Leveraging the relationship : knowledge processes in school-university research networks of master's programmes

Citation for published version (APA):

Cornelissen, L. J. F., Liou, Y.-H., Swet, van, J., Beijgaard, D., & Bergen, T. C. M. (2015). Leveraging the relationship : knowledge processes in school-university research networks of master's programmes. *Research Papers in Education*, 30(3), 366-392. <https://doi.org/10.1080/02671522.2014.919522>

Document license:
TAVERNE

DOI:
[10.1080/02671522.2014.919522](https://doi.org/10.1080/02671522.2014.919522)

Document status and date:
Published: 01/01/2015

Document Version:
Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
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Leveraging the relationship: knowledge processes in school-university research networks of master's programmes

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Published online: 27 May 2014.

To cite this article: Frank Cornelissen, Alan J. Daly, Yi-Hwa Liou, Jacqueline Van Swet, Douwe Beijaard & Theo C.M. Bergen (2015) Leveraging the relationship: knowledge processes in school-university research networks of master's programmes, Research Papers in Education, 30:3, 366-392, DOI: [10.1080/02671522.2014.919522](https://doi.org/10.1080/02671522.2014.919522)

To link to this article: <http://dx.doi.org/10.1080/02671522.2014.919522>

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Leveraging the relationship: knowledge processes in school–university research networks of master’s programmes

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(Received 18 September 2013; final version received 26 April 2014)

This study investigated the way developing, sharing and using of research-based knowledge occurred in the school–university research network of a master’s programme for in-service teachers in the Netherlands. Over a 10-month period, a combination of quantitative and qualitative network data was collected. Data were analysed at three network levels: school, pairs of master’s students and research supervisors, and individuals. Overall, results indicate that building knowledge productive relationships in a master’s programme is a complex endeavour. Although individual master’s students and research supervisors aimed for continuing knowledge processes in school and university after student’s graduation, few actually did. The school context and the strategies of research supervisors provided students with too little support for sustaining the knowledge processes. This study shows from a network perspective the complexities, challenges and potential of developing partnership relationships in a master’s programme between schools and universities as well as between master’s students and research supervisors.

Keywords: network; practitioner research; school–university partnership; master’s programme; knowledge processes; teacher education

Introduction

Recent developments in education indicate that continuous professional development of in-service teachers is crucial in improving the quality of education (Darling-Hammond et al. 2009). Research suggests that such professional development often occurs through social interactions and depends on social relationships to provide access to other people’s resources – such as knowledge, abilities and skills (Bourdieu 1986; Borgatti and Foster 2003). Studies of educational reform and school change have begun to illustrate the importance of these relationships and social interactions among teachers and leaders in schools (De Lima 2008; Daly 2010), as well as in the educational system in which these schools are embedded (Coburn and Russell 2008; Daly and Finnigan 2010a, 2010b).

The growing evidence for the important role of relationships in educational reform has two major implications for institutes of Higher Education (HE) that

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support the professional development of in-service teachers. First, the support of institutes of HE should not be limited to the development of the individual teacher, but should also focus on supporting teachers in building productive relationships with colleagues inside and outside their school communities. Second, institutes of HE and their faculty members themselves should engage in relationships with school staff to collaborate in the development of schools and education. In the past two decades, we have witnessed a growing number of experiments with partnerships in which institutions of HE focus on supporting and establishing such relationships with school staff, for example: professional development schools (Darling-Hammond 2005), school–university (research) partnerships (McLaughlin and Black-Hawkins 2007) and school–university networks (Veugelers and O’Hair 2005). In these partnerships, institutes of HE often support teachers in developing a research role alongside their teaching roles and aim at closer integration of research-based knowledge and practice by means of teacher research. The premise in these partnerships is that by supporting teacher research valuable knowledge can be developed, which can be shared and used for the benefit of school and university practice. Partnership work shows that establishing productive relationships between schools and universities that support these knowledge processes is promising, but complex, and many questions remain (McLaughlin and Black-Hawkins 2007).

In this study school–university partnerships were studied from a network perspective in a teacher education context, i.e.: school–university research networks embedded in master’s programmes. Recently, scholars have suggested that postgraduate master’s programmes for in-service teachers may be a promising new avenue in developing school–university research networks that link schools and university and enable development, sharing and use of valuable knowledge of teacher research (Baumfield and McLaughlin 2006; van Swet, Ponte, and Smit 2007). Given the recent proliferation of this kind of network, there is a dearth of empirical knowledge about its nature, processes and outcomes. This study examines the way knowledge is developed, shared and used in a school–university research network in the context of a master’s programme. The main aim is to increase our understanding of the way these knowledge processes occur on different network levels and are influenced by aspects of this type of network.

