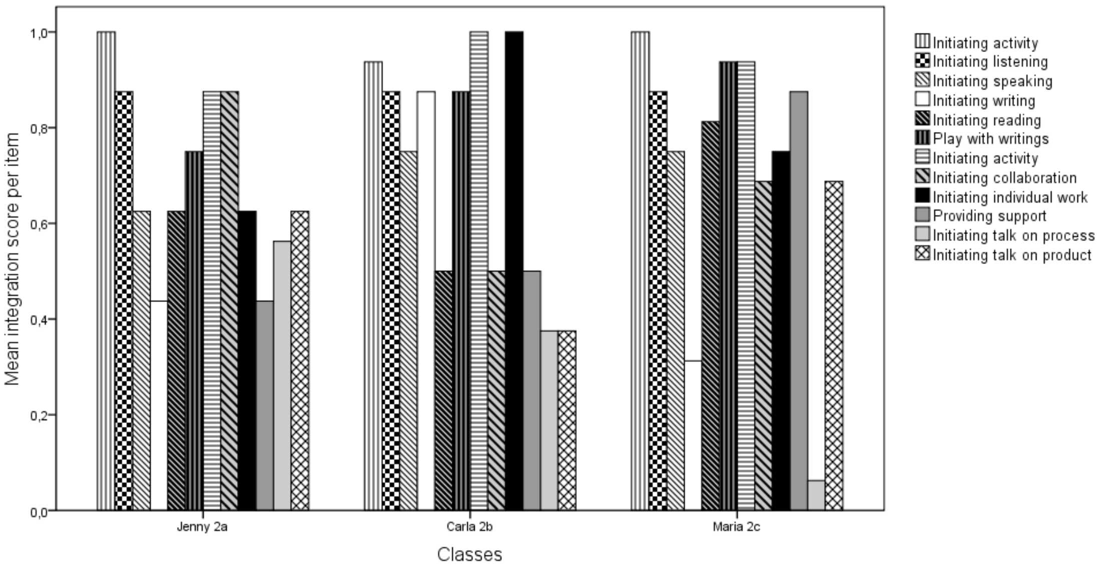

Figure 4.2 Distribution of the mean score of integration items of on- and off-computer activities per teacher

Figure 4.3 shows a distribution of observation data on integration over eight weeks in the three classes. The time of eight weeks, the three teacher worked with PictoPal was found to account for differences in integration $R = 0.73$, $p = 0.00$. A significant correlation was found between integration and time working with PictoPal for class of Jenny ($R = 0.91$, $p = 0.00$) and Maria ($R = 0.83$, $p = 0.01$). For the class of Carla the correlation between time and integration was weak and non-significant $R = 0.32$. The time spent working with PictoPal explained a significant proportion of variance in integration extent for class of Jenny and Maria, respectively $R^2 = 82$, $F(1,6) = 27.999$, $p = 0.00$ and $R^2 = 68$, $F(1,6) = 12.990$, $p = 0.01$. This showed that integration increased over time for Jenny and Maria, but not for Carla.

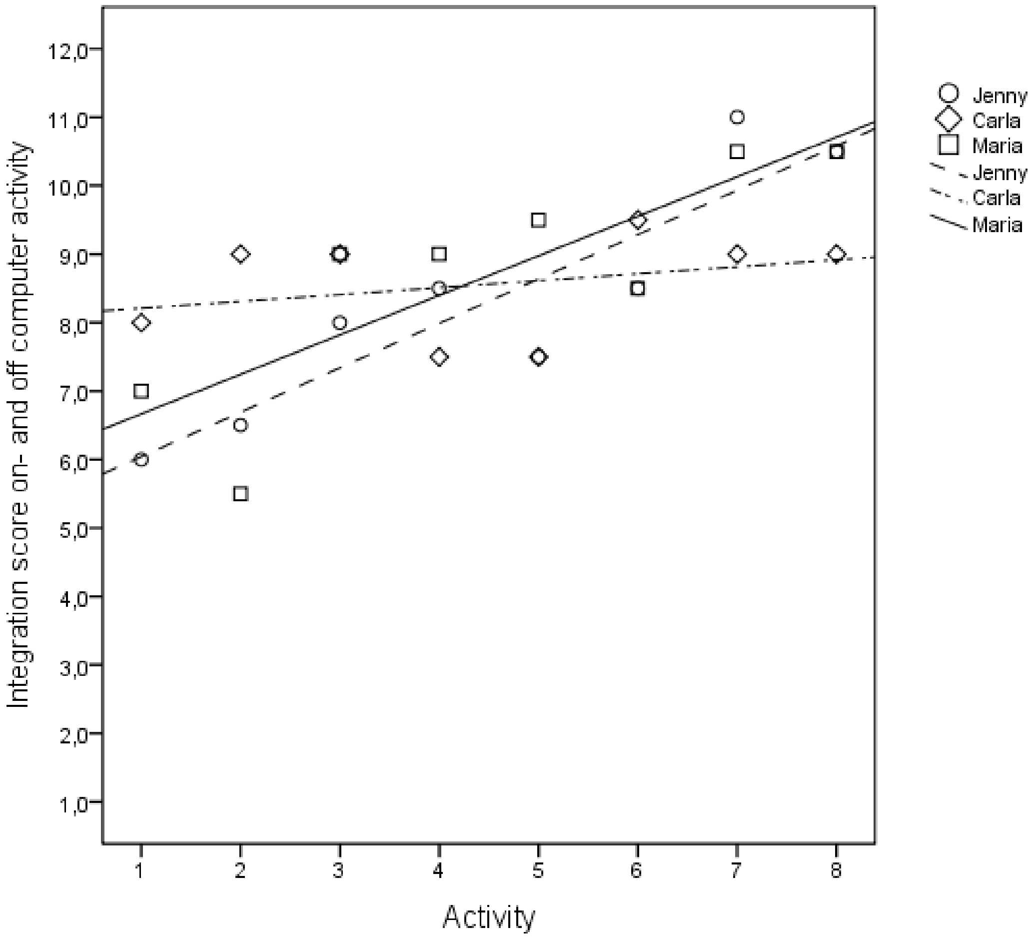

Figure 4.3 Distribution of observation data on the twelve items of the integration of the on- and off-computer activities over eight weeks

4.4.8 Pupil learning outcomes

Table 4.5 shows the number of pupils in the experimental and control groups, and presents an overview of the early literacy mean test scores. To reveal the impact of PictoPal on pupil learning, an ANCOVA was performed with post-test scores on early literacy as a dependent variable and level (pupils of the co-designer experimental group and the control group) as independent variable, and the pre-test scores on the early literacy test as a covariate. The results showed a significant difference for level F (1,102) = 4.829, p = 0.03, $\eta 2$ = 0.05. When corrected for the national language test scores, a similar effect was found F (1,104) = 9.293, p = 0.00, $\eta 2$ = 0.08. The pupil learning outcomes of co-designer classes (Maria, Jenny and Carla) were significantly higher on a post-test (M = 16.16, SD = 2.18) than the learning outcomes in the control group (M = 15.11, SD = 2.98). The effect of PictoPal can be regarded as small, as 8 % of the variance in pupils' early literacy test scores can be explained by PictoPal.

Table 4.5 *Number of pupils, means and standard deviations of emergent literacy test and effect sizes for experimental and control group*

	Experimental group n **= 42**	**Control group** n **= 63**
Pre-test mean *(SD)*	13.47 (2.87)	13.72 (2.98)
Post-test mean *(SD)*	16.14 (2.20)	15.00 (3.05)
Learning gain mean *(SD)*	2.62 (3.08)	1.47 (3.66)
Cohen's *d*	1.05	0.43

Table 4.6 shows the pre-and post-test means and Cohen's *d* per class. In all classes large effect sizes were found. To reveal any differential impact of PictoPal on pupils' learning outcomes in classes of Jenny, Carla and Maria a Kruskal-Wallis test was performed. The hypothesis was tested that the medians for post test scores do not differ between classes of Jenny, Carla and Maria. The results of the analysis indicate that there is no significant difference in the medians. This result was replicated with an ANCOVA with pre-post differences as the dependent variable, classes (of Jenny, Carla and Maria) as an independent variable and scores on the national language test as a covariate which showed no significant differences for class.

Table 4.6 *Number of pupils, means, standard deviations, medians, and effect sizes of early literacy test per class*

	Class Jenny n = 20	**Class Carla** n = 15	**Class Maria** n = 7
Pre-test mean *(SD)*	13.85 (2.87)	13.60 (2.10)	12.43 (4.31)
Pre-test median	13.00	14.00	12.50
Post-test mean *(SD)*	16.20 (2.33)	15.60 (2.16)	17.14 (1.77)
Post-test median	16.50	16.00	17.00
Learning gain mean *(SD)*	2.35 (2.85)	2.00 (2.20)	4.71 (4.64)
Cohen's *d*	0.83	0.94	1.38

4.5 Discussion

The present study sought to explore teacher involvement in the co-design and implementation of technology integrated media and activities, and pupil learning outcomes. The central research question was: When teachers are involved in co-designing technology-integrated activates for early literacy, what does that imply for curriculum implementation and pupil learning outcomes?

Teacher views on pedagogy seemed to influence co-design involvement and teachers' perceptions about the co-designer role. Teachers with a developmental approach to teaching were found to persist in co-design involvement. In contrast, teachers holding an experience-based approach to teaching, and neutral/negative perception toward computers discontinued co-design, citing a mismatch between their perceptions about pedagogy and the kind of curriculum activities being co-designed. The way teachers adopted or rejected the role of co-designer appeared to be affected by their perception of appropriateness of the innovation, which they formed during their involvement in co-design.

As anticipated, the teachers in this study were highly concerned with curriculum practicality. Teachers with a developmental approach to pedagogy and early literacy, and a positive attitude toward computers seemed to perceive their co-designed PictoPal-curriculum as well-defined, aligned with their teaching practice and worth their invested effort. This is in line with findings of Abrami et al. (2004) that teacher perceptions of curriculum value affect curriculum use. However, it provides a new insight by showing that teachers' perceptions about practicality in conjunction with views on pedagogy influence their decision whether or not they will co-design media and activities for implementation. Doyle and Ponder (1978) suggested that teachers' effort to be invested in a new curriculum (costs) depends on teachers' perception on how beneficial it is for their practice (benefits). This study showed that the fit between teachers' perceptions about pedagogy and practicality seems to affect both the teachers' perceived benefit and decisions to continue or discontinue investment of efforts in co-design. This implies that teacher perceptions about curriculum practicality also affect teacher involvement in co-design. The finding that teacher views on pedagogy influence curriculum implementation (Tondeur et al., 2008b) and the finding that teacher perspectives on learning with computers relates strongly to teachers' implementation of skill-based computer software (Niederhauser & Stoddart, 2001) can thus be corroborated and extended to include practicality as mediating factor between views on pedagogy and technology and implementation.

The teachers and the interns who co-designed PictoPal had positive perceptions about the role as co-designer of a team product which in their perception was practical and fitted their pedagogy. Also, they felt a sense of co-ownership of co-designed curriculum activities, in contrast to teachers who discontinued co-design, citing no co-ownership. Results on implementation suggest that teachers do not differ in integration of on- and off-computer activities, although this could change over time. They emphasized more or less the same pedagogical aspects when implementing the technology integrated activities.

More importantly, the teachers who implemented PictoPal planned to continue to use PictoPal, even without attention or support from researchers. It seems plausible that PictoPal-implementation had justified or reinforced feelings of co-ownership and perceptions of practicality, fostering the willingness to continue with implementation. In extension of Fullan's (2011) call for teacher ownership as being crucial factor for reaching successful educational reform, this study suggests that teacher engagement in reform through the role of co-designer could affect teachers' ownership positively and possibly sustained implementation, if there is a consistency between pedagogy views and perceptions about practicality.

The implemented curricular media and activities had a positive impact on pupil early literacy learning outcomes in all classes. In line with previous research involving teachers in design (Cviko, McKenney, & Voogt, 2013), pupils learning with PictoPal improved early literacy significantly more than control group.

A limitation in this study is the absence of a control group at the same schools for pupil learning comparisons, because no other classes were available to serve as control groups at the participating schools. This limitation has been addressed by adding pupil groups in the quasi-experimental design from kindergarten classes with teachers holding similar views on teaching, technology and early literacy.

This study demonstrated that when teachers are involved in co-design, teachers' pedagogy views, their role, practicality and co-ownership are important factors influencing implementation of early literacy activities and pupil learning outcomes. The lesson learned from this study is that teacher perceptions of appropriateness for their teaching/classrooms is crucial for implementation to be effective. In conclusion, kindergarten teacher perceptions about pedagogy, technology and practicality seem to influence their co-design involvement. Involving and supporting kindergarten teachers in the co-design of technology-integrated learning media and activities contributes to implementation and pupil learning. This is largely because involvement in co-design enhances teacher ownership of the innovation.

CHAPTER 5[§]

Teacher roles in designing technology-rich learning activities for early literacy: A cross-case analysis

The present study aims to provide insight into the value of different teacher roles in designing and implementing technology-rich learning activities for early literacy. Three cases, each with a different teacher role (executor-only, re-designer, co-designer) were examined. In the executor-only role, teachers implemented ready-made activities. In the re-designer role teachers collaboratively re-designed existing activities, and in the co-designer role, teachers collaboratively designed new activities. In each role, teachers implemented the learning activities. Ten teachers and ten classes participated in the three cases. Teacher perspectives about their assigned role, the practicality of the technology-rich learning activities, and co-ownership were measured using interviews. Technology integration was observed during curriculum implementation. Pupil early literacy learning outcomes were measured using a pre-test post-test quasi-experimental design. Positive perspectives about the assigned role, curriculum practicality and a sense of co-ownership were found in the co-designer case. Concerns about practicality of technology-activities were raised in the executor-only and re-designer cases. Teachers in the re-designer case were reserved about the role assigned to them. The extent of integration of technology-rich activities was highest in the co-designer case and lowest in the executor-only case. Significant learning gains were found for each teacher role. This study concludes that involving teachers in design of technology-rich activities positively affected teacher's perceptions and implementation, and that each teacher role (executor-only, re-designer, co-designer) contributed to the effectiveness of technology-rich activities.

[§] This chapter has been submitted as: Cviko, A., McKenney S., & Voogt, J. (Submitted). Teacher roles in designing technology-rich learning activities for an early literacy curriculum: A cross-case analysis.

5.1 INTRODUCTION

The teacher's role in creating and facilitating children's learning in technology-rich classrooms is increasingly becoming important in supporting early literacy development. Even though teachers expect rapid increases in the use of technology-rich learning materials, this is not yet seen in practice (ten Brummelhuis & van Amerongon, 2010). In an effort to improve language education in Dutch primary schools, national attainment targets as well as interim goals for early literacy have been formulated to help kindergarten teachers focus their efforts (Tomeson, van Koeven, Schippers, & Klein Tank, 2008). While research has shown that technology can offer valuable tools for developing early literacy (e.g. Cheung & Slavin, 2012), kindergarten teachers are still struggling to integrate them effectively (cf. Bølgan, 2012). Integrating technology refers to the process in which technology is used as a tool to support teaching and pupil learning (Keengwe & Onchwari, 2009). How teachers integrate technology-rich learning activities is presumed to affect pupil learning outcomes (Levy, 2009). A teacher's meaningful integration of computer-supported activities can enhance pupil early literacy development (Hyun & Davis, 2005). Benefits for young children in terms of enhanced learning outcomes indicate effectiveness of technology-rich activities for early literacy (e.g. Tracey & Young, 2007). In this study, effectiveness of ICT-rich activities is defined in terms of pupil early literacy learning outcomes.

Research in the field of early literacy has established links between: (a) teacher involvement in designing pupil learning activities (Perry, Hutchinson & Thauberger, 2007); (b) implementation of literacy curricula (Dickinson & Caswell, 2007; Neuman & Cunningham, 2009); and (c) pupil learning outcomes (McCutchen et al., 2002). However, few studies explore the role of teacher involvement in developing learning activities, implementing them, and commensurate pupil learning outcomes.

Teachers' perspectives about teaching/learning, technology, and subject matter influence classroom implementation (Tondeur, Hermans, Van Braak, & Valcke, 2008a). Further, the implementation of technology-rich curricula can be influenced through interrelated factors, including teacher perceptions about their role during implementation (Broadhead, 2001); notions about curriculum practicality (Doyle & Ponder, 1978) and co-ownership of the curriculum (Fullan, 2011). The manner in which teachers are involved in the design and implementation of technology-rich learning activities could influence how they perceive their role, practicality and co-ownership, and thereby actual implementation and pupil learning outcomes.

