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A new model of educational innovation: Exploring the nexus of organizational learning, distributed leadership, and digital technologies

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Abstract This study presents the development process of a new model of educational innovation, that involves the use of digital technologies. The model is based on a broad theoretical framework together with research involving this long-term case study. The backbone of the model consists of a fundamental revision of a multi-level Organizational Learning Framework incorporating the influence of the external school context (outside of the school context) and various aspects of leadership. The conceptual model not only clarifies the learning capacity of the teachers and administration, in accordance with the organizational learning approach, but can also be used as a tool for the investigation of planned interventions in line with the 'learning school' conception. The incorporation of the concept of leadership practice strengthens the original Organizational Learning Framework on all levels in the school organization. The conceptual model integrates and improves theoretical frameworks for context-conscious leadership, organizational learning and distributed leadership. An important outcome of this study is an increased understanding of the relation between distributed leadership and collective sense-making as an important prerequisite for the incorporation of digital learning materials in teaching practice.

Keywords Educational innovation · Sustainability · Distributed leadership · Leadership practice · Organizational learning

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Introduction

Changes in the political, social and educational environment put pressure on schools to improve the quality of their educational outcomes (Chval et al. 2006; Moolenaar et al. 2010; Waslander 2007, 2010). Against the backdrop of large-scale reform efforts in 2005, ten secondary schools in the Netherlands formed a legal construct to support each other in achieving better educational results in order to finance infrastructure and Information and Communication Technology (ICT) improvements. They established the "Educational Improvement Cooperative" (EIC) as a strategic alliance (Srivastava and Frankwick 2011) for developing and sharing ideas, digital learning materials and teaching experiences based on inter-institutional goals, in order to enhance self-regulated, authentic and social-interactive learning arising from process-oriented classroom practices (Zuylen and Zuylen 2005). The implementation of the use of digital learning materials requires integration of ICT within education, which enhances capacity for knowledge development in pupils, teachers and countries (Wiseman and Anderson 2012).

At many schools, there is continual improvement of educational practices and students' results, but there are also many schools at which educational innovations are not implemented successfully (Datnow 2002). Some theories of change address this sort of difference in response to innovation from a one-dimensional perspective such as leadership or professional development or innovation strategy. Along with researchers such as Coburn (2003), März et al. (2013), and Werkman et al. (2005), we are convinced that there is a need in the field of educational innovation and school development for the development of theory about the complexity of the innovation process over time. In this article we will address that problem by constructing an integrated conceptual model of educational innovation from a multi-dimensional standpoint. First we propose a theoretical framework based on a review of the relevant literature. Then we present the research question, methodology and results for a single case study. We continue by analyzing the results, using insights from the theoretical framework. And finally, we critique our findings and present a conceptual model for sustainable innovation with a central place for organizational learning, context-conscious leadership and distributed leadership.

Theoretical framework

Educational innovation is directly or indirectly aimed at improving the academic performance of students. From school effectiveness research, we know that the professionalism of the teacher and, by extension, the quality of the instructional process plays an important role in student achievement (Diseth et al. 2012; Scheerens 2010). Sustainability of educational reform depends highly on the willingness and capacity of teachers to change their understandings, behavior and action repertoire (März et al. 2013; Runhaar et al. 2007; Weick 1995). Furthermore, many researchers have argued in past decades that it is necessary to study educational innovation from multiple perspectives and through the use of complex

multi-level models (Hallinger and Heck 2011; Scheerens 2010, 2013; Werkman et al. 2005). In a previous study we distinguished four domains of influential factors that interact to affect both the teaching behavior of teachers and, correspondingly, the adaptation of their mindsets about education (Rikkerink 2011; Simons 2006, 2013; Verbeeten 2011). A brief description of each domain is given below.

Context

The school organization, the process of innovation within schools, and the professional development of teachers and teachers' ideas are all influenced by their environment (Carpay 2010; Coburn 2004; Scheerens 2010). The relation between context and school organization is reciprocal. Waslander (2007, 2011) refers to this phenomenon as 'Context management'. School organizations are faced with different, often conflicting demands, desires and expectations of stakeholders and mandates from the government. Schools may use the chances and opportunities in their immediate environment and/or within the national context in different ways (Waslander 2011). Research studies show that schools with a high innovative potential are able to integrate externally developed, successful innovations in their own organization and keep disturbing factors away from teachers. Another characteristic of an innovative school is to be able to provide their teachers with a stimulating learning environment (Waslander 2007, 2011).

Teacher characteristics

Educational innovation depends on what teachers think, feel and do (Scheerens 2010; van Veen 2003). Any form of spontaneous innovation in the classroom or planned change of educational practices calls for the reconstruction of cognitive maps or personal interpretative frameworks (such as mindsets). Furthermore, the acquisition of new skills and, especially, the unlearning of old habits are important conditions for successfully implementing educational changes (März et al. 2013; Runhaar 2008; Runhaar et al. 2007; Simons 2006). In addition, a personal commitment to change (van Veen 2003; Van Veen et al. 2005) as well as an organizational commitment is required (Hulpia and Devos 2010; Hulpia et al. 2011). Commitment to change is related to motivational factors such as teachers' emotions (Van Veen and Sleegers 2006), motivation (Leithwood et al. 2002; Thoonen et al. 2011), passion and work engagement (Schaufeli and Bakker 2004a, b; Moolenaar et al. 2010).

Teacher learning

Teachers who have the opportunity to share their experiences and their concerns about problems in the classroom are better able to regulate discrepancies between their personal interpretative framework, feelings and professional behavior (Miedema and Stam 2009). Scheerens (2010) points to a shift in the nature of the professional development of teachers. Inspired by theories of adult learning and conceptions of situated learning, attention is shifting to lifelong professional learning in the context of the school organization. As a result of this development,

reform literature has focused on the arrangement of workplace conditions that foster collaboration between teachers and, especially, activities in which teachers work interdependently to create optimal learning conditions for students (de Groot et al. 2011; Imants 2002; Kwakman 2003; Lovett and Gilmore 2003; Runhaar et al. 2007; Thoonen et al. 2011). Organizational structures such as 'working teams', 'communities of practice', 'professional learning communities', 'quality learning circles' have these principles in common, but it is still unclear in what way and to what extent they differ, and whether they can be organized as interventions or pop up by themselves as emergent processes (Brouwer et al. 2012; de Laat and Simons 2003; Imants 2002). In this context, it is especially interesting to consider the dynamic interaction between processes at the level of individual teachers, groups and teams and processes at the level of the organization as a whole (Bapuij and Crossan 2004; Crossan et al. 1999; Imants 2002).