Theoretical framework

School–university research networks embedded in master’s programmes

In school–university research networks embedded in master’s programmes, university supervisors support master’s students (i.e. in-service teachers) in developing knowledge by conducting practice-oriented research in their own schools. This practice-oriented research refers to a broad array of research approaches that are geared toward the practice of practitioners, such as action research, self-study and design research (Zeichner and Noffke 2001). Knowledge processes that originate from such master’s students’ research are expected to continue within teachers’ professional practice after their graduation, and may have immediate and future educational benefits. Figure 1 illustrates this school–university research network in the context of a master’s programme.

Figure 1 shows that in the master’s programme the relationship between the research supervisors and their master’s students in schools provides a potential

Figure 1. School–university research network in the context of a master's programme.

bridge between university and school by connecting networks of both organisations. In such a school–university network knowledge that is developed in practice-oriented research of master's students can be shared and used with colleagues in school as well as university.

A master's programme that is enacted as a school–university research network places new demands on schools and universities, as well as the teachers and supervisors involved. In the school–university research network, the master's programme is no longer a single endeavour of postgraduate teacher education, but instead one that fosters the development of productive relationships between schools and universities (McLaughlin and Black-Hawkins 2007; van Swet, Ponte, and Smit 2007). Universities not only focus on supporting master's students in developing valuable knowledge through conducting research and graduating from the programme, but also aim to increase collaboration and knowledge exchange in schools and universities. In this approach, university faculty may, for example, collaborate with principals and teachers at their students' schools in finding ways to develop, share and use valuable knowledge from students' research in school or university (Martin, Snow, and Franklin Torrez 2011).

The literature on school–university research partnerships suggests the importance of forming a partner network structure that may facilitate the building of collaborative relationships, which may foster knowledge processes (e.g. LePage et al. 2001; Baumfield and McLaughlin 2006). In an earlier study, we have argued that it is therefore critical to take structural and relational dimensions into account in forming research networks and understanding the knowledge processes that take place within these networks (Cornelissen et al. 2013). These structural and relational dimensions suggest four possible types of school–university research networks in master's programmes, which are shown in Figure 2.

Figure 2 shows how school–university research networks in master's programmes may differ (see for a more elaborate description Cornelissen et al. 2013). The vertical axis in Figure 2 describes the structural dimension, which shows the physical proximity of the university staff towards the school environment of the

Figure 2. Representation of possible school–university research networks in master’s programs based on dimensions of proximity and reciprocity.

practitioners with whom they collaborate. We distinguish two types of school–university research networks in master’s programmes that differ in such physical proximity:

- (1) University-centred: in this type of school–university network, master’s programmes are characterised by the fact that universities offer postgraduate education for in-service teachers primarily within a university setting (van Swet, Ponte, and Smit 2007). As these programmes are offered exclusively at the university they are considered ‘distant’ from the master’s students’ school settings.
- (2) School-centred: in this type of school–university network, master’s programmes are offered by teacher education institutes that are completely embedded in the school setting of their master’s students (Caillier and Riordan 2009; Cornelissen et al. 2014) and, in this sense, are very close in proximity. In this context, the university staff is able to offer the master’s programme to in-service teachers as well as work collaboratively within the same school environment with their masters’ students.

The horizontal axis in Figure 2 describes the relational dimension, which shows the degree of reciprocity in research collaboration relationships between university and school staff. We distinguish two types of relationships that differ in reciprocity:

- (1) One-way relationships: one partner, either the school or university, initiates the research process with the other party playing a more supportive role or both partners conduct research, but there is little mutual engagement in each other’s research.
- (2) Reciprocal relationships: relationships with high levels of mutual engagement between the school and university and with many collaborative opportunities to mutually exchange knowledge, experiences and resources. Research agendas, goals, methods and outcomes are discussed and research activities are collaboratively undertaken.

Based on these dimensions, more insight can be gained into different types of school–university research networks in master’s programmes and the way knowledge based on master’s students’ research is developed, shared and used in school and university practice.