The present study is based on the assumption that teacher involvement in curriculum design influences curriculum implementation and thereby pupil learning outcomes. By investigating three different roles for teachers (executor-only re-designer, co-designer) this study seeks to explore their contribution to implementation and pupil early learning outcomes. The executor-only role involves teachers in implementing ready-to-use ICT-rich early literacy activities. The re-designer role and the co-designer role each involve teachers in designing activities before implementing them. In the re-designer role, teachers collaboratively adapt ready-to-use activities and materials for their current curriculum. In the co-designer role, teachers collaboratively design new learning activities and materials for their classes. The executor role requires teachers to invest time and effort in implementation, the re- and co-designer roles require teachers to invest their time and efforts in collaborative design as well as implementation.

The study involves kindergarten teachers in the development and implementation of specific technology-rich learning activities and materials, called PictoPal. Based on a subset of Dutch national interim goals for early literacy, PictoPal features integrated on- and off-computer activities, which can be used in multiple ways. Teachers can (collaboratively) create their own content (co-design), modify existing content (re-design), or simply implement what is already provided (executor-only).

This study seeks to understand which of these three teacher roles contributes most to developing early literacy in pupils. Specifically, differences and similarities pertaining to the aforementioned interrelated sets of factors: teacher perspectives about teaching/learning, early literacy, technology, teacher perceptions about their assigned role, practicality of curriculum and co-ownership; curriculum implementation; and pupil learning outcomes are examined across teachers who were involved with PictoPal in different ways (as co-designers, re-designers, or only executors).

5.2 THEORETICAL FRAMEWORK

5.2.1 Roles of teachers in curriculum design

A teacher's primary task is to engage pupils in activities that enhance their learning outcomes (Keengwe & Onchwari, 2009). To implement technology successfully, teachers need to understand why technology tools are important to young children, how to use teaching strategies, and apply the technology tools in the classroom (Parette, Quesenberry, & Blum, 2010). According to Hutinger, Bell, Daytner, and Johanson (2006) teachers need help in developing an understanding of how implementation of technology integration will impact children, and time to make the change. Active involvement in the design of technology integrated activities can help teachers implement them effectively in their classrooms.

Teacher engagement in curriculum design could influence teacher perceptions about their role in curriculum implementation, their sense of co-ownership and curriculum practicality (cf. Fishman et al., 2003). Teachers can have different roles in curriculum design: executing ready-made plans only, re-designing existing learning activities and materials, or (collaboratively) designing new ones (Carl, 2009; O'Donnell, 2008; Roschelle, Penuel, & Shechtman, 2006). Higher role acceptance may be expected among the re-designers than the co-designers, because re-design is a natural activity for most teachers, whereas co-design may require more effort than teachers are used to. Similarly, executors, re-designers and co-designers may differ in their expectation of the benefit of implementation for their pupils. According to McGrail (2005) teachers are likely to accept technological change when they are convinced of benefits for their pupils and teaching. According to Abrami et al. (2004), teacher perceptions about costs and successful implementation and value of an innovation explain about 43% of the variance in curriculum use. Teachers' participation in team design (as re-designers or co-designers) can yield a greater sense of co-ownership toward the resulting products (Kirk & MacDonald, 2001), than when not involved in design. Further, benefits for ownership are likely to be higher in the co-designer role than in the re-designer role, since the freedom and amount of teacher input is greater in the co-designer role. Taken together, teacher roles in design (re-designer and co-designer) may enhance teacher perceptions of practicality of newly designed technology rich-activities, contribute to how teachers integrate technology, and influence overall effectiveness (i.e. pupil learning). Based on the assumption that the roles in design may be more effective than no participation in design, the focus of this study is to investigate which teacher role (executor-only, re-designer, co-designer) yields the greatest effect on technology integration and pupil learning outcomes.

Teacher role 'executor'

Teachers often take on the role of executing existing curricula (Carl, 2009). In this role, teachers receive a ready-made curriculum, and can be assumed to have had minimal involvement in the curriculum design. For primary school teachers, executing a new curriculum typically involves anticipating changes/implications for one's teaching role, and coping with concerns about materials and resources required to support implementation (Broadhead, 2001). During implementation, teachers in this role adapt the curriculum to their classrooms settings, for instance to pupil needs and their own pedagogical values (Squire, MaKinster, Barnett, Luehmann, & Barab, 2003).

Teacher role 're-designer'

In the re-designer role, teachers actively take part in the development process by contributing to changes not only during use (e.g. reshaping activities), but also in re-designing the actual resources. This is often done together with other teachers. Not only is this a practical process through which teachers fine-tune things for their own purposes, but it can also be beneficial for teachers to engage in analyzing curriculum together with colleagues, e.g. to deepen their own understanding of the subject matter (Grossman & Thompson, 2004). The active involvement of teachers in re-designing curriculum also stands to contribute to its implementation. Other benefits could be co-ownership, since teachers as re-designers have a clear voice in curriculum development (Carl, 2009). Taking the role of re-designer requires teachers to invest time and effort in (collaborative) work to re-design existing activities and execute the re-designed curriculum.

Teacher role 'co-designer'

Co-designers take part in the development process by participating actively in creating new resources, often together with other teachers (Penuel, Roschelle, & Shechtman, 2007). Extending existing resources with self-made learning materials can be motivational to teachers (Herrington, Specht, Brickell, & Harper, 2009) and create a sense of co-ownership towards the materials. Co-design stimulates actual use, since teachers engage in developing resources that fit into their classroom contexts (Penuel, Roschelle, & Shechtman, 2007). Like the re-designer, the co-designer also works to create and implement curriculum activities, but those of the co-designers are new (as opposed to revised).

5.2.2 Factors influencing curriculum implementation and pupil attainment

The following section describes the factors found in prior research to be relevant for curriculum implementation and pupil attainment. Also, curriculum implementation and pupil learning outcomes are discussed as potential indicators of effectiveness of technology-rich curriculum activities.

Teacher perspectives about teaching/learning, technology and early literacy

Teacher perspectives about teaching/learning, technology, and subject matter are related to the way teachers implement technology-rich curricula (Tondeur, et al., 2008a). In K-8 settings, Kim, Kim, Lee, Spector, and DeMeester (2013) found that teacher perspectives about effective ways of teaching are reflected in their technology integration practices. Teacher perspectives about technology's impact on teaching/learning are found to influence technology integration (Inan & Lowther, 2010).

Teacher perspectives about their role in design

According to Handler (2010), teacher roles in curriculum design and implementation has become central to effective realization of educational innovations. What teachers think about the roles to which they are assigned in curriculum innovation seems important for successful implementation. Broadhead (2001) found that teachers perceive a shift in their role with regard to the implementation of a new curriculum, for instance expecting to be less directive to pupils.

Teacher perspectives about curriculum co-ownership

Teachers' sense of ownership towards a new curriculum is suggested to positively influence curriculum implementation (Fullan & Watson, 2000). Roschelle et al., (2006) found that primary school teachers' sense of ownership evolved over the course of a school year. When teachers were initially involved in the co-design and use of technology in the classroom, they reported feeling that technology was at least partly theirs; while by the end, the teachers became strong advocates of technology use. Teacher ownership towards a new curriculum seems to depend on how teachers are involved (Kirk & MacDonald, 2001). Also, to create sustainable technological interventions, teachers require time to develop ownership (Ketelhut & Schifter, 2011).

Teacher perspectives about curriculum practicality

Considerations about the practicality of an innovation can affect how teachers implement technology. According to the classic work of Doyle and Ponder (1978), teachers judge curriculum practicality on three elements: instrumentality (how well a curriculum is specified); congruence (how well a curriculum fits their own beliefs, including beliefs about pupil needs); and cost (the ratio of efforts required to potential benefits gained). Similarly, a recent study by Shirley, Irving, Sanalan, Pape, and Owens (2011) demonstrated that teachers implementing a technology innovation consider: the alignment of the innovation with their beliefs, as well as the benefits of the innovation compared to accompanying challenges. When a curriculum is well-specified (e.g. including well-structured teacher guides with clear learning objectives and classroom activities), it can be easier for teachers to implement and pupil benefits can increase (Assel, Landry, Swank, & Gunnewig, 2007). How teachers perceive technology applications to align with their current curriculum is found to be positively related with their perceptions concerning usefulness, learning opportunities, possibilities for successful use, and intention to use technology (De Grove, Bourgonjon, & Van Looy, 2012). When teachers perceive a curriculum as useful, they seem likely to implement it, despite potential costs (cf. Broadhead, 2001; Wozney, Venkatesh, & Abrami, 2006).

Curriculum implementation

According to O'Donnell (2008), measures of implementation can help explain if unsuccessful outcomes are due to an ineffective program or due to a failure to implement the program as intended by its designers. In a meta-analysis concerning studies examining K-12 pupils' reading outcomes and technology-based curricula, studies with medium or high implementation ratings were associated with positive effects on pupil learning; while studies with low implementation ratings were associated with no effect (Cheung & Slavin, 2012). The authors suggested cautiousness when interpreting the findings, since studies with no effects would be likely to describe low extent of implementation as a reason for no experimental-control differences. Frechtling, Zhang, and Silverstein (2006) found that implementing essential features of a program—for instance provision of extra support to struggling pupils, and consistent use of the curriculum guides—made a significant difference in student learning. In implementing PictoPal (the tool used in this study), Verseput (2008a) found that more than on-computer activities only, the integration of on- and off-computer activities supported early literacy learning of pupils. Central to the implementation of technology-rich learning activities, is integration into curricular activities in a functionally significant manner (Amante, 2007; McKenney &Voogt, 2009).

Pupil early literacy learning outcomes

The attained curriculum, that is pupil learning outcomes, is often used as a measure of curriculum effectiveness (Fishman et al., 2003). Pupil learning outcomes have also been used as a measure of professional development effectiveness. For example, Lowther et al. (2012) found no significant differences in achievement between pupils whose teachers were and were not involved in a technology use and implementation program. Yet others (e.g. Block et al., 2007) found that experimental subjects outperformed controls in early literacy outcomes following a full day of sessions concerning how to use the technology in the classroom.

5.3 RESEARCH QUESTIONS

With the understanding that teacher perspectives and curriculum implementation influence pupil learning outcomes, the study sought to explore the comparative benefits and drawbacks of each role in terms of contributions to pupil learning outcomes. The present study provided teachers with different roles in curriculum design and implementation: executor-only, re-designer and co-designer. Across the teacher roles, the data were collected to examine differences and similarities in teacher perspectives (about their own role; practicality of the activities; and co-ownership of the designed curriculum activities); integration of the designed activities with classroom work during implementation; and pupil learning outcomes. During implementation, data collection focused on the integration of technology-rich learning activities with off-computer activities. The effectiveness of technology-rich learning activities and materials was measured through pupil learning outcomes. The research question guiding this study was: *"Which teacher role (executor-only, re-designer and co-designer) contributes most to the effectiveness of technology-rich learning activities for early literacy and why?"* The sub-questions were:

RQ1: Is there a difference between *perspectives of teachers* in the roles of executor-only, re-designer, and co-designer respectively on teacher perceptions of: own role, curriculum practicality, and curriculum co-ownership?

RQ2: Is there a difference in the *integration* of technology-rich activities in an early literacy curriculum by teachers in the roles of executor-only, re-designer, and co-designer respectively?

RQ3: Is there a difference between *pupil learning* outcomes when teachers adopt the roles of executor-only, re-designer, and co-designer respectively?

5.4 METHOD

5.4.1 Study design

Because school year-long, in-depth investigation into each teacher role (including several teacher and pupil related measures) was needed, a multiple case-study design (cf. Yin, 2003) was determined the most suitable approach for examining each role. Each type of teacher role was a separate case. The cases, which were considered the units of analysis in the study, were compared on a same set of variables using a cross-case analysis (Miles & Huberman, 1994). Specifically, the variables were: (1) teacher perspectives about: their roles, curriculum practicality, and co-ownership; (2) technology integration; and (3) pupil early literacy outcomes.

5.4.2 Context: PictoPal

Engaging in the meaningful creation of texts and consecutively using the written products supports young children in developing an understanding of written language (McKenney & Voogt, 2009). PictoPal is based on a subset of the Dutch national interim goals for early literacy and aims to foster pupil understanding of: (1) the functions of written language; (2) functional reading and writing; (3) the relationship between spoken and written language; and (4) linguistic awareness. The PictoPal format consists of eight on-computer activities and eight off-computer activities. On-computer activities are created in the software program, Clicker ®. This enables pupils to 'read' words with help of pictograms and voice output, and 'write' depicted words by clicking on them. Once written, children can have the computer read back to them individual words, single sentences, or an entire document. Through this process, pupils create meaningful texts together with their peers, which are then used in off-computer activities. For example, recipes are 'cooked', books are 'read', and weather forecasts are 'broadcasted' by pupils in the classroom. Shown in Figure 5.1, children compose their stories about spring (on-computer) and later read aloud to the class (off-computer). Previous research has demonstrated that PictoPal use can yield statistically significant pupil learning gains (McKenney & Voogt, 2009), and that these appear to be influenced by how teachers integrate the on-computer activities with other, off-computer language activities (Verseput, 2008a).

Figure 5.1 Creating text on-computer (left); using text off-computer (right)

The term, PictoPal, pertains to the unique combination of on-computer and off-computer activities which is structured in a particular way. While the specific vocabulary and contents of each PictoPal modules varies, the structure is its defining feature, and this remains static. Consistent structural elements of PictoPal are: (1) brief preparatory activities before writing commences (usually small-group discussion concerning focusing on the content of the writing task); (2) the number of integrated on-computer- and off computer activities (eight in each module); (3) gradual increase in difficulty level (e.g. starting with single-sentences and ending with complete paragraphs); (4) same range of text types used (e.g. list, letter, story); (5) same (graphic) vocabulary within text types; (6) same conventions in screen layout; (7) each module relates to a broad unifying theme; (8) each off-computer activity entails the use of the written text for its given purpose (e.g. a grocery list is used in the shopping store corner of the classroom); and (9) a teacher guide offering support for the preparatory activity, the on-computer activity and the off-computer activity.

Across cases, the static structural elements of each PictoPal module remained consistent. To safeguard consistency, one technology supporter rendered all the PictoPal content in Clicker® for each case. Executors were given a ready-made module: Spring. Re-designers adapted Spring to Winter, and co-designers created a set of activities with the theme: Nature. The latter two collaboratively created paper prototypes of the activity descriptions and on-computer materials. While vocabulary and specific content differed across modules, each adhered to the structural elements described above.

5.4.3 Participants

The study of teacher roles in the design of PictoPal was carried out over three years, involving kindergarten teachers in PictoPal execution-only (Cviko et al., 2012), re-design (Cviko et al., 2013) and co-design. In each study, a particular teacher role was assigned to teachers. A sub-set of participants in previous studies was used for this cross-case investigation. In total, ten teachers from four schools teaching ten kindergarten classes participated in this study. In the role of 'executor-only', the Spring module was implemented by four teachers in 2009. In the role of 're-designer', Spring was re-designed into Winter and implemented by three teachers in 2010. In the role of 'co-designer', Nature was co-designed and implemented by three teachers in 2011. Table 5.1 shows an overview of the participating teachers per case, their teaching experiences, the schools and the classes (junior versus senior kindergarten) they were teaching.

Table 5.1 *Overview of the participants per case: executor-only, re-designer and co-designer; teaching experience (years); school and class teaching*

Case (year intervention)	Participants	Teaching experience	School	Pupils
Executor-only (2009)	Alice	20	1	Junior
	Carol	10	1	Junior
	Diana	12	1	Senior
	Fiona	33	1	Senior
Re-designer (2010)	Iris	2	1	Junior
	Mira	3	1	Junior
	Jet	6	1	Junior
Co-designer (2011)	Carla	20	2	Senior
	Maria	20	3	Senior
	Jenny	6	4	Senior

Table 5.2 shows an overview of the number of pupils per teacher role, gender and age. There was an age difference between junior pupils in the executor-only and re-designer cases, $t(113) = 4.650$, $p = .00$, with higher mean for junior pupils in the executor-only case than in the re-designer case. The mean difference for junior pupils was three months. No age differences were found between senior pupils in the executor-only case and senior pupils in co-designer case $t(58) = 0.536$, $p = .59$.