Leadership

Leadership has played an important role in complex causal models of educational effectiveness and school improvement (Leithwood et al. 2010; Scheerens 2013). In the last decade a shift has been observed towards the theoretical concepts of leadership as an organizational quality (Spillane et al. 2004), away from leadership as a personal quality of the school leader. This view implies that leadership is spread over several people in the organization, including actors with no formal leadership designation (Spillane 2009; Spillane et al. 2008). Simultaneously, the emphasis shifts from the person of the leader to the concept of 'leadership practice', that is to say, the reciprocal interactions between leaders, followers and the situation in the 'lived organization' (Spillane et al. 2004, 2008; Thoonen et al. 2011). Researchers such as Simons (2006), Leithwood and Jantzi (2006), Mulford and Sillins (2011), Silins and Mulford (2002) and Ten Bruggencate et al. (2012) increasingly agree that the impact of school leadership is mainly indirect and that school leaders influence the quality of teachers and the instructional processes through the school's organizational conditions and cultural aspects. The concept of transformational leadership combines different roles and behaviors that are associated with organizational conditions that foster individual and collective teacher learning and school improvement (Leithwood and Jantzi 2005; Thoonen et al. 2011). Based on a re-conceptualization of what it takes to be a successful principal, Mulford and Silins note: "For those aiming to be successful school principals constantly improving their schools the challenge is to create synergistic effects; the accumulation of a number of effects developed with others over time in the same direction, even though this direction may change as a result of feedback on performance" (2011, p. 80). In this conception, the focus shifts to school improvement by building capacity for professional learning in areas that the administration can actually influence.

Sense-making and the use of digital learning materials

Sense-making is a social intersubjective process (Weick 1995). It begins in processes of interaction between people and through collaboration and discussion. Even individual sense-making supposes a common social context of recognizable norms, values, concepts and habits.

This overview of the research literature allows the construction of a theoretical framework in which the connections of these four domains (context, teacher characteristics, teacher learning and leadership) have a central place. It is characterized by the large number of reciprocal relations among its elements. In our theoretical framework, the domains are specifically related to the practical use and making sense of digital learning materials by teachers (Fig. 1). From a theoretical point of view, the best way of approaching educational innovation is by assuming a complex and reciprocal interaction between the theoretical insights and concepts that we have touched upon in this section.

Research question

How can the multi-perspective theoretical framework be extended and detailed in the form of an integrated conceptual model for complex innovation processes in schools?

Case: School A

In this research project we focused on the first 2 years (Grades 1 and 2) of a program for pre-vocational education at one school, School A, over an 8-year period of adaptive implementation of an educational innovation. School A participated

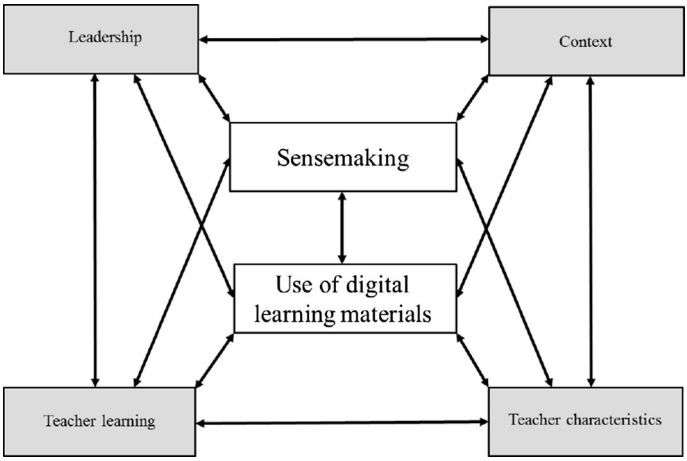

Fig. 1 Theoretical framework

actively in the Educational Improvement Cooperative (EIC; see "Introduction"). Apart from School A we also collected data in five other schools of the EIC for the aim of further research. The reasons for choosing School A as our case are:

1. School A has the same school composition compared with the other schools for developing digital learning materials and teaching experiences based on inter-institutional goals enhancing self-regulated and social-interactive learning. The teachers received comparable training and were involved in this educational innovation.
2. Compared to the other five schools the collected data in School A are well distributed (26 documents, a total of 204 pages) across the four domains of the theoretical framework. That is a (sustainable) condition for developing a detailed conceptual model for complex innovation processes in schools.

The pupils in the first 2 years of School A, a total of 160 pupils, are 12–14 years old. These pupils attend their general courses in 'Learning Houses'. A Learning House is a typical Dutch construct in which 40 pupils are learning and working at the same time. The Learning House concept is characterized by an emphasis on independent learning, active learning methods and various multifunctional work-places for learning and instruction, including ICT and technology enhanced learning (Carpay 2010).

In 2003, the management team (principal and department leaders) at School A decided that the program for the first 2 years needed to be updated in line with current educational reforms. The key principles on which this innovation process was based were: preparation for modern craftsmanship, personal development of pupils and development of the ability to function in a modern knowledge society.

After the decision to innovate, the management team communicated their vision to the teachers. A number of teachers of the first year students were enthusiastic about the possibilities of this concept for pupils who were at risk of failing to keep up with the curriculum and who therefore needed a lot of personal coaching. In the past, these teachers had not had good experiences with classroom-based and frontal instructional methods with these pupils. In the 2003–2004 school year, the central management team gave a group of enthusiastic volunteers the opportunity to test an experimental version of the educational concept, 'Learning House'.

In the 2004–2005 school year, the administration of the school and the teachers developed their educational vision. The principal developed the strategic policy in the same school year. Based on the positive experiences in the first Learning House and on the initiative of a second group of enthusiastic teachers, in the 2005–2006 school year, a second Learning House was started for the Grade 1 pupils (Learning House 2). Based on good results for the two Learning Houses for Grade 1, the management team decided that Grade 2 would also have two Learning Houses (Learning House 3 and Learning House 4) in the 2007–2008 school year. The teachers of Learning House 2 made a proposal to the management team of the school for the integration of an electronic learning environment (elo) and the use of digital learning materials as a core facility for the Learning House. In the 2007–2008 school year, the Learning House 2 group received permission to

experiment with laptops for all the pupils and teachers. As a result, in the next school year, 2008–2009, all pupils in Learning House 2 had their own laptop. A year later, all pupils and teachers in the first 2 years owned a laptop.