Developing, sharing and using knowledge in networks

This study focuses on the knowledge processes of developing, sharing and using knowledge in practice-oriented research, as conducted by master's students (i.e. in-service teachers) in the master's programme. At least two different forms of knowledge can be distinguished (Cornelissen et al. 2013):

- (1) Content knowledge about the topic that is being investigated (e.g. high school students with dyslexia). In the past two decades, there has been a debate on the question of whether such knowledge is 'local' knowledge, which is primarily useful to one's own practice and context, or if this knowledge can be useful to other practices and be relevant to the wider educational community (Cochran-Smith and Lytle 1998; Anderson and Herr 1999).
- (2) Procedural knowledge pertaining to the design and methods used (e.g. how to conduct a specific kind of interview). Developing this kind of knowledge should instigate master's students to develop themselves as reflective practitioners who continue to use research methods to develop, share and use knowledge (Schön 1983; Cochran-Smith and Lytle 1998; Rust and Meyers 2006).

In the literature, different views on the nature of knowledge and the processes in which it is developed, shared and used in a network are described. Paavola, Lipponen, and Hakkarainen (2004) build on the work of Sfard (1998), and describe three main ways of thinking about these knowledge processes. First, they describe knowledge processes from the 'acquisition metaphor', which focuses on knowledge in the head of the individual. In this commonly held view, the individual mind is a kind of 'container', in which knowledge can be constructed during processes of transfer and application. For many years this 'acquisition' view has been dominant in studying knowledge processes (e.g. Salomon and Perkins 1989). Second, Paavola and colleagues describe a contrasting view of the 'participation metaphor', which focuses on interactive knowledge development through participating in communities in situated contexts. Here, knowledge is distributed among individuals and situated in their relationships and participative activities. It is argued that knowledge and knowing are closely tied to the context of events in which people participate (e.g. Lave and Wenger 1991). Third, Paavola and colleagues describe the 'knowledge creation metaphor', which focuses on the process of developing something new. Here, people collaboratively develop mediated artefacts, such as knowledge, ideas, practices, materials and concepts. It is emphasised that during this collaborative process different forms of knowledge and activities interact (e.g. Hargreaves 1999). This view differs from the previous two because it 'addresses processes, practices, and social structures that are likely to encourage formation of new knowledge and innovations rather than adaption to the existing culture or assimilation of current knowledge' (Hakkarainen et al. 2008, 12).

In this study, the developing, sharing and using of knowledge based on master's students' research was examined from the 'knowledge creation' view. The 'knowledge creation' view is considered a promising approach for building and studying knowledge networks in formal educational and informal workplace learning settings (Paavola, Lipponen, and Hakkarainen 2004), as they both occur in the context of a master's programme. It focuses on the interactive process of collaboratively

developing new artefacts such as the knowledge, ideas, practices, materials and concepts that are being developed in practice-oriented research of master's students. Moreover, the 'knowledge creation' view values individual, relational and contextual elements; it is considered that examining knowledge processes from this view can support a rich and broad understanding of knowledge processes in a school–university research network.

Research question

In this study, we investigated the network represented by the fourth quadrant in Figure 1. This type of school–university research network represents a university-centred structure with reciprocal relationships in research collaboration. It combines the kind of structure in master's programmes which occurs most frequently in practice with the kind of relationships in research collaboration that are beneficial to knowledge processes.

The overarching research question that guides this study is: In what way do knowledge processes originating from master's students' practice-oriented research occur in a school–university research network embedded in a university-centred master's programme with reciprocal relationships in research collaboration?

Method

Context

The context for this study was a two-year part-time Master's Programme for Special Educational Needs (MSEN) offered by an institute of teacher education at a university of applied sciences in the Netherlands. We selected this programme as it explicitly aims to build in-service teachers' capacity for critically researching their own practices. Moreover, the institute of teacher education focused on building a community of learners and linking teacher education to educational reform. Students had chosen their own research topics and conducted research in the second year of the master's programme. The research timeline covered over half of that year's study activities. The nature of master's students' research was practice-oriented and aimed at supporting master's students in their professional development and improving their own teaching or school practice. The research was completed with a written research report, which had to meet the European standards for master's education.

During their research, master's students and research supervisors worked in a small tutor group that was established for the purpose of providing research support as well as collaborative learning. The research supervisors occasionally visited the school of their master's students, but most of the time the students travelled to the university for their meetings. The structural dimension of the school–university research networks within this master's programme can therefore be characterised as a university-centred master's programme.