For the executors and re-designers, the control group consisted of pupils from the same school (1) as the experimental group pupils. The control group for the co-designer case also came from school 1, because adding a control group for this case from the same school was not feasible. The experimental and control groups were comparable on basis of the similar approach to teaching kindergarteners in their schools. The teachers in the three cases had similar perspectives on teaching and learning, early literacy teaching and learning, and computer use in kindergarten as established during a pre-intervention interview.

Table 5.2 *Overview of the participating pupils per case, number, gender, mean age (months)*

		Pupils		**Gender**		**Age**	
Case			*n*	*Boys*	*Girls*	*M*	*SD*
Executor-only	Experimental	Junior	52	33	19	58	4.49
		Senior	43	18	25	71	3.67
	Control	Junior	32	20	12	57	4.40
		Senior	41	25	16	70	5.04
Re-designer	Experimental	Junior	68	41	27	54	3.41
	Control	Junior	36	17	19	57	4.66
Co-designer	Experimental	Senior	44	28	16	69	5.80
	Control	Senior	67	30	37	67	6.28

5.4.4 Instruments

Interview

A semi-structured interview was used to study teacher perspectives about their role, curriculum practicality, and co-ownership. An interview scheme guided the interviews with the teachers in each case. An example question is: “What are your views on your role as a re-designer of PictoPal?”

Observation checklist

To study the implementation of PictoPal, an existing integration checklist (Verseput, 2008b) was used to measure the extent of integration of PictoPal on- and off-computer activities. Representing features of good early literacy teaching regarding integration of technology-related activities in classroom practice, the integration checklist contains 12 items measuring the extent of teachers' integration of on- and off-computer activities: (1) Involving pupils; (2) Initiating listening; (3) Initiating speaking; (4) Initiating writing; (5) Initiating reading; (6) Play with writings; (7) Initiating activity; (8) Initiating collaboration; (9) Initiating individual work; (10) Providing support; (11) Initiating talk on process; and (12)

Initiating talk on products. The items were scored on a three-point scale (0 = absent; 0.5 = observable to some extent; 1 = observable to a great extent). An example of item 12 is: "The teacher encourages pupils to talk about their created products". In each case, two researchers observed two activities and discussed their scorings. Since the research assistants were not consistent across the three case-studies, the inter-rater reliability was calculated for each study and considered acceptable. The inter-rater reliability for executor-only case was found to be Cohen's kappa = .67 ($p < .001$), for re-designer case Cohen's kappa = .71, ($p < 0.001$), and for co-designer case Cohen's kappa = .63, ($p < 0.001$), indicating sufficient agreement.

Early literacy test

To study pupil early literacy outcomes, a test for early literacy for 4-5 year olds was used (McKenney & Voogt, 2006). The test consists of items measuring early literacy skills regarding the purposes of reading and writing, linking spoken and written language, functions of written language, and language awareness. The test was designed to ascertain if and how well those learning goals, which are part of the Dutch national interim goals for early literacy, are being achieved. An overview of the test featuring one sample item for each (sub-) goal is provided in Appendix 1. In each case-study, the same test with 17 items was used. However, because of a ceiling effect found in the executor case-study (2009), three new items were added to the test to expand its difficulty level. In the executor-only case-study (2009), three of the items were not included in the analysis, because these decreased the reliability of the test. In the executor case-study, a ceiling effect seemed to have impaired the measurement of senior pupils early literacy. For this reason, a 20 item version of the same test was used in the re-designer case-study (2010) and the co-designer case-study (2011).

The items were scored on a two-point scale (0 = not correct; 1 = correct). An example item is the following task: (1) The researcher sets out color pencils, a pen, paper, scissors, a coloring page, a book, a spoon, a postcard and a grocery list; (2) the researcher presents the items to the child with an open arm gesture and says, "Can you pretend that you are writing something". The item is scored as correct if the child takes either a pencil or a pen and a sheet of paper, and does or imitates the act of writing. For executor-only case (n of items = 14), Cronbach's alpha was .76 on the pre-test and .87 post-test data. For re-designer case (n of items = 20), Cronbach's alpha was .71 on the pre-test and .71 for the post-test data. For co-designer case (n of items = 20), Cronbach's alpha was .64 on the pre-test data and .68 for the post-test data. Cronbach's alpha coefficients between .60 and .70 and above are suggested to imply reliability at an acceptable level (DeVellis, 1991).

5.4.5 Procedure

The data on teacher perspectives about their roles, curriculum practicality and co-ownership were gathered after PictoPal-implementation. About their roles, teachers were interviewed individually in all three cases. About curriculum practicality, executor-only teachers were interviewed in a group interview, while re-designer and co-designer case teachers were interviewed individually. Re-designer and co-designer teachers were also interviewed individually about their co-ownership toward PictoPal (co-ownership was not relevant for executor-only case).

In each case, the duration of PictoPal implementation was eight weeks. Implementation data were gathered for all eight activities per teacher, except for re-design teacher Jet, who did not implement the first and eighth activity, due to time constraints. In each case study, pupils in the experimental and control groups were tested on early literacy prior to and after PictoPal-implementation.
Participants were assigned to one of the cases (executor-only; re-designer; or co-designer) using three criteria:

1. Experience: The teacher has no previous experience with (re-)designing or implementing PictoPal;
2. Timing: Teachers implement PictoPal in the same period of the school year.
3. Activity types: Executor-only teachers implement ready-made PictoPal activities, re-designer teachers implement their re-designed PictoPal activities, co-designer teachers implement their co-designed PictoPal activities.

Within each case study, data on the variables (teacher perspectives, implementation and pupil learning) were used for the cross-case analysis.

5.4.6 Data analysis

To prepare the cross-case analysis, a data matrix was used to display (per case) teacher perspectives about their roles, curriculum practicality and co-ownership. Data from interviews was entered in a table with teacher perspectives in columns and cases in rows. Then, teacher perspectives data of were summarized per case to allow for scanning across the three cases for commonalities and differences per variable (Miles & Huberman, 1994).

The data on implementation were analyzed using analysis of variance. For interpreting effect sizes for $\eta 2$, Cohen's (1988) rule of thumb was used defining effects: .01 indicates a small effect, (about 1 % of the total variance accounted for by group membership); .06 indicates a medium effect; and .14 indicates a large effect. Pupil learning data were analyzed using an analysis of covariance, with pupil pre-test learning outcomes as a covariate. Afterward, relationships between variables were studied by relating variable outcomes in each case.

5.5 RESULTS

5.5.1 Perspectives of teachers on role, practicality, and co-ownership across cases

The perspectives of teachers about their roles, curriculum practicality and co-ownership were compared across the three cases (executor-only, re-designer and co-designer). Table 5.3 summarizes the findings of the cross-case analysis of teacher perspectives.

Table 5.3 *Cross case analysis of teacher perspectives: executor-only, re-designer and co-designer*

	Role	**Practicality**	**Co-ownership**
Executor-only (n = 4)	Embrace the role	[GI]PictoPal not for junior pupils	NA
Re-designer (n = 3)	Not part of the teachers' role	Teachers want pupils to use PictoPal independently	Feel contributors to PictoPal-re-design
Co-designer (n = 3)	Embrace the role	PictoPal is suitable for future use	Feel co-owners of PictoPal

Note: [GI] Group interview; NA = Not applicable.

Teacher role perspectives

As shown in Table 5.3, the cases differed with regard to teacher perspectives about their roles. Executors embraced their role. For example, Carol liked 'being provided with materials', and Alice felt 'at ease executing PictoPal'. When asked about only executing, Fiona and Alice seemed to adjust curriculum activities during implementation. Fiona reported 'there is always something missing or too much represented'. According to Alice '…you are adjusting it too, you are not doing exactly what is prescribed'.

According to re-designer teachers, this role was not the teachers' job. For example, Mira felt the role was: *'not fitting the task and the responsibility of a teacher'*. She explained that: *'sometimes adaptation during implementation might be even more valuable than a role of re-designer, for example when children do not enjoy an activity, a teacher can adapt it'*. Also, teacher Jet felt the re-designer role was not the teachers' role: '*the role makes a teacher reflect about own actions and think about classroom organization, yet it is not a regular practice'*.

As with the executors, co-designers embraced their role. When asked about this role, Carla explained *'feeling co-designer…having gained understanding of what PictoPal is all about'*; Maria felt *'intensively involved in designing'* and Jenny said she was '*activating and quickly responding, focused on finalizing co-design'*.

Curriculum practicality perspectives

Table 5.3 shows differences between cases with regard to perspectives about PictoPal practicality. Executor-only and re-designer teachers were somewhat concerned about the congruency between PictoPal and pupil levels. Executor-only teachers appeared to perceive PictoPal as difficult for junior pupils. They expressed the need for re-designing PictoPal-activities to suit better the level of junior pupils.

Re-designer teachers wanted pupils to use PictoPal independently. According to Jet, the *'re-designed activities were appealing and aligned to pupils' world views, (…) re-design was necessary so that junior and senior pupils could work on their own levels.'* However, re-designer teachers seemed to be concerned about junior pupil abilities to work independently, without teacher guidance. For example, Iris felt *'working with PictoPal was difficult, (…) when reading their writings, junior kindergarteners searched for words, which is easier for senior kindergarteners'*. Mira explained: 'teachers must help children with written products.' Re-designer teachers were positive about the ratio of effort invested in re-design and the benefits gained.

Co-designer teachers were positive about practicality of PictoPal, and they wanted to continue working with it. According to Maria, the co-designed *'PictoPal is congruent with pupils' needs'*. Co-designer teachers were positive about the ratio of effort invested in co-design and the benefits gained. Carla experienced *'implementation as a reward for the co-design effort, while viewing PictoPal beneficial for pupil learning'*.

Co-ownership perspective

Only re-designer and co-designer teachers were asked about co-ownership. As shown in Table 5.3, re-designer teachers felt more like contributors. Jet reported that she had 'only contributed ideas to the product'. Also, Iris felt she 'contributed to [re]-designing the product, but did not feel like a designer of the product'. Mira explained her position of contributor in respect to that of the original designers: *'I assume that it eventually will be your product, and if we write it [re-design it] I do not think you can still say that it is your product.'* However, co-designer teachers reported feeling co-owners of PictoPal. Jenny reported *'feeling fully a co-owner of the co-designed product as they provided a reasonable input themselves in the form and content of PictoPal'*. Carla felt somewhat co-owner, since 'she did the design together with other team members', and Maria felt 'commitment, as ownership would be a bit overrated' (owing to the results being a team products).

5.5.2 Curriculum implementation across cases

Varieties in integration were examined across teacher roles. All teachers in the executor-only and co-designer cases implemented the on- and off-computer activities during eight weeks. In the re-designer case, the first and the sixth off-computer activity was not implemented by one teacher (Jet) due to time constraints.

Integration of on-off computer activities across roles

Table 5.4 shows the means and standard deviations of the results of the integration checklist per teacher role.

Table 5.4 *Integration means and standard deviations per teacher role*

	***n* observations**	***M***	***SD***
Executor-only	32	5.23	2.51
Re-designer	22	6.56*	2.93
Co-designer	24	8.52*	1.43

Note: * Significant at the level .05.

Figure 5.2 shows a distribution of the mean observation score on the twelve integration items for each teacher role. To test the hypothesis that there was no difference in integration between teachers' roles, an ANOVA was performed with the extent of integration as the dependent variable and the case (executor-only, re-designer and co-designer) as independent variable. This showed a difference for teacher case F (2,77) = 12.930, p = 0.03, η^2 = 0.25. This difference could be interpreted as large (Cohen, 1988), since 25% of the variance in integration scores can be explained by teacher role. To reveal differences between the roles a post hoc test was performed. This showed that co-designer teachers integrated the on- and off-computer activities to a significantly higher extent than the executor-only teachers (p = .001) and re-designer teachers (p = .01). Further, re-designer teachers integrated the on- and off-computer activities to a significantly higher extent than executor-only teachers (p = .04). Finally, the co-designer case had a smaller standard deviation compared to executor-only and re-designer cases, which could indicate that co-designer teachers had a relatively high extent of integration throughout implementation.

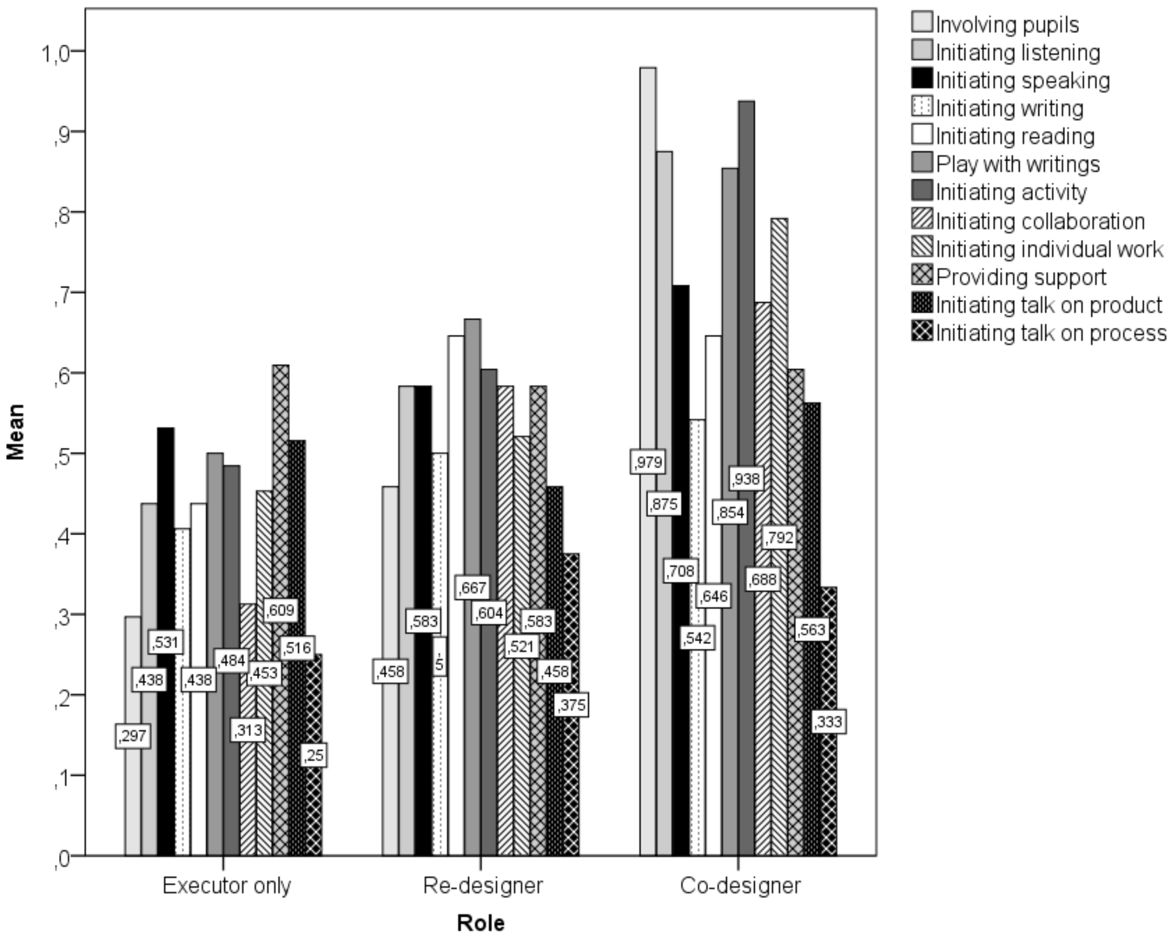

Figure 5.2 Distribution of implementation data on the twelve integration items per teacher role

Implementation over time

Figure 5.3 shows the distribution of the observation data on curriculum implementation over time (results of the integration checklist per week per teacher role). A regression analysis was performed with time (eight weeks in which teachers implemented eight on-and off computer activities) and case (executor-only, re-designer and co-designer) as independent variables and integration as dependent variable. A main effect was found for the duration β = .487, p = .00, $\eta 2$ = .39 and a main effect was found for teacher role β = .499, p = .00, $\eta 2$ = .40. Duration and teacher role are each significant predictors for integration of on-and off computer activities. The effect sizes can be regarded as large effects according to conversion table suggested by Cohen (1988). There was no significant interaction between time and case. A combination of teacher role and duration is not a significant predictor for the extent of integration.