Methods

Participants

Teachers working in the 'Learning Houses' responded to two questionnaires ($n = 16$ and $n = 25$, from a total population of 50 teachers). Three teachers, the principal and two department leaders participated in semi-structured interviews. Discussion reports from discussions within the teacher team of Learning House 2 ($n = 5$) are also important data.

Procedure and data collection

We chose an inductive approach in which we integrated theoretical insights with empirical data from a single case study of 8 years of educational innovation at School A. The research was change-oriented, which was particularly relevant for the problem definition, the design, the creation of teachers' support, the relevance and the implementation of the innovation.

The data collection began in 2007–2008 and focused on the period from 2003 to 2010. The innovation process started in the 2002–2003 school year, and we followed the process until the first signs of anchoring of the innovation in one department, in the 2010–2011 school year. The way the research was to be presented and the way in which the anonymity of the interviewees and the school was to be ensured were discussed with teachers and representatives of the management team of School A. As a result, the management team promised their full commitment to this research project.

All together the data collection involved 26 documents, a total of 204 pages, excluding the completed questionnaires and transcripts of audio recordings. We collected policy documents, plans, personal communications with school leaders and teachers, reports of meetings of the school management team and reports of team meetings concerning the innovation concept of Learning Houses. Along with this, we based our analysis on two teacher questionnaires and semi-structured interviews with representatives of the strategic management, middle management and teachers.

For the interviews with teachers, we asked the administration of the school to select three teachers. Criteria for the selection were teaching different courses, having different functions in the school and having different ideas about and experience with the educational innovation in the school. During the interviews we asked the interviewees about contextual influences, their personal experiences, participation of the representatives of the management team in working teams, professional development programs and the way individual and collective learning took place.

To strengthen construct validity, we had the informants verify and, if necessary, supplement and correct the reports of the conversations, interviews and the focus group before we included them in the database. The results of the questionnaires were discussed with representatives of the strategic and operational management. Their comments were also reported and included in the database. The opinions, actions, situations, events we describe in the result section, are therefore based on evidence from multiple different types of sources [i.e., data and methodological triangulation, as recommended by Yin (1994, p. 93)].

Data analysis

Developing an integrated conceptual model by means of an inductive approach requires repeated challenging of theoretical insights by empirical data, and vice versa. The views on ensuring reliability and construct validity we used as guidelines for the data collection and data analysis are taken from Yin (1994) and Miles and Huberman (1984). This process was conducted according to the following steps.

Step 1

Independently, two researchers searched the database for segments of text pertaining to the phenomena (opinions, actions, situations, events) that relate to the innovation process. Whenever these phenomena invoked associations with concepts from the theoretical framework, these were noted. Surprising, notable and divergent segments were also marked. The two collections of segments (one from each researcher) were then compared to each other and, after deleting overlapping segments, they were combined into one corpus of segments with notes.

Step 2

In the next phase of the research the two researchers, again mutually independent, ordered the segments in the corpus into four global clusters which, more or less, corresponded with the four domains of the theoretical framework depicted in Fig. 1. These two (personal) orderings of segments were also combined, during a repeated process of comparing and reordering, until an agreement was reached. In the opinion of the authors, these four clusters adequately cover the complexity of educational innovation. The clusters are:

- Cluster 1: Reciprocal influence of the context on school leaders and teachers
- Cluster 2: Teachers' personal characteristics
- Cluster 3: Innovative and distributed leadership
- Cluster 4: Learning processes and the role of the school management team

Step 3

After reflecting on the text segments included within each cluster, jointly two researchers organized the segments into categories. Each category is defined by a

brief description indicating the substance of the category. The results section for each cluster includes a table giving the description of the category substance, the number of segments in the category and the sources from which the segments originated. During the cyclical process of reflection on the segments in the categories and based on insights from research literature, the researchers looked for 'emerging patterns' (Ghesquière et al. 2004). This process yielded the first clues or indicators as to how phenomena within the reality of the innovation process at School A influence each other and which concepts from the research literature best represent these patterns. In the conclusion section we give a justification of existing and adapted concepts and frameworks that match the observed emergent patterns.

Step 4

Finally, the analysis and our interpretation of the results were presented, discussed and 'verified' with the principal, two representatives of the middle management and a teacher leader. This form of management feedback for School A also contributes to strengthening of the construct validity (Yin 1994).

Results

Cluster 1: Reciprocal influence of the context on school leaders and teachers

External context and school leaders

In the database we found 21 text segments that give an indication of the influence of the context on the thoughts and strategic actions of the school leaders, and vice versa. These 'indicators' can be divided into three categories. In Table 1 we note the number of indicators per category and the manner in which those indicators are spread over the different kinds of source documents in the database.

Table 1 Cluster 1: Reciprocal relationship between context and school leaders

Category	Number of relevant text segments in the corpus	Type of source document
1. Following the trends in school improvement	3	Strategic policy and plans; Interview principal
2. EIC influence on policy development	10	Results EIC; Results Learning House 2; Personal communication; Interview principal; Interview department leaders; Focus group teachers
3. Aligning with innovation processes in the school	8	Strategic policy and plans; Results Learning House 2; Personal communication; Questionnaire; Interview principal; Interview department leaders; Focus group teachers
Total	21	

External context and teachers

In the database we found 28 indicators concerning the influence of the context on the thoughts and actions of teachers, and vice versa. We organized them into five categories (Table 2).

Cluster 2: Teachers' personal characteristics

In the database we found 40 segments containing information about the relationship between teacher characteristics and their use of and opinions about digital learning materials. We have organized these segments into five categories (Table 3).

Cluster 3: Innovative and distributed leadership

In the database we found 52 segments that indicate leading of an innovation process on different levels in the school organization. From those segments we compiled three categories (Table 4) of strongly-related 'indicators'.

Cluster 4: Learning processes and the role of the school management team

Learning processes of teachers and teams

In the database we found 32 segments that indicated teachers' individual and collective learning processes (Table 5).