Research design

We used a multi-method case study design to examine knowledge processes in one of the schools where MSEN students (i.e. in-service teachers) were conducting research in their university's MSEN programme. We examined the network at the level of the whole network (MSEN students, their school colleagues and research

supervisors), dyad (pair of MSEN student and research supervisor), and individual (MSEN student or research supervisor). The network-level analysis enabled us to understand the overall structure of the knowledge processes' network within school by examining the patterns of interactions among school members. The dyad-level analysis explored the quality of relationships between the school's MSEN students and their research supervisors in terms of supports and constraints in knowledge processes when conducting practice-oriented research at their school. The individual-level analysis deepened understanding of how MSEN students and their research supervisors experienced knowledge processes over time.

Selection of participants

We purposively selected participants based on four criteria: (1) A school at which several in-service teachers were conducting research in the MSEN programme; (2) A school at which university and school staff were engaging in a collaborative process of mutually developing, sharing and using knowledge based on MSEN students' research; (3) An in-service teacher conducting practice-oriented research in the second year of the MSEN programme; (4) An educator in the MSEN programme who supported in-service teachers (i.e. master's students) in conducting practice-oriented research in school. The first criterion enabled us to take into account a variety of individual network participants in the same school context and to distinguish differences and similarities among them. The second criterion enabled us to study a university-centred master's programme in which reciprocal relationships were present to support knowledge processes. This resulted in the selection of five participants who were closely involved in MSEN students' research: three master's students and their two research supervisors (see Table 1).

The MSEN students were all working at the same school for special education (primary and secondary education). This school was located in the southern part of the Netherlands and provided education to students aged from 4 to 20, with severe, profound and complex learning and behavioural difficulties. Students were divided by age into eight grade levels. For each group of students, teachers shared responsibility with teacher assistants. Furthermore, there was specialised staff to support the teachers, such as a school psychologist, physiotherapist and speech therapist. The school supported their teachers' professional learning and development, but had little experience with teachers conducting research into their own school practice.

Table 1. Selected participants.

Participant	Age	Task in school or university	FTE ^a
Master's student 1 (MS1)	37	Classroom teacher	0.6
Master's student 2 (MS2)	30	Classroom teacher	0.8
Master's student 3 (MS3)	46	Classroom/peripatetic teacher, coordinator, management member	1.0
Research supervisor 1 (RS1) ^b	56	University educator, consultant, programme coordinator	1.0
Research supervisor 2 (RS2) ^c	52	University educator, consultant, management member	1.0

^aFTE = Full time-equivalent; ^bRS1 is the supervisor of MS2; ^cRS2 is the supervisor of MS1 and MS3.

Data collection

Whole network questionnaire

At the end of the 10-month data collection period we conducted a questionnaire with questions about individual attributes and social relationships around knowledge processes in schools (see Figure 3). The survey provided us with quantitative data about the network, dyads and individuals and gave insight into the structure and network positions of the five selected participants after the MSEN students finished their research.

This survey was distributed to 50 respondents: the three selected MSEN students, all of their 45 school colleagues and the two selected university research supervisors. Data collection resulted in a 100% response rate. We piloted the questions with a school teacher and a university educator to improve formulations. Questions were designed to collect data about individual attributes (their ages and grades they were teaching) and social relationships around knowledge processes in school. We asked respondents to respond to the following prompt: 'Please select, from whom do you get new ideas for teaching?' We provided them with a roster of school staff, including the two university research supervisors, and asked them to assess the relationships with their colleagues on a binary scale (0 = No interaction; 1 = Interaction).

Personal network questionnaire

The personal network questionnaire collected quantitative data about social relationships in the individual network of a respondent (i.e. 'ego') (Wasserman and Faust 1994). We conducted the same personal network survey at four different times, asking questions about individual attributes and social relationships between school staff during knowledge processes (see Figure 3). We focused this questionnaire on the knowledge processes originating from MSEN students' research, as this would enable us to better understand the role of relationships both during and after their research in the school–university research network. The questionnaire was conducted with the three selected MSEN students and the two selected university research supervisors. Data collection resulted in a 100% response rate. We piloted the questions with a school teacher and a university educator to improve formulations. Questions were designed to:

- (1) Nominate colleagues who gave respondents new teaching ideas while discussing MSEN students' research. We asked respondents to respond to the prompt: 'What colleagues in school provided you new ideas for your teaching when you discussed your research?' Research supervisors were

Figure 3. Data collection process.

asked to only consider ideas connected to the research of the MSEN student they were supervising and only consider colleagues in their own teacher education institute.