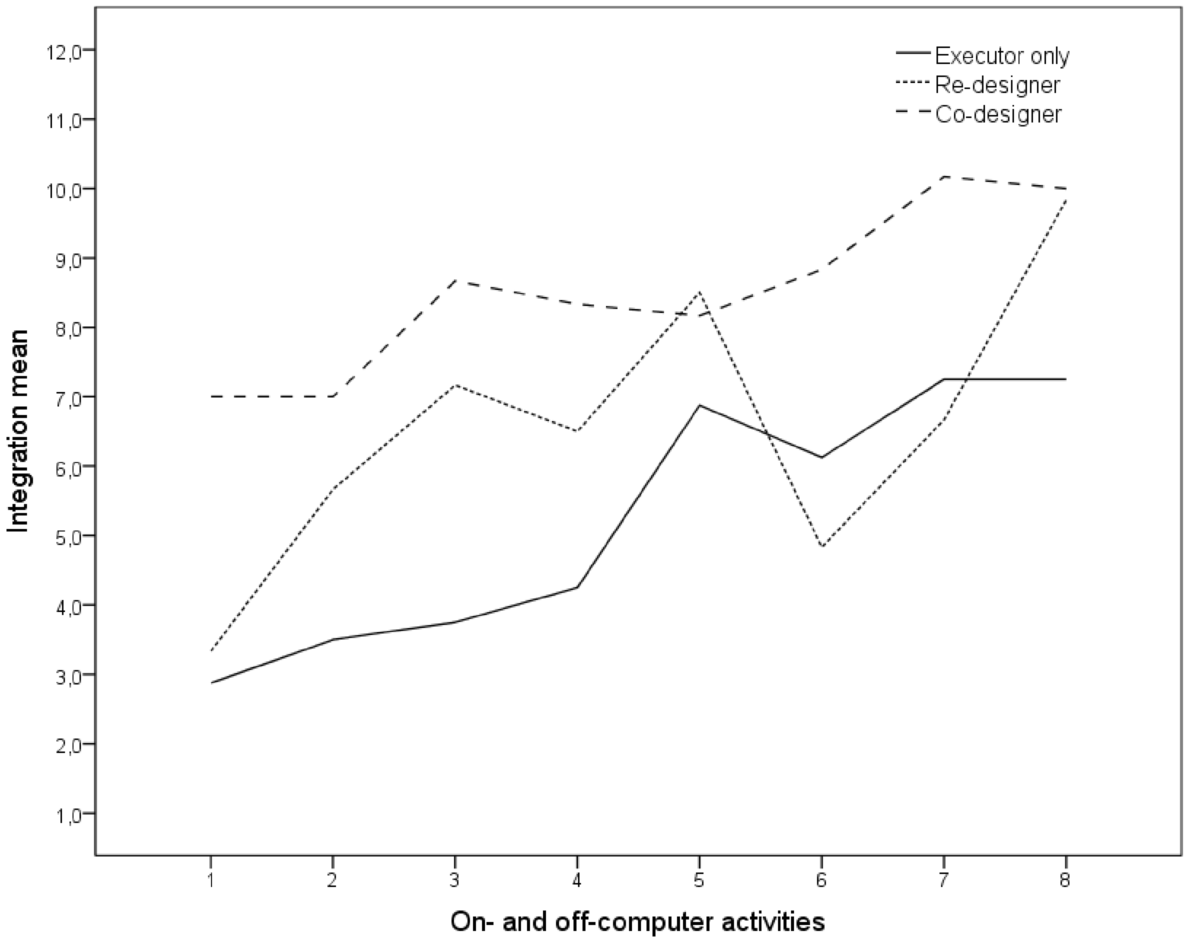

Figure 5.3 Distribution of the integration means for each role over eight weeks (for eight activities during eight weeks)

5.5.3 Pupil learning outcomes within and across cases

Within each case (executor-only, re-designer and co-designer), pupil early literacy outcomes were compared between experimental and control groups. Table 5.5 shows pupil learning outcomes in the three experimental conditions and the respective control groups. To test the hypothesis that pupil learning outcomes do not differ between the experimental groups and control groups a series of ANCOVA's were performed with pupil post-test scores as dependent variable, group (experimental versus control) as an independent variable and pre-test as a covariate.

In the executor-only case, significant differences between junior pupil learning outcomes were found for group F (1,70) = 17.524, p = .00, $\eta 2$ = .20. Junior pupils in the experimental group scored higher (M = 10.98, SD = 1.84) than junior pupils in the control group (M = 8.59, SD = 2.70). Also, significant difference between senior pupil learning outcomes was found for group F (1,87) = 17.535, p = .00, $\eta 2$ = 0.17. Senior pupils in the experimental group scored higher (M = 12.28, SD = 1.65) than the senior pupils in the control group (M = 10.95, SD = 1.57). As mentioned previously, the findings in the executor-only case are based on 14 of the 17-item test for early literacy. The effects for both senior and junior pupils appears to be large, since about 20% and 17% of the variance respectively is accounted for by group.

In the re-designer case, significant difference between junior pupil learning outcomes was found for group F (1,87) = 11.963, p = .00, $\eta 2$ = 0.12. Junior pupils in the experimental group (M = 13.73, SD = 3.31) scored higher than junior pupils in the control group (M = 11.70, SD = 3.31). This finding is based on the 17-item test with 3 additional items (20 in total, as discussed earlier). Also, for junior pupils in re-designer case, the effect size appears to be large, since about 12% of the variance is accounted for by group.

In the co-designer case, significant differences were found between experimental and control group senior pupil learning outcomes F (1,102) = 4.829, p = .03, $\eta 2$ = 0.05. Senior pupils in the experimental group (M = 16.14, SD = 2.20) scored higher than senior pupils in the control group (M =15.00, SD = 3.05). This finding is based on the 17+3 (20 total)-item test. The effect appears to be small, since about 5% of the variance is accounted for by group.

The effect sizes (Cohen's d) for senior pupils in the executor-only case (Cohen's d = 1.09) and co-designer case (d = 1.02) indicate that in both groups the intervention had a large effect on pupil learning outcomes. Also, for junior pupils in both the executor-only (Cohen's d = 1.75) and re-designer cases (Cohen's d = 1.41) the effect sizes are large, indicating that the interventions had large effects on pupil learning.

Table 5.5 *Number of junior and senior pupils, pre- and post-test means and standard deviations, and effect sizes per teacher role and its control group*

			Pre-test			**Post-test**			**Effect size**
	Group	**Pupils**	*n*	*M*	*SD*	*n*	*M*	*SD*	*Cohens' d*
Executor-only	Experimental [a]	Junior	41	7.20	2.44	41	10.98	1.84	1.75*
		Senior	50	10.04	2.40	50	12.28	1.65	1.09*
	Control [a]	Junior	32	6.31	2.79	32	8.59	2.70	0.83
		Senior	41	9.78	2.66	40	10.95	1.57	0.54
Re-designer	Experimental [b]	Junior	63	9.35	2.90	63	13.73	3.31	1.41*
	Control [b]	Junior	27	9.44	2.85	27	11.70	3.31	0.73
Co-designer	Experimental [b]	Senior	43	13.47	2.87	42	16.14	2.20	1.02*
	Control [b]	Senior	65	13.72	2.98	63	15.00	3.05	0.43

Note: *Significant at the .05 level; [a] 14-item test used; [b] 20-item test used.

5.6 DISCUSSION

5.6.1 Summary of the findings

The present study examined three different roles of teachers (executor-only, re-designer, co-designer) in designing and implementing activities and materials. In this particular case, we examined teachers creating technology-rich learning activities and materials for early literacy. This study addressed three sub-questions, each of which focused on a different variable in each of the three roles; the variables were: teachers' perspectives about their roles, curriculum practicality and co-ownership of the designed and implemented activities and materials; curriculum implementation; and pupil learning outcomes.

Findings showed differences in teacher perspectives between teacher roles. In contrast to re-designer teachers, executor-only and co-designer teachers embraced their roles. With regard to curriculum practicality, executor-only and re-designer teachers seemed to view technology-rich activities as less suitable for independent use by (junior) kindergarteners. A sense of co-ownership seemed greater in co-designer teachers, than in re-designer teachers. Implementation findings indicate significant differences between teacher roles. Co-designer teachers integrated activities to a higher extent than re-designer and executor-only teachers. Re-designer teachers integrated activities to a higher extent than executor-only teachers. Significant differences in pupil learning outcomes were found between experimental and control groups for each teacher role. The findings on pupil learning outcomes suggest large effects for both junior pupils with teachers in executor-only and re-designer roles, and for senior pupils with teachers in executor-only and co-designer roles.

5.6.2 Limitations

Differences in teacher perspectives about their assigned roles might be explained by the differences in years of teaching experience. Re-designer teachers had relatively few years of teaching experience as compared to executor-only and co-designer teachers. While some studies show that in experienced teachers' classrooms students use more and a wider variety of technologies as in the beginning teachers' classrooms (Wetzel, Zambo, & Ryan, 2007), others show that novice teachers are more likely to use technology in their classrooms than experienced teachers. A study by Mueller, Wood, Willoughby, Ross, and Specht (2008) showed that years of teaching experience do not significantly affect technology integration, while a study by Inan and Lowter (2010) showed that teachers readiness to integrate technology decreases when teachers' years of experience increase, indicating that veteran teachers' readiness and technology integration were lower in comparison to less-experienced teachers. It is plausible that in contrast to experienced teachers, less experienced teachers have more experience with technology and computer proficiency (Inan & Lowther, 2010) and are less hesitant to use it, but lack practical strategies to overcome barriers to technology integration such as beliefs about teacher-student roles (Ertmer, 2005) or resources to overcome barriers to technology integration (Mueller et al., 2008).

The eight weeks of duration of PictoPal may have limited the study to detect effects in pupil learning outcomes between teacher roles. A longer period of time for implementation could provide more insight in effectiveness of PictoPal, since time for implementation has been found to yield enhanced pupil early literacy learning outcomes (Landry et al., 2012; Hutinger, et al., 2006). Also, there may have been some variation in the quality of the three modules. While the effect sizes for pupil learning were higher with the re-designed module (than co-designed) and highest with the researcher-designed module, it is also notable that significant pupil learning gains were found in all cases. Despite the potential ceiling effect previously detected with senior pupils (Cviko et al., 2012), this study indicated large effects for learning gains of PictoPal for senior pupils groups in classes of both executor-only and co-designer teachers. It should be noted that junior pupils in the executor-only case were younger than the junior pupils in the re-designer case. The age difference may explain the large effect size for the difference in learning outcomes between the experimental and control for junior pupils in the executor-only case. Another limitation is the absence of senior pupils in re-designer case and the absence of junior pupils in co-designer case. Ideally both senior and junior pupils should be involved in all three cases to allow for separate learning outcome comparisons. However, because this study was performed under natural conditions in the kindergarten classrooms of volunteer teachers, the cost of being able to control all variables was accepted in exchange for the benefit of high ecological validity. A further limitation concerns the co-designer case control group, which consisted of pupils from a different school than the pupils in the experimental group. Although, teachers from the different schools were similar with regard to their perspectives about teaching/learning, early literacy and technology, it remains possible that differences in teaching early literacy may have influenced pupil learning outcomes. In this study, the pupil assignment to experimental and control group from a same school was not possible because there were no other kindergartens at that school.

5.6.3 Discussion

This study explored three different teacher roles to provide insight into the value of the roles in designing and implementing technology-rich activities for early literacy. The overarching research question was: " *Which teacher role (executor-only, re-designer and co-designer) contributes most to the effectiveness of technology-rich learning activities for early literacy and why?"*

Across all three teacher roles, significant pupil learning outcomes were found between experimental and control groups. In each role, the effect of PictoPal on pupil learning outcomes was large. Yet, between roles significant differences were found in integration, with highest integration in the co-designer role, medium in the re-designer role, and lowest in the executor role. However, a link between pupil learning outcomes and implementation findings cannot be made easily. This is because, across cases, high levels of on- and off-computer integration did not accompany high pupil learning outcomes. Findings showed that, compared to their respective pupil control groups, statistically significant levels of learning took place in cases with low, medium and high levels of implementation. This finding is consistent with a study from Lowther et al. (2012), which found no significant effects on pupils' achievement, when teachers were involved in a technology integration program, but is contrary to results of other studies (Block et al., 2007; Savage et al., 2010), which show a positive relationship between teacher involvement in technology use programs and pupil learning outcomes.

The executor-only role

The executor teachers embraced their role, most likely because they were provided with ready-made curriculum activities and materials. However, executor-only views about practicality were primarily concerned with (junior) pupils' independent use of PictoPal. It could be that during implementation, executor-only teachers observed that pupils need teacher guidance and feedback, which was in sharp contrast with their own preferences for pupils to work independently with PictoPal. This could have prompted teachers to think about using PictoPal at a level appropriate to junior (and senior) pupils' abilities. However, as previously shown (e.g. Klein, Nir-Gal, & Darom, 2000), teacher guidance affects pupils' performance positively, because teachers can create learning experiences at appropriate pupil ability levels. A link between implementation of technology-rich activities and pupil early literacy outcomes was less clear. Pupils from classes of executor-only teachers had high learning outcomes, although the extent of integration of executor-only teachers was significantly lower compared to re- and co-designer teachers. A study of Savage et al., (2010) identified no significantly greater pupil learning literacy outcomes in the condition in which teachers did not implement a technology-rich program effectively (e.g. no well-planned activities) compared to pupils not exposed to intervention. The executor-only role contributed to PictoPal-effectiveness, as indicated by the large effect found for pupil learning gains. However, teachers struggled with the practicality of PictoPal, which could obstruct implementation in the long run.

The re-designer role

In contrast to executors, re-designers were not only concerned with (junior) pupils' (independent) use of PictoPal, but also with their role. In the long run, re-designers may not be inclined to provide teacher guidance to all pupils because, similar to executors, re-designers wanted PictoPal to accommodate independent use by pupils. Compared to co-designer implementation, re-designers integrated PictoPal-activities to a significantly lower extent. It is plausible that teachers' involvement in re-design has provided them with an opportunity to understand the purpose of the curriculum materials. This indicates that the involvement may have contributed to the higher extent of integration (as compared to that of the executors). An explanation for why the re-designer extent of integration was lower than that of co-designers could be the rather reserved perspective re-designers had about their role, which they considered not to be part of teachers' daily practice. Teacher perspectives about their role can pose barriers for implementing technology in their classes. A possible explanation for lower extent of integration in re-designer case could be a lower sense of co-ownership, compared to co-designers. The differences between re- and co-designers' perspectives about their role and sense of co-ownership highlight the importance of how teachers are engaged in designing technology-rich learning activities. Implementation findings indicated that the re-designer role contributes to implementation of PictoPal, more than executor-only role.

The co-designer role

Involvement in co-design has provided teachers with an opportunity to understand the purpose of PictoPal, which could have contributed to a higher extent of integration in the co-designer case compared to executor-only case. The implementation findings support the finding of Penuel, Roschelle, & Shechtman (2007) that co-design stimulates actual curriculum use. When comparing co-designers and re-designers, there was a discrepancy in implementation, with higher integration for co-designers, despite equal teacher involvement (time, and effort) in (co-and re-)design. Also, the perspective on curriculum practicality could be explanatory for implementation. Co-designer teachers, with the highest extent of integration, perceived PictoPal as good for future use, congruent with pupils' needs, and were positive about the ratio of effort invested and the benefits gained. The findings support the previously identified link between perceiving a curriculum useful and a greater chance to implement the curriculum (Wozney et al., 2006). Another explanation, for higher integration for co-designers compared to re-designers, is the finding that co-designers felt co-ownership, while re-designers felt contributors to the design. The findings support the notion that involvement in curriculum development can be fruitful for implementation and can create a sense of ownership (Fullan, 2003).

5.6.4 Conclusion

In conclusion, the findings of this study suggest that involving teachers in co-design of technology-rich activities contributes most to implementation, teacher sense of co-ownership and positive teacher perspective about role and curriculum practicality. All three roles for teachers (executor-only, re-designer, and co-designer) seem to contribute to the effectiveness of technology-rich activities. Results suggest that the large effects on pupil learning in each condition associated with different teacher roles were indicative for effectiveness of technology-rich activities for early literacy. Future research should examine how teachers in the executor-only, re-designer and co-designer roles affect opportunities for pupil learning when designing and implementing activities, to offer more insight in the relationship between curriculum implementation and pupil learning outcomes. Pupil early literacy development can be stimulated by technology rich-activities implemented by teachers with different roles, but a high extent of integration of technology activities is most likely to occur in kindergarten classes of teachers as co-designers.