Table 2 Cluster 1: Reciprocal relationship between context and teachers

Category	Number of relevant text segments in the corpus	Type of source document
1. Politics and educational reform legislation	2	Focus group teachers; Interview principal
2. Views on ICT and educational innovation	2	Questionnaire; Interview principal
3. Higher vocational education and external institutions	9	Personal communication; Interview principal; Interview department leaders; Focus group teachers
4. Educational Improvement Cooperative (EIC)	12	Strategic policy and plans; Personal communication; Results EIC; Questionnaire; Interview principal; Interview department leaders; Focus group teachers
5. Parents	3	Interview department leaders; Focus group teachers
Total	28	

Table 3 Cluster 2: Teachers' personal characteristics

Category	Number of relevant text segments in the corpus	Type of source document
1. Taking initiative versus passive behavior	16	Strategic policy and plans; Personal communication; Results Learning House 2; Questionnaire; Interview principal; Interview department leaders; Focus group teachers
2. Positive versus negative critical attitude	5	Strategic policy and plans; Results Learning House 2; Interview principal; Interview department leaders
3. Experience and affinity with ICT	17	Strategic policy and plans; Results Learning House 2; Questionnaire; Interview principal; Interview department leaders; Focus group teachers
4. Lack of time and/or work pressure	4	Personal communication; Questionnaire; Focus group teachers
5. Influence of the immediate social environment	6	Interview principal; Interview department leaders; Focus group teachers
Total	48	

Table 4 Cluster 3: Innovative and distributed leadership

Category	Number of relevant text segments in the corpus	Type of source document
1. Coordination between educational innovation and strategic leadership	19	Strategic policy and plans; Results Learning House 2; Personal communication; Results EIC; Interview principal; Interview department leaders
2. Transformational leadership	16	Strategic policy and plans; Results Learning House 2; Results EIC; Interview principal; Interview department leaders; Focus group teachers; Questionnaire
3. Collaborative sense-making between leaders at all levels	17	Results Learning House 2; Results EIC; Personal communication; Interview principal; Interview department leaders; Focus group teachers
Total	52	

Leadership practices and organizational learning

In the database we found 34 segments which contain information about school leaders' influence on the innovation process (Table 6). These segments show large differences between the innovation strategies of Grades 1 and 2. We have divided those segments into two categories.

Table 5 Cluster 4: Learning processes of teachers and teams

Category	Number of relevant text segments in the corpus	Type of source document
1. Exchange of individual experiences	9	Results Learning House 2; Personal communication; Questionnaire; Interview department leaders; Focus group teachers
2. Boundary experiences and sense-making	9	Results Learning House 2; Personal communication; Results EIC; Questionnaire; Interview principal; Interview department leaders
3. Working team or community of practice	11	Results Learning House 2; Personal communication; Interview department leaders; Interview principal; Focus group teachers
4. Institutionalization	3	Results Learning House 2; Interview department leaders
Total	32	

Table 6 Cluster 4: Leadership practices and organizational learning

Category	Number of relevant text segments in the corpus	Type of source document
1. Stimulating collective learning	29	Strategic policy and plans; Results Learning House 2; Personal communication; Results EIC; Questionnaire; Interview principal; Interview department leaders; Focus group teachers
2. Ensuring institutionalization	5	Strategic policy and plans; Results Learning House 2; Results EIC; Questionnaire
Total	34	

Conclusions

Conclusion Cluster 1: Reciprocal influence of the context on school leaders and teachers

Almost all segments in Tables 1 and 2 show that the school context exerted a big impact on developments at School A. The large variation in the types of source documents represented is striking, and provides strong triangulation of the evidence supporting this finding. We note, however, clear differences between school leaders and teachers. Until 2005, the administration focused primarily on government policy and inspiring innovations occurring in other schools. After the founding of the EIC, however, the policy at School A was strongly influenced by the vision and expertise in this school network. School policy and EIC policy influenced each other

mutually from 2006 to 2011. The result was that the administration of School A increasingly planned the implementation of the Learning House concept and integration of ICT within educational practice at the school.

For teachers, the emphasis was different. The highly polarized public debate in the Netherlands with powerful lobby groups in favor of and opposed to radical innovations in education played a greater role for teachers (Table 2, category 2). Then there was the pressure from schools of higher education, which also promoted educational renewal. Parents were not necessarily against innovations, but above all they were asking for solutions to practical problems, such as safe online surfing (Table 2, categories 3 and 5). According to teachers, the EIC increasingly influenced policy and educational practice at the school over the course of time (Table 2, category 4). However, teachers, especially those from Grade 1, indicated that participation in the EIC had provided practical learning materials and useful training. In contrast, many teachers from Grade 2 articulated the feeling that reform was introduced too quickly and rigorously under the influence of the EIC. However, we see a varied picture of the pressure that teachers encountered. A small but highly motivated and active group of teachers, especially in Grade 1, embraced the innovation policy. A large group of teachers was waiting or was less enthusiastic.

Category 3 in Table 1 sheds light on the complex relationship between context and the innovation strategy of leadership at the school. Especially in the period up to 2005, practicability and acceptance in the workplace were important for guiding the reform process. From 2005 on, time constraints and consistency in educational practice in all grades constituted the dominant principles of the innovation strategy.

The first conclusion we draw is excellently expressed by Coburn, that is: "… the environment penetrates schools in substantial ways, reaching within structures to influence teachers' worldviews and practices" (Coburn 2004, p. 234). Likewise, our second conclusion is consistent with findings from Coburn (2004). The information contained in Cluster 1 shows that it is very important to follow educational reforms over time because important shifts can occur in the complex interactions between context and school during the innovation process. The third conclusion is consistent with the outcomes of Waslander's (2007, 2011) large-scale research into comprehensive school reform. She has stated that schools that are able to innovate successfully and enduringly, are also able to influence the innovation process itself, which means that they do not just react to external pressure, but that they also look to take the opportunities that are there to be grasped in situations such as this. Waslander (2007, 2011) refers to this phenomenon as 'Context management'. However, we characterize the way in which the management team of School A took capacity to change of teachers into account as an aspect of sustainable strategic leadership (Hargreaves and Fink 2006). That is why we chose 'Context-conscious leadership' as a 'sensitizing concept' (Glaser and Strauss 1967); it represents the combination of context management and sustainable leadership. Figure 2 is a graphic representation of this double balance present in the concept of context-conscious leadership.