- (2) State the position of nominated colleagues, and assess the quality of relationships with nominated colleagues with respect to trust, engagement, expertise and value. We asked four questions derived from Cross et al. (2001) and Borgatti and Cross (2003) that examined: (1) *Trust*: 'With whom do you discuss personal matters?'; (2) *Engagement*: 'When seeking advice who understands your issue and assists in solving the issue?'; (3) *Expertise*: 'Who do you consider to have knowledge and skills?'; (4) *Value*: 'Who has expertise that is of value in your work?'

Logs and interviews

Qualitative data was collected from the three selected MSEN students and the two selected university research supervisors. Data collection took place over four time periods during and after MSEN students' research. These periods co-occurred with the periods in which the personal network data was collected (see Figure 3). At the beginning of the data collection, the participants were given instructions to keep a log to report on critical incidents. Critical incidents were defined as moments during their practice when they experienced that knowledge originating from MSEN students' research was developed, shared or used effectively or ineffectively. Focusing on these critical incidents helps track down concrete events from the participants' own practice and experiences (Butterfield et al. 2005; De Laat 2006). MSEN students were explicitly asked to exclusively report on knowledge processes connected to their own research. Research supervisors were asked to report only on knowledge processes connected to the research of their MSEN students. They were asked to report on any significant critical incident during that particular period. As an aid to writing their logs, participants received a sheet with guiding questions. These questions not only focused on describing the critical incident itself, but also on their thoughts, feelings and reasons for their behaviour (Butterfield et al. 2005). Examples of these questions and the critical incidents reported on in their logs are given in Table 2.

At the end of each period the researcher collected the participants' logs through e-mail. After reading the reports the researcher conducted a semi-structured telephone interview with each participant. Each interview lasted for 1–1.5 h and was transcribed verbatim. An interview protocol was used to explore aspects of the critical incidents, which the participants had reported in their logs (see Table 2 for sample questions). In this way, we could gain a broad and an in-depth insight into how participants perceived the knowledge processes in the network. Interviews were conducted once every 8–10 weeks over a period of 10 months (see Figure 3). A total of 20 interviews were conducted with five participants (four interviews with each participant) over the course of the year. In total, 69 critical incidents were collected with interview data about each incident. The number of critical incidents for each participant included: MSEN Student 1 (MS1) (17), MSEN Student 2 (MS2) (13), MSEN Student 3 (MS3) (12), Research Supervisor 1 (RS1) (13) and Research Supervisor 2 (RS2) (14). On average the participants reported three or four incidents in each period, with a maximum of six and a minimum of two.

Table 2. Examples of critical incidents, log and interview questions.

Knowledge process	Critical incidents	Log questions	Interview questions
Developing	Master's student discusses and revises the content of her questionnaire together with a school colleague	<ul style="list-style-type: none"> • What happened? • When did it happen? • What was the occasion? 	<ul style="list-style-type: none"> • What happened exactly? • What was the purpose of the activities?
Sharing	Master's student talks to a colleague from another grade about insights from her study in the room for smokers at school	<ul style="list-style-type: none"> • What did you develop, share or use? • What did you think? • What did you feel? 	<ul style="list-style-type: none"> • What did relationships look like during the activity? • In what way did people collaborate?
Using	Master's student and research supervisor use the research outcomes to create a university course for teacher training	<ul style="list-style-type: none"> • What did you do? • Who were involved? • What did others do? • What was the result? 	<ul style="list-style-type: none"> • In what way were outcomes used to support processes in school? • In what way were people supported in developing, sharing or using knowledge?

Data analysis

We analysed the quantitative and qualitative network data at each network level: the school, dyad and individual. The quantitative analysis focused on examining the network structures and patterns of relationships among colleagues during knowledge processes in the school, and the qualitative analysis on explaining and understanding these structures and patterns from the participants' perceptions.

Quantitative analysis

Social network analysis was used to examine patterns of interactions between network members during knowledge processes. Social network data obtained from the surveys were entered into UCINET (Borgatti, Everett, and Freeman 2005) for calculating network measures. We used NetDraw (Borgatti 2002) to generate visual representations of the network. We applied social network measures to examine network properties at the level of the school network, dyad and individual.