From this study, several implications can be derived. First, the implementation of technology-rich activities can be improved through teacher involvement in re-design or co-design. Second, when planning the innovation, teachers should be informed prior to involvement about the possible roles, as well as the responsibilities and (dis-)advantages of each. Comparing and contrasting the various roles with teachers could help them embrace the role that suits them best. Teachers raising practicality concerns about technology-rich activities should be supported in designing ways to overcome their concerns, since teacher views about the practicality of technology-rich activities seemed positively related to implementation of the activities.

CHAPTER 6
Discussion

This chapter discusses the findings from the four sub-studies about teacher roles in designing ICT-rich learning for early literacy. First, the research is introduced by describing the research aim, the teacher roles, the variables examined, and the context of the study. Then, the research outcomes are summarized per study. Thereafter, conclusions are formulated. Followed by a discussion about the research methodology and a discussion of the outcomes, this chapter ends with recommendations for research and practice.

6.1 INTRODUCTION

The aim of the dissertation was to explore the comparative benefits and drawbacks of various teacher roles (i.e. executor-only, re-designer, and co-designer) on the effectiveness of ICT-rich learning activities for early literacy. Specifically, the aim was to understand how each teacher role influences integration of ICT-rich activities and subsequent pupil learning outcomes. This was undertaken in the context of implementation of a set of ICT-rich activities for early literacy, called PictoPal. PictoPal consists of a series of eight on- and off-computer activities, and focuses on four national interim goals for early literacy, namely: 1) The functions of written language, 2) The link between spoken and written language, 3) Functional reading and writing, and 4) Language awareness. To reach the early literacy goals, teachers can implement PictoPal by integrating the on-computer activities with off-computer activities. By providing insight into the value of different teacher roles in the design of ICT-rich activities, this study can help determine ways of supporting teachers with technology integration for early literacy learning.

The main research question was:
"Which teacher role (executor-only, re-designer, or co-designer) contributes most to the effectiveness of an ICT-rich learning environment for early literacy?"

The main research question encompasses the comparative benefits and drawbacks of the teacher roles for effectiveness of ICT-rich learning activities in the context of PictoPal. Effectiveness of ICT-rich learning activities was defined in terms of pupil learning outcomes. To answer the main research question, four sub-studies were performed. In each of the first three studies, one teacher role was examined through teacher perceptions, integration of on- and off-activities, and pupil learning outcomes. The fourth sub-study focused on comparing the three teacher roles with respect to teacher perceptions, integration, and pupil learning to understand the value of each teacher role for effectiveness of ICT-rich activities for early literacy.

The research questions of the four sub-studies were, respectively:

1. *How do teacher perceptions of teaching/learning, technology and innovation impact integration of a technology-rich curriculum for emergent literacy and in turn, how does teacher technology integration of the curriculum impact pupil learning?*

2. *What does teacher involvement in re-designing technology integrated activities, imply for implementation and learning outcomes?*

3. *When teachers are involved in co-designing technology integrated activities, what does that imply for curriculum implementation and pupil learning outcomes?*

4. *Which teacher role (executor-only, re-designer and co-designer) contributes most to the effectiveness of technology-rich learning activities for early literacy and why?*

In the executor-only role, teachers implement ready-to-use activities. In the re-designer role, teachers collaboratively re-design existing activities, and in the co-designer role, teachers collaboratively design new activities. Teachers in the executor-only role implemented the activities in their classes, but did not participate in designing. Teachers in the re-designer and co-designer roles were involved in collaborative design with a team of teachers, as well as in implementing PictoPal activities in their classrooms. Thus, in each role, the teachers implemented ICT-rich learning activities.

The same set of variables was examined in all studies. These were: teacher perceptions about teaching/learning in kindergarten, early literacy, technology, one's own role, and curriculum practicality; integration of on- and off-computer activities; and pupil learning outcomes. Additionally, teacher perceptions about co-ownership and collaborative design were investigated in the re- and co-designer studies.

The study reported in this dissertation investigated what different teacher roles in design (i.e. executor-only, re-designer, and co-designer) imply for effectiveness of ICT-rich learning activities for early literacy. As mentioned previously, effectiveness of ICT-rich learning activities was defined in terms of pupil learning outcomes. Pupil learning outcomes were presumed to be affected by how teachers in their respective roles integrate (ready-to-use, re-designed, and co-designed) ICT-rich learning activities. Therefore, throughout implementation of the ICT-rich learning activities, the extent of integration of on- and off-computer activities was measured. Within each teacher role, teacher perceptions and degree of integration of on- and off-computer activities were used to understand and explain contribution of each teacher role to effectiveness of ICT-rich learning activities.

6.2 SUMMARY STUDIES: OUTCOMES

6.2.1 Study 1: Teacher role executor-only (Chapter 2)

The first study aimed to better understand the factors that influence integration of ICT-rich activities, and the potential connection between integration and pupil learning outcomes given the executor-only role. The study examined how teachers provided with ready-to-use PictoPal materials and activities perceive teaching/learning, technology and innovation, in addition to how they integrate on- and off-computer activities. Also, pupil learning outcomes were examined in a quasi-experimental design in two junior and two senior kindergarten classrooms.

The findings revealed that a high extent of integration was linked to: a developmental approach to teaching/learning (e.g. helping pupils to construct meaning); positive attitudes towards technology and PictoPal; teacher confidence about implementation; perceiving PictoPal being congruent with pupils' skills; and investment of effort in implementation. A medium extent of integration was linked to a facilitative approach to teaching/learning (e.g. providing children with the tasks to elicit autonomous activity); and investment of effort in implementation. A low extent of integration was linked to a facilitative approach to teaching/learning; and concerns about technology. The experimental group significantly outperformed the control group, with medium effect size for the proportion of variance explained by PictoPal and a large effect size for the learning gain. Significant differences were revealed between the junior classes and one of the senior classes, with a medium effect size for the proportion of variance explained by class. In all four classes using PictoPal, large effect sizes were found for the learning gains.

The findings imply that a developmental approach to teaching and learning, positive perceptions about technology and PictoPal are linked to a high extent of integration. However, they do not suggest that a significantly higher extent of on- and off-computer activities is linked to significantly higher pupil learning outcomes.

6.2.2 Study 2: Teacher role re-designer (Chapter 3)

The second study aimed to gain a better understanding of what involvement of teachers in the re–design of ICT-rich activities implies for implementation and pupil learning. Two case studies were performed involving a total of six teachers in re-designing, whereby five of them implemented PictoPal in three junior and two senior kindergarten classrooms. The study examined teacher perceptions about collaborative re-design, their role, co-ownership, and curriculum practicality; and integration of on- and off-computer activities. Pupil learning outcomes were studied in a quasi-experimental design.

Findings showed no difference in the extent of integration of on- and off-computer activities between the five teachers. Findings on pupil learning outcomes showed that the experimental groups significantly outperformed the control groups, with medium effect sizes for the proportion of variance explained by PictoPal. In the experimental groups, the effect sizes for the learning gains were large. Significant between-class differences in pupil learning outcomes were found with medium and large effect sizes for the amount of variance explained by class. Also, medium and large effect sizes were found for the learning gains in the five classrooms.

This study implies that the team members' similar extent of integration is linked to the teachers' positive perceptions about collaborative redesign; positive perceptions about practicality; perceiving the re-designer role as not a regular teacher practice; and a slight sense of co-ownership toward PictoPal. The extent of integration of on- and off-computer activities could not be linked straightforwardly to the significant between-class differences in pupil learning outcomes.

6.2.3 Study 3: Teacher role co-designer (Chapter 4)

The third study aimed to gain a better understanding of what involvement of teachers in co-design implies for implementation and pupil learning. A case study was performed to investigate the co-designer role for teachers. Five teachers and two intern teachers were involved in two teams that collaboratively designed a new series of PictoPal activities. This study examined teacher perceptions about: teaching/learning, technology and early literacy; their co-design team, their own role, practicality; and co-ownership of PictoPal activities. Also, integration of on-and off- computer activities was examined in three classes, along with pupil learning outcomes. A quasi-experimental design was used to study pupil learning outcomes.

Findings showed no differences in the extent of integration of on- and off-computer activities between the three teachers. Findings on pupil learning outcomes showed a difference in outcomes between the experimental and the control groups. Pupils in the experimental group outperformed the pupils in the control group, with a small size for the proportion of variance explained by learning with PictoPal. The effect size for the learning gains in the experimental group was large. There was no significant difference in pupil learning outcomes between the three classes working with co-designed PictoPal. In each of the three classes working with PictoPal, the effects sizes were large for the learning gains.

Teachers involved in co-designing PictoPal activities seem to reach a similar extent of integration of PictoPal activities and similar pupil learning gains in their classes. This study implies that a specific view about teaching/learning (i.e. developmental approach), positive perceptions about technology and curriculum practicality, and a sense of co-ownership can be linked to the similar extent of integration between teachers.

6.2.4 Study 4: Cross-case study (Chapter 5)

The fourth study aimed to provide insight into the value of the different teacher roles in designing ICT-rich activities. To investigate comparative benefits and drawbacks of the teacher roles, a cross-case study was performed. Ten participants were selected from the previous studies, with four teachers in the executor-only case, three teachers in the re-designer case and three teachers in the re-designer case. The variables compared across cases were: teacher perceptions about their role, curriculum practicality, and co-ownership; integration of on- and off-computer activities; and pupil learning outcomes.

Findings revealed that teachers in the co-designer and executor-only cases embraced their roles. Co-designer case teachers were more positive about the practicality of PictoPal activities than teachers in both the executor-only and the re-designer cases. Co-designer case teachers perceived a greater sense of co-ownership towards PictoPal, than re-designer case teachers.

Significant differences in the extent of integration of on- and off-computer activities were found between the three cases, with a large effect size for the proportion of variance explained by case. The extent of integration was higher in the co-designer case than in the re-designer case. Also, integration was higher in the re-designer case than in the executor-only case. Both teacher role and time of eight weeks of working with PictoPal were significant predictors for degree of integration.

Pupil learning outcomes were significantly higher in the three cases, than in their respective control groups. Large effect sizes for the proportion of variance explained by PictoPal were found for both the executor-only case junior and senior pupil groups; a medium effect size was found for the re-designer case junior pupil group; and a small effect size was found for the co-designer case senior pupil group. In all the three cases, large effect sizes were found for the learning gains, measured as the difference between pre- and post-test.

This study implies that positive perceptions about teacher role, practicality, and co-ownership complement the highest extent of integration. Re-designer and co-designer roles appear to contribute more than the executor-only role to integration of on- and off-computer activities. Since pupil learning outcomes were significantly enhanced in all cases, all teacher roles contributed to the effectiveness of ICT-rich learning.

6.3 Overall conclusion of the study

This dissertation set out to examine teacher roles (executor-only, re-designer or co-designer) to answer the research question about which one contributes most to effectiveness of an ICT-rich learning environment for early literacy. Based on the four studies about teacher roles the following answer of the research question can be provided. Each teacher role (executor-only, re-designer, and co-designer) contributes significantly to the effectiveness of ICT-rich early literacy learning activities.

Although pupil learning outcomes were presumed to be affected by how teachers in their respective roles integrate (ready-to-use, re-designed, and co-designed) ICT-rich learning activities, this study suggests that across teacher roles, pupil learning outcomes were not straightforwardly related to the extent of integration.

Given the findings of this study, several considerations are worth noting with regard to identifying which teacher role is best suited for implementation and effectiveness of ICT-rich learning. Though the main research question relied upon pupil learning outcomes, it is not easy to give a straightforward answer. This study concluded that involvement of teachers in design enabled them to fully embrace the products and materials to be implemented. This sense of co-ownership is an important factor; in this study, it yielded high degrees of integration and willingness to extend implementation of PictoPal activities beyond the research context. From this viewpoint, it becomes clear that the co-designer role is best suited for the long-term feasibility of implementing ICT-rich learning activities, despite the smaller effect sizes found in pupil learning outcomes.

One may argue that the executor-only role is best suited for teachers who cannot easily adopt a role in design, and who want to improve the pupil learning outcomes in the short term, at the cost of ownership and thorough understanding of the curriculum activities. Although teachers in this study expressed that PictoPal can be suitable for children who are able to work with activities independently, the executor-only role may not be best-suited for implementation in the long run, because teachers may not fully embrace the PictoPal activities. In other words, the executor-only role can be feasible for those children who are able to use PictoPal without guidance from the teacher. A combination of roles is also possible, whereby teachers design materials for those kindergartners, who require teacher guidance, and use ready-made activities for kindergarteners who can work with the materials independently. This combination is already in place in all of the schools who participated in this study that continued with PictoPal outside of the research project.

A surprising finding in this study was that teachers did not perceive the re-designer role to be a regular practice for teachers. Despite the fact that re-designing was new for these teachers, they viewed it as a learning experience, worth investing their time and effort. Teachers re-designed PictoPal activities to reach their goal of creating activities suited for both junior and senior pupil levels.

Even though they did meet this goal (i.e. differentiated materials were realized and both junior and senior kindergartners exhibited significant learning gains) the teachers decided that PictoPal was best suited for those children who can work with it without teacher guidance (typically, the more advanced learners). A possible explanation is that the teachers in the role of re-designer as well as teachers in the role of executor-only held a view that children should work and learn as much as possible independently, specifically with on computer activities. It is possible that the tacit teaching goal and view of these teachers was stimulating independent learning of pupils in kindergarten classes (since these teachers came from the same school, that strongly supported independent learning). It is also possible that teachers felt this way for pragmatic reasons (e.g. that it not feasible to facilitate computer activities while other children in the class are doing different activities). A combination of these explanations seems likely.

6.4 REFLECTIONS ON THE RESEARCH METHODOLOGY

6.4.1 General approach

Doing research in a kindergarten classroom can be complex, because of complications such as classroom scheduling, technical infrastructure, and teacher time/commitment. The complexity of doing research in practice presents challenges to the research design. For example, pupil populations in the classrooms of the teachers investigated can differ, making it problematic to compare the interventions. Experimental designs in practice contexts may not provide a coherent picture of factors influencing implementation of interventions and pupil learning, because it is impossible to hold certain variables constant (e.g. implementation and pupil classroom experiences), while manipulating others (e.g. teacher roles in design), in order to examine effects of interventions.

In this study, a case study methodology was considered suitable to investigate what role is the best for a kindergarten teacher regarding technology-rich early literacy learning. Unlike other methods such as some experimental designs or surveys, case studies inherently take the context into consideration (Yin, 2003). A case study approach allowed for in-depth investigation of each teacher role, describing the context and circumstances in which a specific role was undertaken, as well as the variables measured.

The findings and conclusions for implementation and effectiveness of ICT-rich learning activities in the specific context of kindergarten classrooms through a case study can be helpful for extending research to in this context. Specifically, a well-described case study provides sufficient information for readers to ascertain if and how research findings might be of value in similar contexts. Such information can also help researchers test how widely applicable new findings might be. For example, subsequent studies can investigate if certain predictions hold under a broader range of certain circumstances.

A case study approach allows for the execution of an ecologically valid study. The results of this study were highly relevant for kindergarten early literacy classrooms, because the study was undertaken under natural conditions. The quasi-experimental design used in this study shaped the possibility to examine early literacy outcomes of kindergarteners, making the case study findings more robust.

6.4.2 The researcher's role

The role of the researcher in these case studies is important to describe, because the researcher actively participated in the setting in which the study was undertaken and did not only gather data. The researcher in this study was a participant observer , but also facilitated teacher teams and supported them when needed. Researchers can influence study outcomes, because they are present and act in specific ways (e.g. in positive, supportive and motivating ways) during the research. The researcher's presence may have prompted teachers to answer interview questions in socially-desirable ways, or to teach differently when being observed, than they do in daily practice. This is known to be a potential disadvantage of participatory observation which, in this study, could have affected all sub-studies. To mitigate this, triangulation was used (not only observations but also group interviews with teachers) to study implementation of PictoPal. The results of observations were evaluated together with teachers in each case study. In this way, opportunities were provided for participants to check if observations represented their actual classroom implementation.

Besides introducing bias that might affect the participants, researchers may also be subject to bias. In the process of data-gathering, there is a potential danger that a researcher may interpret situations being observed or tested in a particular way, which might not necessarily have been observed as such by others. To minimize the threats related to the role of researcher for research validity and reliability, research assistants were engaged in data gathering and data-entry, while for data-analysis critical friends (colleagues) were engaged in reviewing data tabulations and interpretations of data (e.g. as an audit task during a master class about qualitative methods). Disagreements in interpretations between observers and reviewers were discussed until agreement about interpretation was reached. Member checks were undertaken, in which teachers reviewed the data from interviews during evaluations meetings featuring presentation of the research results and interpretations. In this way, teachers also had a role in validating data interpretations.