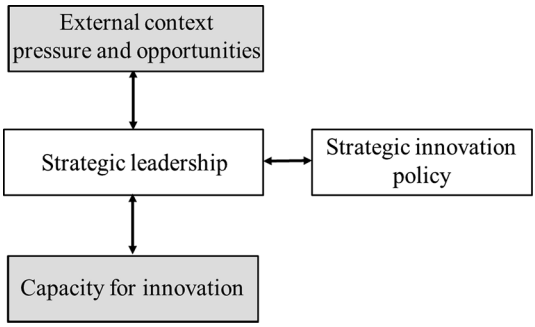

Fig. 2 The double balance in the concept of context-conscious leadership

Conclusion Cluster 2: Teachers' personal characteristics

Through the interviews with school leaders and teachers, we discovered that both of these groups recognize a wide variety of psychological factors (16) within individual teachers. This is confirmed by text segments from other sources present in the five categories in Cluster 2. Depending on the situation, opinions and behavior of colleagues, such psychological factors can have either a positive or a negative influence on the introduction of digital learning materials in the teaching practice. We saw a difference between the predominantly positive and active teachers in Grade 1 and the much more reserved and reluctant teachers in Grade 2. The positive characteristics that influence the innovation process show similarities with the three dimensions of work engagement (Schaufeli and Bakker 2004b) and feelings of self-efficacy (Thoonen et al. 2011). We found that these positive characteristics occurred especially with teachers in small groups who had taken the initiative to give shape to the innovation. It is remarkable how often we heard from our interviewees about an 'innovative team culture' (Moolenaar et al. 2010) in which affinity with ICT and enthusiasm go hand in hand with collaboration, mutual support and shared perceptions concerning the Learning House concept and the use of digital learning materials. Furthermore, based upon the data included in category 5 of Table 3, we found that the effect of teacher characteristics on the use of and beliefs about digital study material is closely connected to the social environment in which teachers perform their jobs. Therefore, it is our conclusion that it is necessary to study teachers' personal characteristics in connection with the way they function within formal and informal groups and to how those groups or teams are being led.

Conclusion Cluster 3: Innovative and distributed leadership

From the segments we gathered in Cluster 3, it is apparent that the way in which leadership was practiced had a large impact at multiple points on events that took place within the school. It appears from the segments in category 1 (Table 4) that leadership behavior was not something to be observed only with people who had a

formal management position at a strategic, tactical or operational level in School A. We conclude that many aspects of leadership were also exerted by teachers and assistant teachers, especially in the initial phase of the innovation process. At the same time, we found that leaders also communicated and reflected among themselves about leading the innovation process and about the way in which they communicated with the teachers and external stakeholders such as the EIC. The view of leadership that we developed based on interviews and meetings is strikingly defined by Hargreaves and Fink (2006, p. 95): "it is leadership that spreads, that is a distributed and shared responsibility that is taken as well as given." A distributive perspective on leadership in School A is very valuable for understanding the successful start of the innovation process (Hargreaves and Fink 2006; Ho and Ng 2012; Spillane et al. 2004, 2008).

In the segments in category 2 (Table 4) we recognize two of the three broad categories from the transformational leadership model of Leithwood and Jantzi (2006): 'Developing people' (especially intellectual stimulation, individualized support, focus on professionalism) and 'Redesigning the organization' (emphasis on collaboration and participating in school decisions). Also in this category we see that transformational leadership practices were spread over all levels of the organization at School A. In the interviews with school leaders and teachers, we find strong evidence that the distribution of leadership contributed to the teachers' motivation to develop the Learning Houses in Grade 1. Leadership that is 'taken as well as given' is also a characteristic of leadership in the view of Spillane et al. (2004). In their distributed perspective on leadership, they do not place the accent on spreading tasks over many different individuals within the organization, but on spreading leadership activities within the social context. Leadership is codependent on the specific situation and counterplay a leader encounters from the other actors in the situation. The other actors (teachers and other leaders) are, therefore, not 'followers' who follow instructions as rational human beings, or copy ideas, but people who try to make sense of the situation and act accordingly. Spillane et al. (2004) claim that leadership continues to be re-enacted in 'leadership practices' (LP) (Fig. 3) through concrete interactions between people under the influence of specific aspects of the situation. According to these authors, leadership practice is the most suitable unit of analysis to measure the impact of leadership.

Fig. 3 The concept of leadership practice (Spillane et al. 2004, p. 11)

In summary, we find that the distribution of (transformational) leadership over a multitude of people in School A contributed to the successful development of the Learning House concept in Grade 1. We conclude from the evidence in categories 1 and 2 of Table 4 that only prolonged analyses at a micro-level (by analyzing leadership practices) can demonstrate how the intensive collaboration, co-creation and common sense-making of teachers and leaders contributed to that success (operational level). The segments in category 3 show that both leaders and teachers emphasized the importance of giving clear and consistent guidelines to teachers (tactical and strategic level). The leaders at School A realized the importance of this search for consensus between leaders at all levels of the school organization. They stated that they spent a lot of time on this. We conclude, in line with Hulpia and Devos (2010), that collaboration and open communication between leaders at different levels of the organization is an aspect of distributed leadership-in-practice that might influence teachers' organizational commitment. We have visualized this phenomenon in Fig. 4, which demonstrates that the development of collective sense-making about the direction and approach of the innovation process between leaders across the three organizational levels can also be studied from the perspective of leadership practice.

Conclusion Cluster 4: Learning processes and the role of the school management team

The data, shown in Table 5, demonstrate that collaboration between teachers, learning on the job and in professional development courses were common practice. It appears to be a characteristic of the professional culture of School A. This image is emphasized by the expressed opinion of School A's leaders that educational innovation depended strongly on a change in the teachers' vision about education. However, at the same time, we found large differences in the daily practices of Grades 1 and 2.