Network-level analysis. We conducted social network measures of *density*, *reciprocity*, *centralisation* and *E-I index* to gain insight in the network structure (Wasserman and Faust 1994). Density refers to the ratio of the number of existing relationships to the possible number of relationships between network members in the network. Density ranges from 0 (no relationships in the network) to 1 (all network members are connected). Reciprocity refers to the ratio of the number of reciprocated relationships to the total number of observed relationships in the network. Reciprocity ranges from 0 (no reciprocated relationships in the network) to 1 (all observed relationships are reciprocated). Centralisation refers to the difference between one or a

few highly central network members with many relationships and the other more peripheral network members. Centralisation ranges from 0 (all network members have the same number of relationships) to 1 (all network members only have one relationship in the network with the same single network member). E–I index refers to the degree of group-embeddedness and cross-group connections. The E–I index ranges from –1 (all relationships are internal to certain subgroups) to 1 (all ties are external to certain subgroups).

Dyad-level analysis. As the student–supervisor relationship is at the core of the research in the university’s MSEN programme, we combined the personal network of the student and his/her supervisor to create their dyad network. Sociograms were generated for each dyad network to understand the patterns of relationships between the student and his/her supervisor. We examined the quality of these dyad networks, by measuring their density and reciprocity. In each dyad, we also examined similarities/differences between the size and quality of the personal network of the student and his/her supervisor. Therefore, we compared personal network measures of *size*, *density* and *reciprocity* between the MSEN student and research supervisor in each dyad.

Individual-level analysis. In our individual-level analysis, we explored the personal networks of the three MSEN students and their two research supervisors over time to get a better understanding of the way knowledge processes originating from MSEN students’ research occurred in the school–university research network. In our analysis, we focused on the strong relationships between each participant and his/her colleagues as they facilitate interactive knowledge processes. We defined these strong ties as relationships that network members perceive to be characterised by all four examined relationships (i.e. trust, expertise, engagement and value). Such ties are considered to foster interaction, collaboration and knowledge processes. We calculated the number of strong relationships that each participant indicated within his/her own organisation at four time points. We summarised outcomes in graphical time patterns for each individual in order to gain insight into the development of these personal networks.

Qualitative analysis

The interviews were audio-taped and transcribed verbatim. In our analysis of the interview data, we focused on understanding how participants perceived the knowledge processes. Three main elements of the network were explored, which corresponded with the three levels of the quantitative analysis: individual network members (individual level), relationships between the network members (dyad level) and context of events in which (joint) activities by network members take place (network level). The analysis of the transcript data followed an approach described in more detail in the study of – Cornelissen et al. (2011) – in which 15 aspects were distinguished of these three network elements. From this study a category system was used to select fragments from the interviews. This category system was considered a reliable instrument for analysing the data based on its scores for inter-rater reliability (*Cohen’s Kappa* of 0.74), and intra-rater reliability (*Cohen’s Kappa* of 0.83). The categories referred to 15 aspects of the individual network members, their relationships and the context of events during knowledge processes originating from the research of MSEN students (see for a description of the categories

Cornelissen et al. 2011). It resulted in the selection of 1772 fragments. Examples of fragments pertaining to these different knowledge processes and network elements are presented in the results section. Table 3 presents the percentages of fragments by members, their relationships and context of events during processes related to developing, sharing and using knowledge.

We describe our analysis for each element parallel to the levels in the quantitative analysis: context of events (network level), relationships between network members (dyad level) and individual network members (individual level).

Context of events. We started by assembling fragments pertaining to the context of events in which knowledge processes took place for each individual participant. A comparison of fragments examined the knowledge processes. After we clustered and summarised the fragments referring to a common theme, a descriptive label was assigned to each fragment cluster. We compared the themes of the individual participants, focusing on differences and similarities in the labels and summaries.

Relationships. We started by assembling fragments pertaining to each individual's relationships with colleagues when knowledge processes took place. We counted and compared the number of fragments belonging to dyad 1 (MS1 and RS2), dyad 2 (MS2 and RS1) and dyad 3 (MS3 and RS2). After we clustered and summarised fragments referring to a common theme for each participant, a descriptive label was assigned to each fragment cluster. We then compared the extracted themes for dyads 1, 2 and 3, focusing on differences and similarities in the labels and summaries.

Members. We started by assembling fragments pertaining to the individual members. We divided the fragments among each of the four instances when they were collected. We focused our individual analysis on distinguishing developments over time in the way knowledge processes originating from practice-oriented research of master's students were experienced by individual participants. This enabled us to compare for each individual participant their quantitative relational time patterns derived from the personal network analysis with their qualitative perceptions of developments in their personal networks and knowledge processes over time. After we compared the fragments over time, we clustered and summarised fragments referring to common themes, which described developments in the participants' personal networks.