6.5 Reflections on research outcomes

The first basic assumption of this dissertation was that involvement of teachers in curriculum design can contribute to curriculum implementation (Fullan, 2003). The second assumption was that teacher perceptions about teaching/learning, early literacy and technology influence implementation (e.g. Tondeur, et al., 2008a). The third assumption was that curriculum implementation positively influences pupil learning outcomes (Cheung & Slavin, 2012). In this section we reflect on these assumptions, based on the study findings.

6.5.1 Teacher involvement in curriculum design

The first assumption underpinning this study was that involvement of teachers in designing ICT-rich learning activities positively influences implementation of the activities. From this study, it can be concluded that teacher roles in design of ICT-rich learning activities positively influence classroom implementation of on- and off-computer activities. Specifically, the cross-case study revealed that teachers with active roles in design of ICT-rich learning activities (re-designer and co-designer) had a significantly higher extent of integration of on- and off-computer activities, compared to teachers not actively involved in design (executor-only). In line with Penuel, Roschelle, & Shechtman (2007), this study demonstrated that teams of teachers designing activities can be fruitful for actual classroom implementation. The integration during classroom implementation, as demonstrated by teachers in the re-designer and co-designer roles, may have been more aligned with the intentions of the teachers themselves who re- or co-designed PictoPal, than in the case of executor-only.

Explanations for these results may be provided by the findings on teacher perceptions about curriculum practicality and co-ownership. Involving teachers in design may induce teachers' commitment because of their input in the design of activities. They may feel valued in contributing their practical insights into the materials their pupils will learn with. This leads to co-ownership, which could motivate teachers to enact the on- and off-computer activities in an integrated manner. Practicality of PictoPal activities and co-ownership toward PictoPal were found to be present in the studies involving re-designers and co-designers. The findings are in line with other studies (Wozney et al., 2006; De Grove et al., 2012) suggesting that teachers perceiving a curriculum to fit their current curriculum were likely to implement it successfully.

An active role in design may give teachers an opportunity to see the fit between the activities being designed and their current curriculum, which may contribute to a better understanding of how to implement the designed activities. Also, feeling co-owner of the designed activities may induce motivation and enthusiasm in teachers for implementing the activities, which may contribute to implementation.

6.5.2 Teacher perceptions influence curriculum implementation

The second assumption in this study was that teacher perceptions about teaching/learning, ICT, and early literacy influence the implementation of ICT-rich learning activities. Specifically, the nature of perceptions about teaching/learning and early literacy can either positively or negatively influence implementation of ICT-rich activities, whereas positive perceptions about technology positively influence implementation.

Based on this study, it can be concluded that a high extent of integration of on- and off-computer activities during implementation is related to: a developmentally-oriented view of teaching/learning; and viewing early literacy as an important domain. The conclusion corroborates the findings of Kim et al. (2013), who showed that teacher perceptions about teaching and learning were related to their technology integration practices.

Based on this study, it can be concluded that positive perceptions of technology are related to a high extent of integration of on- and off-computer activities during implementation. The conclusion is in line with the study of Hermans et al. (2008)

which showed that positive attitudes toward technology positively influences classroom implementation concerning technology integration. Engagement of teachers in meaningful experiences with technology integration could positively influence teacher attitudes toward technology integration in their classes. Ertmer and Ottenbreit-Letwich (2010) recommended an approach which emphasizes technology uses that directly align with teachers' existing beliefs. According to the authors, time, small steps, and teacher collaboration are needed for transforming teachers beliefs to be more open for technology integration.

6.5.3 Implementation and pupil outcomes

The third assumption in this study was that pupil learning outcomes are affected by how teachers implement a curriculum. In this study, the extent of integration of on- and off-computer activities was investigated as an indicator of classroom implementation. The study demonstrated that high degrees of integration could not be linked straightforwardly to high pupil learning outcomes. This finding does not corroborate to the finding of Cheung and Slavin (2012) who found that studies with high implementation ratings were associated with large effects on pupil learning. In this study, ICT-rich learning activities positively affected pupil learning outcomes. The study demonstrated that pupils showed significantly improved early literacy outcomes compared to their respective control groups. However, in this study implementation of PictoPal was measured by *how* teachers integrated the on- and off-computer activities; whereas this study did not evaluate the quality of re- and co-designed PictoPal activities, such as the learning difficulty and the learning opportunities of the activities, indicating that there is more to implementation, than the extent of integration.

In the executor-only study, significantly different pupil learning outcomes were found in classes of teachers integrating the ready-to-use on- and off-computer activities to significantly different degrees, with no link between higher extent of integration and higher pupil learning outcomes. This could mean that integration does not affect pupil learning outcomes. From the second and the third study no conclusions can be drawn with regard to how the extent of integration affects pupil learning outcomes. Specifically, teachers in the re-designer role did not differ in the extent of integration, whereas the pupil learning outcomes did differ between their classes. Teachers in the co-designer role did not differ in the extent of integration and no differences were found in pupil learning outcomes between their classes.

The PictoPal materials produced in each case were extremely similar in structure, difficulty and style, as described in Chapter 5. However, because the vocabulary and content of each set of materials produced did vary, it is possible that the extent of integration was less important than the variation in the content and quality of the PictoPal activities for influencing early literacy outcomes of pupils. The pupil learning outcome findings from the cross-case study support this. Specifically, when comparing senior pupil learning outcomes with their respective control groups, the proportion of variance attributable to learning with PictoPal activities was larger in the executor-only case than in the co-designer case. Yet, the small differences in the effect sizes between the executor only and co-designer case may not weigh off the benefits of teachers developing a sense of co-ownership, as was the case when teachers had a co-designer role. In the long run, children may benefit more from co- and re-designed materials, because their teachers fully embrace them and this positively affects implementation.

6.6 RECOMMENDATIONS

6.6.1 Recommendations for research

Based on this study, several recommendations are provided for further research concerning teacher roles in designing ICT-rich materials and learning activities. This study combined case studies in natural settings for studying how teachers design and implement technology-rich materials and activities for early literacy with a quasi-experimental design for investigating pupil learning. Further research could use this combined approach in other educational contexts, benefitting from the rigor of the quasi-experimental design and the ecological validity of the case study.

Although not deemed feasible within the scope of this study, future investigations could pay more explicit attention to the variation in quality of teacher-made curriculum materials, as well as the resulting effects on pupil learning outcomes, and integration of ICT-rich learning activities. Teacher designed materials and activities could be reviewed by experts and compared to the ready-made PictoPal activities. If, indeed the variety in quality does account for differences in pupil learning outcomes, then exploration into ways of mitigating this variety seems warranted. For example, perhaps language experts could collaborate with teachers during design.

Also, instead of mitigating variation in materials content and quality, future research could remove it. For example, teachers in the role of executor-only could be assigned to implement the activities co-designed or re-designed by other teachers. In this way, the key variable of design participation could be changed while the materials are kept constant. The effects on both the extent of integration and pupil learning could be investigated.

Future studies could also explore teacher roles in longitudinal research to examine how these evolve over time, and in different phases of their profession. For example, it is plausible that novice and veteran teachers may develop over time differently in their roles which could affect their technology integration. In this respect it could be helpful to know what kind of role likely suits teachers in different stages of their teaching.

With respect to measurement of pupil learning outcomes, future research incorporate differentiated tests, e.g. with difficulty levels for senior pupils and junior pupils. By including items with different difficulty levels possible ceiling effects could be resolved. Also, when investigating learning outcomes, it should be kept in mind that the learning curve of junior pupils differs from the learning curve in the senior pupil population. For example, it is easier for a pupil to score high if the first time of measurement the pupil scored high. Yet, for pupils who score low on a pre-test it is easier to improve during intervention and score high on a post-test. To resolve this problem, future research should include weighted items in the test measuring learning outcomes in a pre-post design.

6.6.2 Recommendations for practice

Based on this study, it can be recommended that schools who wish to support early literacy development in kindergarteners can benefit from engaging their teachers in collaborative design of ICT-rich activities, such as PictoPal. Of the various roles teachers may have, co-design may result in highest levels of ownership and therefore longer use of the activities. Co-design of materials and activities enables teachers to explore possibilities of how to connect technology with curricular themes and activities.

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DUTCH SUMMARY

De ontwikkeling van beginnende geletterdheid met behulp van ICT-rijke leeractiviteiten: Docentrollen en leerprestaties

INTRODUCTIE

Tegenwoordig is informatie- en communicatietechnologie (ICT) onderdeel van de beleveniswereld van jonge kinderen, omdat kinderen vaak op jonge leeftijd ermee in aanraking komen op school en thuis. ICT heeft de potentie om het leren van kleuters op basisscholen te ondersteunen. Wanneer ICT-rijke leeractiviteiten geïntegreerd zijn met niet ICT-rijke activiteiten op een voor de kinderen betekenisvolle wijze kan ICT het leren van kinderen stimuleren. Voor docenten echter is het vaak een uitdagende taak om ICT-rijke activiteiten te integreren met andere curriculumactiviteiten om het leren van kinderen te stimuleren. De vraag die zich opwerpt, is hoe docenten ICT-rijke activiteiten het beste kunnen integreren zodat de implementatie in hun klassen het leren van hun leerlingen ondersteunt. In deze studie worden drie rollen (uitvoerder, her-ontwerper en co-ontwerper) onderzocht die docenten kunnen aannemen ten behoeve van de effectiviteit van ICT-rijke activiteiten voor beginnende geletterdheid.

Beginnende geletterdheid behelst de ontwikkeling van mondelinge taal, schriftelijke taal en begrip (Cooper, 1993). Beginnende geletterdheid is een belangrijk onderdeel van de ontwikkeling van het jonge kind, omdat het een precursor is van het (begrijpend) leren lezen en daarmee een bouwsteen voor succesvolle participatie in de maatschappij. In deze studie is gebruik gemaakt van ICT-rijke activiteiten voor beginnende geletterdheid, genaamd PictoPal. Het doel van PictoPal is de ontwikkeling van beginnende geletterdheid van jonge kinderen (4-6 jaar oud) te stimuleren. PictoPal bestaat uit een reeks van acht computer- en klassenactiviteiten toegespitst op vier tussendoelen voor beginnende geletterdheid, namelijk: 1. Functie van geschreven taal, 2. Relatie tussen gesproken en geschreven taal, 3. Functioneel lezen en schrijven en 4. Taalbewustzijn.

In elke docentrol (uitvoerder, her-ontwerper en co-ontwerper) werd PictoPal geïmplementeerd door docenten. Echter, docenten werden op verschillende manieren betrokken bij het ontwerpen van PictoPal. In de uitvoerdersrol implementeerden docenten de reeds bestaande PictoPal, zonder deel te nemen aan het ontwerp van PictoPal. In de her-ontwerpersrol werden docenten betrokken in het gezamenlijk herontwerpen van PictoPal voor hun kleuterklassen. In de co-ontwerpersrol werden docenten actief betrokken bij het ontwerpen van nieuwe ICT-rijke activiteiten.

Deze studie is gebaseerd op drie assumpties. De eerste assumptie is dat het betrekken van docenten in het gezamenlijk ontwerpen van ICT-rijke activiteiten de implementatie van ICT-rijke activiteiten ten goede komt. Het gezamenlijk ontwikkelen van activiteiten voor eigen klas kan docenten helpen een beter begrip te verkrijgen van de activiteiten en de aansluiting tussen ICT-rijke activiteiten en andere klassenactiviteiten. Daarnaast kan het gezamenlijk ontwikkelen van activiteiten docenten helpen de praktische uitvoerbaarheid van de activiteiten te bepalen. Het gezamenlijk ontwikkelen van activiteiten kan de betrokken docenten stimuleren zich mede-eigenaar te voelen ten aanzien van de activiteiten. Mede-eigenaarschap betreffende curriculumactiviteiten die docenten ontwikkeld hebben kan de implementatie van de activiteiten bevorderen (Fullan, 2003).

De tweede assumptie is dat percepties van docenten over onderwijzen/leren, ICT, beginnende geletterdheid van invloed zijn op implementatie van ICT-rijke activiteiten. De aard van overtuigingen van docenten over onderwijs en leren bepalen hoe docenten computers in de klas gebruiken, bijvoorbeeld een constructivistische aard van overtuiging voorspelt geïntegreerd computergebruik in de klas (Hermans et al., 2008). Ook overtuigingen van docenten betreffende het onderwijzen en leren van beginnende geletterdheid kunnen medebepalend zijn voor implementatie van ICT-rijke activiteiten voor beginnende geletterdheid. Daarnaast blijkt een positieve attitude van docenten ten aanzien van computers een positieve invloed te hebben op het werken met computers in de klas (Hermans et al., 2008).

De derde assumptie is dat implementatie van curriculumactiviteiten van invloed is op de leerprestaties van leerlingen. Eerder onderzoek heeft aangetoond dat hoge leerprestaties van leerlingen gerelateerd zijn aan hoge implementatie ratings van ICT-gerelateerde curriculumactiviteiten (Cheung & Slavin, 2012), maar het onderzoek van Lowther, et al. (2012) toonde geen significante verschillen in leerprestaties van leerlingen aan tussen docenten die ICT-gerelateerde activiteiten implementeerden en docenten die niet betrokken waren bij implementatie van ICT-gerelateerde activiteiten.

In de studie zijn de volgende variabelen onderzocht: 1. Percepties van docenten op onderwijzen/leren, ICT, beginnende geletterdheid, docentenrol, mede-eigenaarschap en praktische uitvoerbaarheid van curriculumactiviteiten; 2. Implementatie van ICT-rijke activiteiten; en 3. Leerprestaties van leerlingen. Implementatie was geoperationaliseerd als de mate van integratie van computer- en klassenactiviteiten. Leerprestaties van leerlingen zijn onderzocht als indicator voor de effectiviteit van ICT-rijke activiteiten.

DOEL VAN ONDERZOEK EN ONDERZOEKSVRAGEN

De studie richtte zich op het betrekken van docenten in het gezamenlijk ontwerpen van ICT-rijke activiteiten door drie verschillende rollen. Het doel van deze studie is inzicht te krijgen in de waarde van drie verschillende rollen voor docenten om beginnende geletterdheid van kleuters te stimuleren door middel van ICT-rijke leeractiviteiten.

De hoofdonderzoeksvraag was:
Welke rol voor docenten (uitvoerder, her-ontwerper, co-ontwerper) draagt het meeste bij aan de effectiviteit van de ICT-rijke activiteiten voor beginnende geletterdheid?

Om de hoofdonderzoeksvraag te beantwoorden zijn er vier deelstudies uitgevoerd, namelijk 1. Deelstudie uitvoerdersrol, 2. Deelstudie her-ontwerpersrol, 3. Deelstudie co-ontwerpersrol en 4. Cross-case studie. De respectievelijke deelonderzoeksvragen waren:

1. Hoe beïnvloeden percepties van docenten op onderwijzen/leren, ICT, en innovatie de integratie van een ICT-rijk curriculum voor beginnende geletterdheid en hoe beïnvloedt integratie de leerprestaties van leerlingen?
2. Wat betekent het betrekken van docenten in het herontwerpen van ICT-rijke leeractiviteiten voor implementatie en leerprestaties?
3. Wat betekent het betrekken van docenten in het co-ontwerpen van ICT-rijke activiteiten voor curriculum implementatie en leerprestaties?

4. Welke rol voor docenten (uitvoerder, her-ontwerper, co-ontwerper) draagt het meeste bij aan de effectiviteit van ICT-rijke activiteiten voor beginnende geletterdheid en waarom?

ONTWERP VAN ONDERZOEK

In de eerste deelstudie is de rol van uitvoerder toegewezen aan docenten. Docenten is gevraagd om reeds bestaande ICT-rijke activiteiten te implementeren in hun kleuterklassen. Gedurende een informatiebijeenkomst zijn de docenten geïnformeerd over de ICT-rijke activiteiten en het tijdpad van implementatie. In de eerste deelstudie zijn de percepties van vier docenten op het onderwijzen/leren, ICT en ICT-gerelateerde innovaties bestudeerd. Daarnaast is er onderzocht in hoeverre de vier docenten PictoPal computer- en klassenactiviteiten integreerden. Ook zijn de leerprestaties op beginnende geletterdheid van de leerlingen uit de klassen van de vier docenten onderzocht.