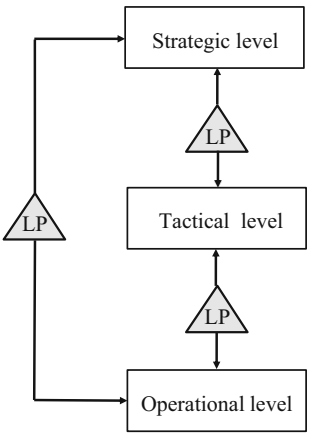

Fig. 4 Coordination and communication between school leaders across the organizational levels from the perspective of leadership practice

The Organizational Learning Framework (Fig. 5) by Crossan et al. (1999) offers a dynamic construct that we consider to be perfectly suited to analyze and interpret the actions, situations, events and learning processes that occurred at School A over a period of 8 years. In the Organizational Learning Framework, the process leading to the assimilation of newly developed knowledge and skills in the organization is symbolized by the feed-forward flow over three levels (solid lines). The application and exploitation of what was learned before leads to a feedback flow (dotted lines), for example, by interventions directed to standardization and control of the new practice. The permanent tension between the feed-forward and feedback flows of learning is the essence of the Organizational Learning Framework.

This is demonstrated in the evolution of the group of teachers who worked together in Learning House 2. After the initiative by some teachers to develop their own version of a learning house, we see a balance arising between the bricolage process of trial and error and implicit and explicit learning in the context of an ongoing dialogue between teachers on the one hand, and the collective attempt of teachers and school leaders to search for a stable state of progress and exploitation of what has been learned on the other. The result was a successful application of the Learning House concept in a completely digitized environment, realized approximately 4 years after the concept was first introduced.

Crossan et al. (1999) characterize these flows of learning at every level of the organization by different psychological processes. Like Weick (1995), they mostly place at the individual level the processes of sense-making that deal with personal interpretations of experiences ('Intuiting'), which can lead to new ideas (creativity) or to changing their own behavior (implicit learning). The effects of individual learning can only influence others when the personal learning process is demonstrated and explained, and then shared with colleagues who have had similar experiences. When these exchanges ('Interpreting' in the Organizational Learning Framework) lead to the development of shared ideas, shared agreements and a

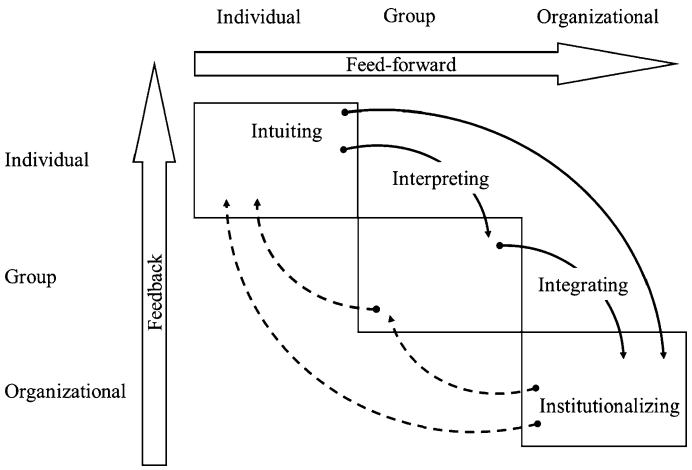

Fig. 5 Organizational Learning Framework (Crossan et al. 1999, p. 532)

mutually coordinated practice ('Integrating') through collective reflection, we call this collective sense-making at a group level. The data from category 2 (Table 5) show that this was a turbulent process in which feelings, new and old knowledge and professional practices competed with each other. To handle such "boundary experiences" it is imperative that teachers can share their concerns in a safe group (Miedema and Stam (2009), and that is exactly what the data show. All the data we have gathered about the teacher team of Learning House 2 points to the conclusion that their collaboration follows a cyclical pattern: try out teaching practices in the new setting and then discussing their experiences together. These meetings can best be described as occasions for sense making concerning The Learning House concept and its application, after which the cycle repeats itself.

The cyclical relation between psychological processes such as Intuiting and Interpreting-Integrating in the Organizational Learning Framework is comparable with the Identity Construction model of Geijsel and Meijers (2005). They analyze the development of a professional identity as a circular process of "discursive meaning-giving" in communities of practice and "intuitive sense-giving" at a personal level. In both models, interaction, communication and collective reflection are essential. On the one hand, these activities help develop the identity of teachers and on the other hand, they help to cement the collectively developed expertise into the foundation of the organization. Sustainable development, that is, Institutionalization, originates when these processes are being systematically supported, stimulated and warranted in the organization. We conclude that the information in Table 5, insofar as it relates to teachers from Grade 1, outlines a developmental process that is a good illustration of feed-forward as outlined in the theoretical framework of Crossan et al. (1999).

We observed that during the development of the Learning House concept in Grade 1, the leadership practices were mostly directed at signaling the developments in the work place that were in line with the existing policy. Subsequently, these developments were treasured, morally and materially supported and then sent off in the right direction, in close deliberation with teachers. As a result, the feed-forward process did not turn into a fragmented and chaotic innovation practice, but was stabilized by interventions. Consequently, a slowly growing workable Learning House was developing.

The implementation strategy for Grade 2 resembles what Crossan et al. (1999), after Schumpeter (1959), termed "creative destruction". From one year to another, the school management team asked the Grade 2 teachers to implement the fully developed model of digitized Learning Houses. It became clear from the results that this approach did not lead to inducing a cyclical process of individual and collective sense-making, enthusiasm and feelings of ownership. Moreover, the feed-forward flows of learning that we perceived within the teacher groups remained isolated events. Teachers stated that neither the leaders, nor the teachers in this setting managed to successfully extend the good practices that already existed to a team level.

The remarkable difference between what happened in Grade 1 (2003–2007) and Grade 2 (2007–2010) can be explained by the school leaders' changing of the innovation strategy. Furthermore, examples of leadership practices in the research data also demonstrate that the relationships between teachers and leaders were

currently undergoing a process of change and that this had an effect on the individual and collective learning processes (categories 1 and 2 of Table 6). Our conclusion is therefore that we must integrate the concept 'Leadership Practice' (Fig. 3) of Spillane et al. (2004) into the Organizational Learning framework of Crossan et al. (1999). Now we can visualize how interventions at every level of the organization influenced the feed-forward and feedback flow of learning in School A (Fig. 6).

General discussion

The multiple theoretical perspectives and multilevel approach to the processes of educational innovation in the school organization resulted in an overall theoretical framework (see Fig. 1). This framework was very useful for analyzing the results from a long-term case study, which has enabled us to replace the original framework with a more elaborate version (see Fig. 7). We used Figs. 2, 3, 4 and 6, which were instrumental in analyzing the data set from School A, for the revision. The combination and integration of these figures to produce Fig. 7 enabled us to identify and solve a number of problems inherent in the individual figures and the theoretical concepts which they represent. From this point on, we will denote Fig. 7 as our 'integrated conceptual model for educational innovation'.

Context-conscious leadership

In the results for Cluster 1, we determined that context-conscious leadership is a useful concept to describe how the strategic management of School A was able to

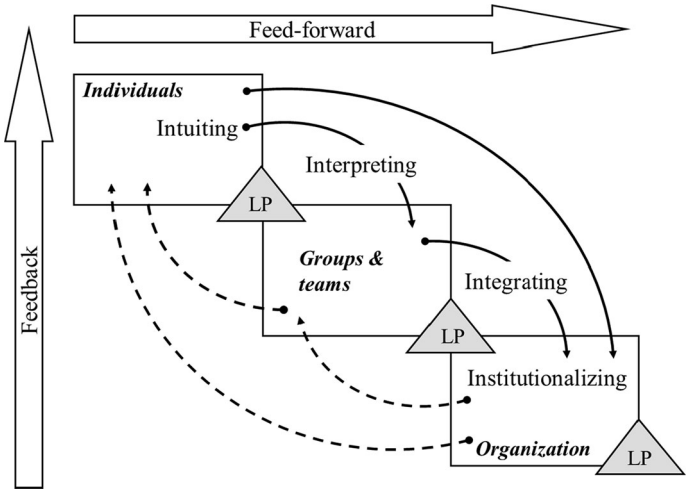

Fig. 6 The integration of the Organizational Learning Framework (Fig. 5) and the concept of leadership practice (Fig. 3)

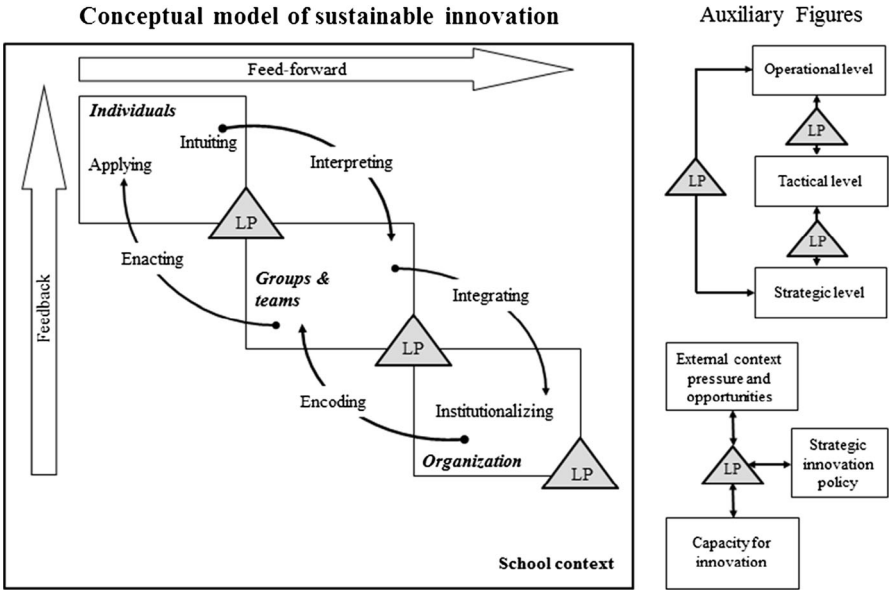

Fig. 7 The impact of distributed leadership on organizational learning: an integrated conceptual model with two auxiliary figures

create a dynamic balance between external pressure on the school to change on the one hand, and the capacity of the school organization to renew itself on the other (see Fig. 2). Therefore, we concluded that the dynamic concept of context-conscious leadership must be integrated into the conceptual model.

Leadership practice as an engine for organizational learning

We found the Organizational Learning Framework proposed by Crossan et al. (1999), shown in Fig. 5, to be a stimulating analytical tool. It turned out to be very profitable to investigate the relationship between the use of digital learning materials and teachers' learning at three levels: the individual, the group and the organizational level. An analysis of the tension between feed-forward and feedback processes at School A contributed significantly to understanding the differences in the use of digital learning materials in Grades 1 and 2. These results made it clear to us that the Organizational Learning Framework should form the backbone of the revised conceptual model (Fig. 7).

Innovative and distributed leadership

The results for Cluster 3 showed that leadership and alignment played an important role at all levels of the school organization. Furthermore, it showed that the leadership style and the type of intervention, as well as the communication and coordination between the organizational school levels, are important to understand

processes at School A (see Fig. 4). These data are best explained by the concept of distributed leadership as viewed by Spillane et al. (2004) and by Ho and Ng (2012). Finally, it proved to be very enlightening to analyze the interaction between leaders and teachers in a specific setting; namely, when leaders executed a particular leadership task. According to Spillane et al. (2004, p. 11), the recursive relations between leaders, followers, and their situation is the essence of his concept of 'leadership practice'. Informal leadership is a key factor in his concept (Spillane 2009). This reinforces the conclusion by Spillane et al. (2008) that important information is missed when the data set only includes information about formally designated leaders and the organization-as-designed. Clusters 3 and 4 showed that processes at the level of analysis of leadership practices also provided explanations for changes in the flows of learning within the Organizational Learning Framework. This is the reason we chose Fig. 6 as a basis for the model that is represented in Fig. 7.

Why is Fig. 7 innovative?

We consider the incorporation, elaboration and integration of dynamic concepts such as the Organizational Learning Framework (Crossan et al. 1999), LP framework (Spillane et al. 2004) and context-conscious leadership as the most significant improvement and enrichment of the original theoretical framework (Fig. 1). The incorporation of the concept of leadership practice strengthens the original Organizational Learning Framework on all levels in the school organization. We therefore propose to replace the theoretical framework depicted in Fig. 1 by a more elaborated conceptual model, shown in Fig. 7. An important outcome of this study is an increased understanding of the relation between distributed leadership and collective sense-making as an important prerequisite for the incorporation of digital learning materials in teaching practice. This conceptual model therefore is a basis for (international) researchers and school leaders to innovate within their organization.