In de tweede deelstudie is docenten gevraagd deel te nemen aan het herontwerp van ICT-rijke activiteiten. Drie her-ontwerpbijeenkomsten zijn georganiseerd door docenten en onderzoeker en begeleid door onderzoeker. De herontwerptaak hield in dat docenten gezamenlijk de reeds bestaande ICT-rijke activiteiten zodanig herontwerpen dat de activiteiten aansluiten bij het curriculum en het niveau van kleuters in hun klassen, maar dat de structuur, en moeilijkheidsgraad van de activiteiten niet verandert. Daarbij hoorde ook de eis dat elke computeractiviteit betekenisvol geïntegreerd is in een klassenactiviteit en past binnen een thematische afstemming van alle activiteiten. Docenten maakten hun herontwerp op papier. Vervolgens zijn de herontwerpen van docenten door onderzoekers en assistenten omgevormd tot activiteiten op de computer en klassenactiviteiten in handleidingen voor de docenten. Zes docenten waren betrokken bij het herontwerp van PictoPal-activiteiten en vijf docenten bij implementatie van de her-ontworpen activiteiten. De onderzochte variabelen waren docentenpercepties van hun rol als her-ontwerper, van mede-eigenaarschap, en van de praktische uitvoerbaarheid van PictoPal. Daarnaast zijn de mate van integratie van computer- en klassenactiviteiten en de leerprestaties van de leerlingen op beginnende geletterdheid onderzocht.

In de derde deelstudie zijn zeven docenten betrokken in het gezamenlijk ontwerpen van ICT-rijke activiteiten. De ontwerptaak voor de docenten was om aan de hand van voorbeeldactiviteiten gezamenlijk nieuwe activiteiten te ontwerpen die aansluiten op het curriculum en het niveau van de kinderen. De activiteiten hoorden geïntegreerd en thematisch afgestemd te zijn, zonder dat de structuur en moeilijkheidsgraad van de activiteiten verandert. Het co-ontwerpen nam drie bijeenkomsten in beslag. De ontwerpen van docenten zijn na afloop van de ontwerpbijeenkomsten omgevormd tot activiteiten op de computer, klassenactiviteiten en een handleiding voor de docenten. Drie van de zeven docenten implementeerden de co-ontworpen PictoPal in hun kleuterklassen. De volgende variabelen zijn onderzocht in deze studie: docentenpercepties op het onderwijzen/leren, ICT, beginnende geletterdheid, de rol als co-ontwerper, praktische bruikbaarheid en mede-eigenaarschap, de mate van integratie en leerprestaties van leerlingen.

De vierde studie is ontworpen om de drie docentrollen te vergelijken in een cross-case analyse. Voor het toewijzen van docenten aan één van de drie cases zijn de volgende criteria gebruikt: 1. docenten hebben geen eerdere ervaring met implementatie of (her-)ontwerp van PictoPal, 2. docenten implementeren hetzelfde type van PictoPal-activiteiten binnen eenzelfde conditie (aangedragen of her-ontworpen of co-ontworpen activiteiten), en 3. docenten implementeren PictoPal in dezelfde tijdsperiode van het schooljaar. In een cross-case analyse werden de cases op dezelfde set van variabelen vergeleken: docentenpercepties over hun rol, praktische uitvoerbaarheid, en mede-eigenaarschap; de mate van integratie van computer- en klassenactiviteiten; en de leerprestaties. Deze vierde studie was gericht op de waarde van de verschillende docentenrollen (uitvoerder, her-ontwerper, co-ontwerper) voor de implementatie van ICT-rijke leeractiviteiten voor beginnende geletterdheid en leerprestaties van leerlingen.

METHODOLOGIE

In deze studie is de *case study* methode gebruikt voor de drie deelstudies gericht op de uitvoerdersrol, her-ontwerpersrol en de co-ontwerpersrol. In de vierde studie is een *cross case study* toegepast om de drie docentrollen te vergelijken. Een quasi-experimenteel ontwerp is gebruikt om leerprestaties van de leerlingen in elke case te onderzoeken.

In elke studie zijn kwalitatieve en kwantitatieve data verzameld. Percepties van docenten zijn gemeten door interviews met docenten. Implementatie van PictoPal, geoperationaliseerd als de mate van integratie van computer- en klassenactiviteiten, is gemeten door observaties met behulp van de Checklist Integratie (Verseput, 2008b). Beginnende geletterdheid leerprestaties zijn gemeten door gebruik te maken van de Beginnende geletterdheidtest voor kinderen van 4-5 jaar oud (McKenney & Voogt, 2006). Leerlingen zijn voorafgaand aan en na afloop van de implementatie van PictoPal getest. De controle groepen leerlingen hebben niet met PictoPal geleerd maar met het gangbare taalcurriculum en zijn in dezelfde periode getest als de leerlingen in de experimentele groep.

De docent en haar klas is in de eerste drie deelonderzoeken beschouwd als case en analyse-eenheid. In de vierde studie zijn de docenten met een bepaalde rol als case en analyse-eenheid beschouwd. Voor de analyse van de kwalitatieve data over percepties is een comparatieve methode gebruikt, waarbij de overeenstemmingen en verschillen tussen de cases geïdentificeerd werden. De data betreffende de mate van integratie en de leerprestaties van leerlingen zijn geanalyseerd gebruikmakend van kwantitatieve analysetechnieken.

RESULTATEN

De resultaten van de studie over de uitvoerdersrol toonden aan dat de mate van integratie gerelateerd was aan een ontwikkelingsgerichte benadering op onderwijs en aan positieve percepties over ICT. De docenten verschilden significant in de mate van integratie van computer- en klassenactiviteiten. Kinderen die met PictoPal leerden, hadden significant hogere leerprestaties vergeleken met de kinderen die niet met PictoPal leerden. De proportie verklaarde variantie door de onafhankelijke variabele, het leren met PictoPal, was groot. In de experimentele groep was de effectgrootte voor de leerwinst groot.

Tussen de vier klassen verschilden de leerprestaties significant. De proportie verklaarde variantie door de klas was van gemiddelde grootte. In alle klassen was de effectgrootte voor leerwinst groot. Een hoge mate van integratie bleek niet gerelateerd aan hoge leerprestaties.

Uit de studie over de docentenrol als her-ontwerper bleek dat de mate van integratie niet verschilde tussen de docenten. De docenten hadden positieve percepties van gezamenlijk herontwerp en van praktische uitvoerbaarheid van de activiteiten. Daarnaast bleek uit deze studie dat de docenten een gering mede-eigenaarschapsgevoel ten aanzien van de PictoPal-activiteiten hadden en de rol van her-ontwerper als ongebruikelijk in de onderwijspraktijk ervoeren. De leerprestaties van de leerlingen die met her-ontworpen PictoPal-activiteiten leerden, waren significant hoger dan de leerprestaties van de leerlingen die PictoPal niet gebruikten. De proportie variantie in de leerprestaties verklaard door het leren met PictoPal was van gemiddelde grootte.

De leerprestaties verschilden significant tussen de klassen in twee vergelijkingen, namelijk een vergelijking tussen twee klassen onderling, en een vergelijking tussen drie klassen onderling. In de respectievelijke vergelijkingen waren de proporties verklaarde variantie door de klas gemiddeld en groot. Gedurende implementatie van PictoPal nam de mate van integratie toe, maar een hoge mate van integratie bleek niet gerelateerd te zijn aan hoge leerprestaties.

Uit de resultaten van de studie over de docentenrol als co-ontwerper bleek dat een ontwikkelingsgerichte onderwijsbenadering van docenten gerelateerd is aan een gelijke mate van integratie van de computer- en klassenactiviteiten. Ook bleken percepties van docenten op het onderwijzen/leren van invloed te zijn op de betrokkenheid van docenten in het co-ontwerpen. Positieve percepties van de praktische uitvoerbaarheid en het gevoel van mede-eigenaarschap bij docenten bleken gerelateerd te zijn aan een gelijke mate van integratie van computer- en klassenactiviteiten. Docenten verschilden niet in de mate van integratie van computer- en klassenactiviteiten. In vergelijking met leerlingen die PictoPal niet gebruikten, hadden de leerlingen die met co-ontworpen activiteiten leerden significant hogere leerprestaties, met een kleine effectgrootte. Hoewel de leerprestaties niet verschilden tussen de klassen met leerlingen die PictoPal gebruikten, werden wel grote effectgroottes gevonden voor leerwinst. De resultaten toonden aan dat docenten gelijke mate van integratie vertoonden en dat hun leerlingen gelijke leerwinsten behaalden.

De cross-case studie toonde aan dat de co-designersrol gerelateerd was aan positieve docentenpercepties van die rol, van praktische bruikbaarheid van curriculumactiviteiten en van het gevoel van mede-eigenaarschap bij docenten.

De mate van integratie was het hoogst in de co-ontwerpersrol. Deze bevinding duidde erop dat de docentenrol co-ontwerper het meest bijdraagt aan de implementatie van ICT-rijke activiteiten. Significante leerprestaties van leerlingen werden gevonden bij elke docentenrol. Deze bevinding duidde erop dat de docentenrollen uitvoerder, her-ontwerper en co-ontwerper bijdragen aan de effectiviteit van PictoPal. De effectgroottes in leerprestatiescores bleken groot voor de uitvoerdersrol, gemiddeld voor de her-ontwerper rol en klein voor de co-ontwerper rol. Deze resultaten zouden erop kunnen duiden dat het herontwerpen en co-ontwerpen door docenten wellicht de kwaliteit van de activiteiten verlaagt, waardoor de effectgroottes relatief gering zijn in vergelijking met de effectgrootte behaald in de uitvoerdersrol.

CONCLUSIE

Op grond van deze studie kan worden geconcludeerd dat alle drie docentenrollen (uitvoerder, her-ontwerper en co-ontwerper) significant bijdragen aan de effectiviteit van ICT-rijke activiteiten. Ook kan er worden geconcludeerd dat de co-ontwerpersrol het meest bijdraagt aan de implementatie van curriculumactiviteiten en het mede-eigenaarschapsgevoel bij docenten. De studie impliceert ook dat de percepties van docenten van het onderwijzen/leren van invloed kunnen zijn op hun motivatie, en op de daarmee gepaard gaande investering in het co-ontwerpen en implementeren van ICT-rijke leeractiviteiten. Aangezien de bijdrage van de co-ontwerpersrol aan implementatie en mede-eigenaarschap gepaard ging met significant hogere leerprestaties van leerlingen vergeleken met de leerlingen in de controle groep en met grote leerwinst kan er voorzichtig geconcludeerd worden, dat de co-ontwerpersrol het meeste lijkt bij te dragen aan implementatie van ICT-rijke activiteiten op lange termijn. Ook kan er worden geconcludeerd dat de uitvoerdersrol het best geschikt zou kunnen zijn voor het behalen van hoge leerprestaties op korte termijn, maar ten koste van hoge mate van integratie, blijvende implementatie, inzicht in curriculum-activiteiten en mede-eigenaarschap. Deze studie impliceert dat ICT-gerelateerde innovaties samen moeten gaan met betrokkenheid van docenten in het her- en co-ontwerp. Het betrekken van docenten in her- en co-ontwerp draagt bij aan implementatie en het gevoel van mede-eigenaarschap.

APPENDICES

APPENDIX 1

Early literacy aspect – interim goal for emergent literacy	Test item example covering the aspects of early literacy
Functional writing	Put the postcard in the view of a child. Tell a child: You are on holidays and you may send this card to your teacher. Tell me what to write. *Correct: How many elements are named: title, name, receiver, message, closing, own name, address.*
Functional reading	Put sheet C in front of a child. Say to the child, this is the letter that Samir has sent to his grandmother. What do you think what it says? *Correct: How many elements are named: title, name, receiver, message, closing, own name, address.*
Function of written language	Put a blank sheet (B) in front of a child. Tell a child "Can you draw a letter or something similar to a letter? *Correct: looks like letter writing.*
Link between spoken and written language	Put sheet E in front of a child. Tell the child I will read to you and you will point with your finger while I am reading. *Correct: child tries to point to every word being read.*
Language awareness	Take sheet F. Tell the child, I am going to read. When you hear the word 'ball', you can raise your finger. *Correct: child raises his finger two times.*

APPENDIX A

Data collection instrument for chapter 2

Integratiechecklist (Verseput, 2008b)*

Datum: Klas: Docent: Sessie:

Computeractiviteit		
1. Er wordt in groepjes gewerkt tijdens het uitvoeren van de computeractiviteit.	Kinderen zijn niet alleen in de buurt van de computer wanneer zij de computeractiviteit uitvoeren maar altijd met één of meerdere kinderen erbij.	1/0,5/0
2. Er is sprake van samenwerkend leren tijdens de computeractiviteit.	Kinderen leren door tijdens de uitvoering van de computeractiviteit te praten met elkaar over de inhoud van de activiteit en door samen problemen op te lossen.	1/0,5/0
3. De kinderen helpen elkaar tijdens het werken met PictoPal.	Wanneer één van de kinderen vastloopt tijdens de computeractiviteit vraagt deze en ontvangt deze hulp van een van de andere kinderen.	1/0,5/0
4. Het kind is zelf actief tijdens de computeractiviteit.	Bij het leren wordt het hoofd en het lichaam gebruikt. Het kind moet tijdens het uitvoeren van de computeractiviteit dus zelf nadenken en handelingen verrichten.	1/0,5/0
5. De kinderen leren individueel tijdens de computeractiviteit.	Het kind heeft naast de kans op samen te werken ook de kans om individueel kennis op te doen tijdens de computeractiviteit. Dit is te zien doordat het kind ook alleen aan de slag is en handelingen tijdens de activiteit uitvoert. Bijvoorbeeld het typen van een boodschappenlijst.	1/0,5/0
6. Er is voor de kinderen onder-steuning van de docent aanwezig tijdens de computeractiviteit wanneer dit nodig is.	Wanneer een kind vastloopt bij het computeren kan deze op een gemakkelijke manier hulp verkrijgen.	1/0,5/0
7. De kinderen krijgen de kans om over hun computerproces te praten met de docent.	De docent laat kinderen vertellen hoe ze tot het product zijn gekomen, hoe de activiteit verliep of hoe zij de activiteit ervaren hebben.	1/0,5/0
8. De kinderen krijgen de kans om over hun PictoPal-product te praten met de docent.	De docent praat met de kinderen over hun PictoPal-product.	1/0,5/0

Note: * This instrument is used for chapter 2.