The application of the conceptual model in international contexts

The conceptual model (Fig. 7) can be applied in international contexts (e.g., in Finland, where the provider of education has considerable autonomy in selecting learning materials) (Riskua et al. 2014). Another example where this model may be used effectively is in Dutch schools, where teachers will use various (digital) learning materials and are involved in processes of sense-making about the experiences. Comparative research, i.e. cross country analysis, by Kolo and Breiter (2009) in the Hungarian education system shows that different dependencies among the systems elements (teachers, students and their parents, the school as an institution) and of the elements towards the environment will lead to different, country specific dynamics. These dynamics concern aspects of leadership, which is an important and central concept within our model (Fig. 7). Finally, we refer to the United States. In the innovation strategy dubbed 'networked improvement communities', advocated by the Carnegie Foundation, there is a very important

role for teachers (Bryk et al. 2011). In our conceptual model learning processes of teachers are central. The effects of teachers' individual learning will only influence others or spill over, when the outcomes of the individual learning process are demonstrated, explained and then shared with other teachers who have had similar experiences.

Critical comments and questions

In Fig. 7, leadership practices are given control over "the flows of learning" in everyday practice. Kleysen and Dyck (2001) argue that the socio-political processes of 'championing' and 'coalition-building' are essential to explain feed-forward learning. They connect these arguments to aspects of transformational leadership. However, we have also observed other processes that lead us to believe that the more abstract model of leadership practice is preferable. Moreover, the tension between feed-forward and feedback learning in the Organizational Learning framework is also present in the LP framework. In the words of Spillane et al. (2004, p. 12): "tasks designed to promote change may depend, in substantial measure, on the successful execution of tasks designed to preserve the status quo". There is a second reason for the integration of the LP framework in the Organizational Learning framework, which can be found in the definition of 'Situation' in the LP framework (see Fig. 3). Situation stands for "the sociocultural context (including artifacts) that can embody the stable practices". Therefore, the concept of 'situation' corresponds here with "the institutions of the organization including systems, structures, procedures, and strategy" (Spillane et al. 2004, p. 21).

Kleysen and Dyck (2001) rightly point out that the framework of Crossan et al. (1999) gives no specifications for the feedback processes. We agree with their proposal to use the concepts of 'encoding' and 'enactment' for the feedback flow of learning, as counterparts to 'integrating' and 'interpreting', which stand for the feed-forward flow.

In Fig. 7, we have added two auxiliary figures next to the base model. They are adaptations of Figs. 2 and 4. We found these models to be practical tools for the following purposes. One such purpose is for describing context-conscious leadership; we have reinterpreted this concept as a series of LPs on the strategic level that represent the recursive relationship between external and internal context. Another purpose involves describing the coordination between formally and non-formally designated leaders at different levels in the school organization in terms of leadership practice.

In 2009, the Academy of Management Review granted the article "An organizational learning framework: From intuition to institution" (Crossan et al. 1999) the AMR Decade Award. Crossan et al. (2011) responded to this award with some reflections. Based on their analysis of research citations since 1999, they show that the article is often cited and has provoked research that pertains to details of the original framework, but that relatively few authors have extended or modified the Organizational Learning framework itself. The main point of discussion for the review of the 1999 article deals with whether the "multi-level 4I framework" (the Organizational Learning framework) should be considered as a theory, or just as a

unifying framework. However, we do not claim to have developed a definitive theory of Organizational Learning. We are convinced that the merger of the 1999 Organizational Learning framework with the concept of leadership practice and the other additions in Fig. 7 enrich and refine the original Organizational Learning Framework.

Crossan et al. (1999) and Crossan and Berdrow (2003) specifically point to the relationship between leadership and learning in organizations as an important area for further research. When we look back at the development of the creative process in Learning House 2, we see that one teacher who acted as an informal leader (cf. championship in Kleysen and Dyck 2001 and group monitor in De Groot et al. 2011) with individual ICT-expertise (Ho and Ng 2012) played an important role in eliciting an enthusiastic response from colleagues in regard to the implementation of laptops and digital learning materials in their teaching practices. Along with this, we see that the synergy of communication and learning processes from teachers and leaders together, at different levels of the organization, resulted in powerful feed-forward learning in Grade 1. However, the lack of a feed-forward flow in Grade 2 can be explained by the sudden top-down intervention of the top management in order to speed up the introduction and use of digital learning materials. Moreover, we find that managers sometimes took up an active leading role and at other moments placed themselves in a participatory and encouraging role. These choices between types of leadership styles can have both positive and negative effects on organizational learning, depending on the specific circumstances.

This conceptual model is a basis for researchers and school leaders to analyze their specific school and organization related questions (Spillane 2009). Crossan et al. (1999), for example, consider the problematic relationship between institutionalization and intuiting as one of the aspects of the Organizational Learning Framework that should be clarified by further research. This point is also addressed by Wiseman (2007) on institutionalization and Nonaka and von Krogh (2009, p. 647) on 'organizational ambidexterity', the "… balance between being efficient in running today's business, while being adaptive to changes in [the] environment". Governments and school boards sometimes confront schools with large-scale educational reforms that intervene in the established educational practice. In such cases, school leaders can respond with different strategies. For example, in School A in Grade 1, we recognize the self-directed learning ability of a group of teachers under the influence of visionary and transformational leadership. In Grade 2 we see the effect of the top-down implementation of a fully developed educational model that originated elsewhere, namely in Grade 1. The first strategy corresponds with the ongoing process of organizational learning, but we questioned what that means for the vision of organizational learning, where the pressure from outside the organization must be taken into account, leading to interventions by the top management in the institutionalized practice. How can the management team proactively influence the current practice and steer or lead the feed-forward—feedback cycle (intuiting, interpreting and enacting) in the 'right' direction? How can 'leadership for learning' strive to coordinate learning goals at the individual, team and organizational levels (Simons 2006)? To what extent is the 'creative destruction' that Crossan et al. (1999) suggest useful? In this strategy, the teachers

of a team, a department, or the entire organization are forced to refocus on the taken-for-granted nature of educational practice and reconstruct their own cognitive maps and belief systems.

Along with this, there are some further questions to answer: Are there characteristic patterns in leadership practices at a strategic, tactical and operational level? What degrees of freedom are needed for teacher leaders in the workplace in order to translate policy objectives into realistic work goals? What exactly does 'institutionalized' mean when the process of learning at individual and group level is a continuous process involving more or less autonomous teams? Other pressing questions relate to aspects of organizational development associated with scaling up within the organization or mergers between organizations. Is it necessary that each team or department have its own feed-forward—feedback cycle of learning, leading to a team-specific conception of educational practice? Will our enhanced model (Fig. 7) help in addressing these questions?

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