APPENDIX B

Data collection instrument for chapter 2, 3, 4 and 5

Integratiechecklist (Verseput, 2008b)*

Datum: Klas: Docent: Sessie:

Klassenactiviteit		
1. Ieder (aanwezig) kind heeft de mogelijkheid om binnen de week de klassenactiviteiten uit te voeren.	Op verschillende tijdstippen van de dag is er de mogelijkheid om klassenactiviteiten uit te voeren en de docent zorgt ervoor dat ieder kind de activiteit uitvoert. Dit kan doordat de docent vraagt 'wie heeft dit nog niet gedaan' of doordat de docent een lijst bijhoudt.	1/0,5/0
2. Kinderen worden gestimuleerd om te luisteren tijdens de klassenactiviteit.	Dat kan bijvoorbeeld door middel van het voorlezen van verhalen die betrekking hebben op het thema van PictoPal.	1/0,5/0
3. Kinderen worden gestimuleerd om te praten tijdens de klassenactiviteit.	De docent zorgt dat de kinderen met elkaar of met de docent over de klassenactiviteit praten	1/0,5/0
4. Kinderen worden gestimuleerd om te schrijven tijdens de klassenactiviteit.	Dit kan bijvoorbeeld doordat er papier en andere schrijfmaterialen aanwezig zijn tijdens de klassenactiviteit. De leerlingen kunnen deze zelfstandig pakken en het werken met de materialen wordt door de docent gestimuleerd.	1/0,5/0
5. Kinderen worden gestimuleerd om te lezen tijdens de klassenactiviteit.	Dit kan bijvoorbeeld doordat er boeken aanwezig zijn over het thema van de klassenactiviteit of dat er binnen de activiteit geschreven woordjes zijn gerelateerd aan PictoPal.	1/0,5/0
6. De kinderen leren door middel van spelen en ontdekkend leren.	De kinderen worden vrij gelaten bij het gebruiken van hun PictoPal-producten in de klassenpraktijk. Zij kunnen hun eigen ideeën inbrengen en fantasie gebruiken.	1/0,5/0
7. Het kind is zelf actief in het leerproces tijdens de klassenactiviteit.	Bij het leren wordt het hoofd een het lichaam gebruikt. Het kind moet tijdens de klassenactiviteit dus zelf nadenken en handelingen verrichten.	1/0,5/0
8. Er is sprake van samenwerkend leren tussen de kinderen tijdens de klassen-activiteit.	Kinderen leren tijdens de klassenactiviteit door gezamenlijk een activiteit uit te voeren. Tijdens de uitvoering praten de kinderen over de inhoud en lossen zo nodig samen problemen op.	1/0,5/0
9. De kinderen leren individueel tijdens de activiteit	Het kind heeft naast de kans om samen te werken ook de kans om individueel kennis op te doen van tijdens de klassenactiviteit. Dit is te zien doordat het kind ook alleen aan de slag is en handelingen tijdens de activiteit uitvoert.	1/0,5/0
10. Er is voor de kinderen ondersteuning van de docent aanwezig tijdens de klassenactiviteiten.	De docent houdt de klassenactiviteiten in de gaten en grijpt in wanneer het leerproces van de kinderen vastloopt.	1/0,5/0
11. De kinderen krijgen de kans om over hun proces van de klassen-activiteit te praten met de docent.	De docent laat kinderen vertellen hoe ze tot het klassenactiviteit-product zijn gekomen, hoe de activiteit verliep of hoe zij de activiteit hebben ervaren.	1/0,5/0
12. De kinderen krijgen de kans om over hun product van de klassenactiviteit te praten met de docent.	De docent praat met de kinderen over hun product.	1/0,5/0

Appendix C

Data collection instrument for chapter 2, 3, 4, and 5*

Kleuter taaltoets: beginnende geletterdheid (McKenney & Voogt, 2006)

Bij goed vul 1 in G column, behalve waar anders aangegeven

		Naam:	G	F
Functioneel schrijven	1	Tekst typen onderscheiden Leg een boodschappenlijstje, een briefkaart, een kookboek en een prentenboek neer. Zeg het kind, "Pak het boodschappenlijstje" (leg dan het object terug) Goed: lijst		
	2	Tekst typen onderscheiden Leg een boodschappenlijstje, een briefkaart, een kookboek en een prentenboek neer. Zeg het kind, "Pak de briefkaart" (leg dan het object terug) Goed: briefkaart		
	3	Tekst typen onderscheiden Leg een boodschappenlijstje, een briefkaart, een kookboek en een prentenboek neer. Zeg het kind, "Pak het kookboek" (leg dan het object terug) Goed: kookboek		
	4	Een lijstje maken Leg blad A voor het kind neer. Zeg tegen het kind, "Jij gaat voor mama boodschappen halen voor het eten. Wat heb je nodig? Maak een lijstje. Geef het kind de losse plaatjes. Goed: plaatjes zijn geordend, liefst onder elkaar	→ ↓	
	5	Een kaart schrijven Leg het ansichtkaart voor het kind neer. Zeg tegen het kind, "Jij bent op vakantie en mag deze kaart naar de juf sturen. Vertel mij wat ik voor jou moet schrijven." Goed hoeveel elementen komen er in voor: aanhef, naam ontvanger, boodschap, afsluiting, eigen naam, adres	# _ 6	
	6	Een verhaal maken Pak een leeg blad (B). Zeg tegen het kind, "Kun jij mij een verhaaltje vertellen over kabouters?" Teken terwijl het kind vertelt. Goed: verhaal heeft begin en einde		
Functioneel lezen	7	Eigen verhaal lezen Draai blad B naar het kind toe en zeg, "Kun jij dit verhaaltje vertellen?" Goed: kind vertelt iets wat op tekening lijkt		
	8	Een prentenboek lezen Leg het prentenboek (zonder tekst) neer en vraag het kind, "Kun jij mij voorlezen?" (laat 2 bladzijden lezen) Goed: kind vertelt iets wat op de platjes lijkt		
	9	De tekst van een ander lezen Leg blad C neer. Zeg het kind, "Dit is de brief die Samir aan zijn oma stuurde. Wat denk je dat er staat?". Goed: hoeveel elementen komen er in voor: aanhef, naam ontvanger, boodschap, afsluiting, eigen naam	# _ 5	
Functie geschreven taal	10	Symbolen verwijzen naar taalhandelingen Leg blad D neer. Wijs naar de deur met bestek en zeg het kind, "Als je door die door deur naar binnen gaat, wat ga je dan doen?" Goed: iets met eten, restaurant, drinken		
	11	Onderscheid lezen en schrijven Zet losse spullen neer (kleurpotloden, pen, papier, schaar, kleurplaat, boek, lepel , briefkaart, boodschappenlijst). Pak een leeg blad (B). Zeg aan het kind, "Doe net alsof je aan het schrijven bent." Goed: kind pakt pen/potlood lijkt te schrijven		
	12	Onderscheid lezen en schrijven Zet losse spullen neer (kleurpotloden, pen, papier, schaar, kleurplaat, boek, lepel , briefkaart, boodschappenlijst). Pak een leeg blad. Zeg aan het kind, "Doe net alsof je aan het lezen bent." Goed: kind pakt boek/lijst/kaart en lijkt te lezen		

		Naam:	G	F
	13	Tekenen en tekens produceren Pak een leeg blad (B). Zeg het kind, ‘Kun jij een letter of iets wat daarop lijkt tekenen?” Goed: lijkt op letter schrijven		
Gesproken< > geschreven	14	Geschreven woorden kunnen uitgesproken worden Leg blad E neer. Zeg het kind. “Ik lees en jij wijst met je vinger aan.” Goed: kind probeert woord voor woord aan te wijzen.		
	15	Kinderen kunnen woorden als globale eenheden lezen en schrijven Pak een leeg blad (B). Schrijf de naam van het kind. Zeg het kind, “Wat staat hier?” Goed: herkent die als een woord een vertelt iets		
Taalbewustzijn	16	Kinderen kunnen woorden in zinnen onderscheiden Pak blad F. Zeg het kind, “Ik ga lezen. Als je het woordje *bal* hoort, mag je je vinger opsteken.” Lees de zinnen. Goed: kind steekt zijn vinger 2 keer op		
	17	Kinderen kunnen onderscheid maken tussen de vorm en de betekenis van woorden Leg Blad G neer. Zeg het kind, “Dit is een leeuw. Dit is een lam, dit is een lieveheersbeestje. Welk woord is het langst? “Goed: lieveheersbeestje		
Functie geschreven taal	18	Laat het kind de uitnodiging voor een feestje (gedrukt en gevouwen in kwarten) zien. Zeg het kind, “Noel is binnenkort jarig, en wilt uitnodigingen voor haar feestje sturen. Ze zien er zo uit. Waarom wilt Noel een uitnodiging sturen?” Goed: (o.a.) zo dat mensen weten: dat ze mogen komen op het feestje, waar het feestje is, wanneer het feestje is Fout: om mensen te vertellen dat ze jarig is		
Functioneel schrijven	19	Laat het kind de blanco uitnodiging voor een feestje (gedrukt en gevouwen in kwarten) zien. Zeg het kind, “Jij bent ook een keer jarig, en vandaag mag je doen alsof je een verjaardagsfeestje geeft. Doe maar alsof jij deze uitnodiging gaat versturen. Maar zoals je ziet, staan er nu geen woorden in. Wat zou je eerst hierin willen laten schrijven?” Goed: (b.v.) tijd, datum, iets over feest Fout: alleen wie is jarig		
Functie geschreven taal	20	Laat het kind een krantenpagina zien en zeg het kind: Dit is een krant. Waarom lezen mensen de krant? Wat voor dingen staan er allemaal in? Goed (b.v.): Iets over nieuws, weetjes, weer, sport Fout (b.v.): iets wat niet in een krant voor komt		

Note: * A 17-item version of the test was used (items 1-17) for data collection in chapter 2. For the chapters 3, 4 and 5, a 20-item version was used with three test items (items 18-20) in addition to the same 17 items used for data collection in chapter 2.

APPENDIX D

Data collection instrument for chapters 2 and 5

Interview scheme teachers
Datum:
Docent:
Groep:
Aantal jaar ervaring in het onderwijs:

Interview scheme teachers' perceptions about: teaching/learning, early literacy, technology, innovations, skills to implement technology-innovaton, willingness to learn, work conditions, teacher role as executor-only, and curriculum practicality

Onderwijs/leren	Wat is uw visie op goed onderwijs /'good teaching' (in het algemeen)?
	Wat is uw visie op goed onderwijs aan jonge kinderen?
	Wat is volgens u het doel van het onderwijs aan jonge kinderen?
Beginnende geletterdheid	Wat is uw visie op goed onderwijs met betrekking tot taal en beginnende geletterdheid?
	Welke (streef)doelen heeft u ten aanzien van taalonderwijs en beginnende geletterdheid binnen uw groep (binnen groep 1 en/of 2)?
	Hoe werkt u aan de doelen voor taalonderwijs en beginnende geletterdheid in uw groep (groep 1 en/of 2): met welke middelen en met welk tijdpad?
Computers (ICT)	Wat vindt u van de inzet van computers in het onderwijs aan leerlingen van groep 1 en 2?
	Hoe zou u uw ervaringen met computers in de klas (computergebruik door de leerlingen) beschrijven?
	Hoe zou u uw ervaringen met eigen computergebruik beschrijven?
Innovatie	Wat denkt u over vernieuwingen op het gebied van ICT in het onderwijs aan jonge kinderen op deze school?
	Verwacht u dat de vernieuwing PictoPal succesvol zal zijn?
	Wat is uw verwachting met betrekking tot de huidige vernieuwing van het onderwijs aan kleuters (PictoPal)?
	Verwacht u meer moeite en tijd te steken in de vernieuwing (PictoPal) dan de dagelijkse praktijk normaliter in de klas vraagt?
Vaardigheid implementatie	Vindt u dat lesgeven in de leeromgeving PictoPal een extra vaardigheid van de leerkracht vraagt die de leerkracht op dit moment niet heeft?
	Vindt u dat het koppelen van de computeractiviteiten aan de klassenactiviteiten op een voor de kinderen betekenisvolle manier een extra vaardigheid van u als leerkracht vraagt?
	Vindt u dat inrichten en organiseren van de leeromgeving (PictoPal) een extra vaardigheid van u als leerkracht vraagt die u op dit moment niet heeft?
Wil om te leren	Streeft u ernaar zelf te leren van de vernieuwingen op het gebied van ICT?
	Ziet u vernieuwingen van de school als mogelijkheid om zelf te leren?
	Verwacht u te kunnen leren van lesgeven met de nieuwe materialen en werkvormen van de vernieuwing in eigen klas?
Werkcondities	Ervaart u binnen het programma tijdsdruk om voldoende taal en ICT aan te bieden?
	Ervaart u vanuit groep 3 druk om leerlingen van uw groep vaardigheden aan te leren die voorbereiden op leren lezen en schrijven?
Rol	Vindt u dat uw rol als leerkracht het beste kan worden omschreven als uitvoerder van voorgeschreven lessen (zoals bijvoorbeeld in de taalmethode beschreven lessen)? Waaruit blijkt dat?
	Hoe zou u uw rol als uitvoerder van PictoPal beschrijven?
Practicality	Wat vinden jullie van PictoPal?
	Sluiten de PictoPal-activiteiten aan bij de kinderen?

APPENDIX E

Data collection instrument for chapters 3 and 5

Interview scheme for teachers
Datum:
Docent:
Groep:
Aantal jaar ervaring in het onderwijs:

Interview scheme teachers' perceptions about teaching/learning, early literacy, and technology*

Onderwijs/leren	Wat is uw visie op goed onderwijs /'good teaching' (in het algemeen)?
	Wat is uw visie op goed onderwijs aan jonge kinderen?
	Wat is volgens u het doel van het onderwijs aan jonge kinderen?
Beginnende geletterdheid	Wat is uw visie op goed onderwijs met betrekking tot taal en beginnende geletterdheid?
	Welke (streef)doelen heeft u ten aanzien van taalonderwijs en beginnende geletterdheid binnen uw groep (binnen groep 1 en/of 2)?
	Hoe werkt u aan de doelen voor taalonderwijs en beginnende geletterdheid in uw groep (groep 1 en/of 2): met welke middelen en met welk tijdpad?
Computers (ICT)	Wat vindt u van de inzet van computers in het onderwijs aan leerlingen van groep 1 en 2?
	Hoe zou u uw ervaringen met computers in de klas (computergebruik door de leerlingen) beschrijven?
	Hoe zou u uw ervaringen met eigen computergebruik beschrijven?

Note: * This interview scheme was used for chapters 3 and 5.

Interview scheme teachers' perceptions about re-design team*

Werken in het team	Wat vindt u van het werken in het team? Wat vindt u van het functioneren van jullie team en de waarde van het team?
Teamactiviteiten	Wat vindt u van de teamactiviteiten?
Team leider-schap en focus	Wat vindt u van de leiderschap in het team (om het team te leiden)?
	Wat vindt u van de focus in het team?
Vaardigheid her-ontwerpen	Wat vindt u van uw bekwaamheid om de PictoPal-activiteiten te her-ontwerpen?

Note: * This interview scheme was used for chapter 3.

Interview scheme teachers' perceptions about re-design team, practicality and co-ownership*

Rol	Hoe zou u uw rol als her-ontwerper van PictoPal beschrijven?
Practicality	Wat vindt u van de kwaliteit van de PictoPal activiteiten?
	Sluiten de activiteiten aan bij de kinderen?
	Wat vindt u van de verhouding van uw geleverde inspanning in PictoPal en de baten van PictoPal? Vindt u de investering van tijd en energie in balans met datgene wat er uit kwam?
Mede-eigenaarschap	In hoeverre voelt u zich mede-eigenaar van het her-ontworpen PictoPal?
	Voelt u zich eigenaar van de lessen?

Note: * This interview scheme was used for chapters 3 and 5.

APPENDIX F
Data collection instruments used for chapters 4 and 5

Interview scheme for teachers
Datum:
Docent:
Groep:
Aantal jaar ervaring in het onderwijs:

Interview scheme teachers' perceptions about teaching/learning, early literacy, and technology*

Onderwijs/leren	Wat is uw visie op goed onderwijs /'good teaching' (in het algemeen)?
	Wat is uw visie op goed onderwijs aan jonge kinderen?
	Wat is volgens u het doel van het onderwijs aan jonge kinderen?
Beginnende geletterdheid	Wat is uw visie op goed onderwijs met betrekking tot taal en beginnende geletterdheid?
	Welke (streef)doelen heeft u ten aanzien van taalonderwijs en beginnende geletterdheid binnen uw groep (binnen groep 1 en/of 2)?
	Hoe werkt u aan de doelen voor taalonderwijs en beginnende geletterdheid in uw groep (groep 1 en/of 2): met welke middelen en met welk tijdpad?
Computers (ICT)	Wat vindt u van de inzet van computers in het onderwijs aan leerlingen van groep 1 en 2?
	Hoe zou u uw ervaringen met computers in de klas (computergebruik door de leerlingen) beschrijven?
	Hoe zou u uw ervaringen met eigen computergebruik beschrijven?

Note: * This scheme was used for chapters 4 and 5.

Interview scheme teachers' perceptions about co-design team*

Werken in het team	Wat vindt u van het werken in het team? Wat vindt u van het functioneren van jullie team en de waarde van het team?
Team leiderschap	Wat vindt u van de leiderschap in het team?
Vaardigheid ontwerpen	Wat vindt u van uw bekwaamheid om de PictoPal-activiteiten te ontwerpen?

Note: * This interview scheme was used for chapter 4.

Interview scheme teachers' perceptions about: role, practicality and co-ownership*

Rol	Hoe zou u uw rol als mede-ontwerper van PictoPal beschrijven?
Practicality	Wat vindt u van de kwaliteit van de PictoPal activiteiten?
	Sluiten de activiteiten aan bij de kinderen?
	Wat vindt u van de verhouding van uw geleverde inspanning in PictoPal en de baten van PictoPal? Vindt u de investering van tijd en energie in balans met datgene wat er uit kwam?
Mede-eigenaarschap	In hoeverre voelt u zich mede-eigenaar van de ontworpen PictoPal activiteiten?
	Voelt u zich eigenaar van de lessen?

Note: * This interview scheme was used for chapters 4 and 5.

Team notes for observations of teams of teachers co-designing PictoPal

1. Team activities	
2. Team size	
3. Time spent in a team	

Note: ** This scheme was used for chapter 4.