Reliability and validity of this qualitative data analysis were ensured by using: (1) A reliable category system; (2) Peer debriefing by discussing and adjusting the assigned labels and formulation of the summaries with two other researchers who were familiar with the study's conceptual framework but unfamiliar with the specific

Table 3. Division of coded fragments.

Fragments related to	Members (%)	Relationships (%)	Context of events (%)	Total (%)
Knowledge developing	13.9	5.3	8.0	27.2
Knowledge sharing	22.3	5.7	10.9	38.9
Knowledge using	18.3	7.0	8.6	33.9
Total	54.5	18.0	27.5	100.0

case data; (3) Member checking with the participants, i.e. explaining to each participant a summary of their perceptions of the knowledge processes and inviting them to improve or add to the descriptions (Miles and Huberman 1994). Each of the participants confirmed in as the member checks that the summaries of their perceptions were complete and accurate.

Results

In the following sections, the outcomes are described at the level of the whole network (MSEN students' school and research supervisors), dyad (pair of MSEN student and research supervisor) and individual (MSEN student or research supervisor).

School network: few opportunities for sharing and using knowledge across school

Limited relationships across grade levels

On average, network members engaged in knowledge processes with about 16% of their colleagues (*Density* = 0.16) and almost one-third of such relationships between network members were reciprocated (*Reciprocity* = 0.32). In addition, two network members were more central than others in the school network structure suggesting a somewhat centralised network (*Overall Centralisation* = 0.43).

Figure 4 presents a visualisation of the network. The network is not densely connected and has a moderate number of reciprocal relationships (solid black lines). The members are sized by degree centrality (i.e. the proportion of relationships an individual member has with other members); the bigger the node, the more central

Figure 4. School network in knowledge processes.

Notes: Nodes are sized by degree centrality and shaped by position (Teacher: up-triangle; Teacher assistant: down-triangle; Management: square; Support staff: circle; Supervisor: diamond). Lines are sized by reciprocity (Reciprocal ties: thick/black lines; Non-reciprocal ties: thin/grey lines). MS1/MS2/MS3 = Selected MSEN students; RS1/RS2 = Selected research supervisors; Numbers = Master's students' school colleagues.

position the member had in the network. The figure shows that MSEN student 3 (MS3) and Node 35 have the most central positions. Attribute data indicates that these two network members have the same position of being a team coordinator/teacher coach as well as management member.

We also examined the tendency for network closure between grade-level members to form internal (within grade-level group) or external (outside grade-level group) relationships at school. At the overall whole network level, the E–I index was -0.08 , suggesting that patterns of interactions were slightly more internally focused, meaning that members tended to interact slightly more with their grade-level colleagues. However, when we examined this distribution of relationships between network members in school more closely we found a much larger difference in the densities of these external and internal ties (External *density* = 0.18 and Internal *density* = 0.54). This finding indicates that, although cross-grade-level connections existed, individual members in the school network tended to engage in knowledge processes with their own grade-level colleagues significantly more ($p < 0.5$).

Lack of opportunities on school level

Interview analysis of the context of events in which knowledge processes occurred indicated that the school context was mainly focused on enhancing capacity for engaging in knowledge processes on the individual level, i.e. through supporting professional development and research activities of MSEN students in the MSEN programme. To a lesser extent, opportunities were provided for MSEN students that focused on enhancing capacity for engaging colleagues in knowledge processes on the school level, for example: (1) MSEN students presented their research outcomes at monthly ‘coffee lectures’ in school; (2) MSEN students wrote chapters about their research in a book about the collaborative (research) experiences of school and university. RS2 noticed this difference between enhancing capacity on the individual and school level, and worried about the continuation of knowledge processes with such limited opportunities of sharing and using research-based knowledge in school:

For me the question still remains: ‘What happens with all these studies in school on the long term?’ That is for me the urgent question and what do you as a principal do to keep these studies alive?

MSEN students confirmed this concern and mainly reported about individual initiatives in which they tried to engage in continuing knowledge processes with colleagues. For example, MS2 described how he felt the school context did not provide him with enough opportunities to continue such interactive knowledge processes:

We give ‘coffee lectures’ as we call them and I presented about the instrument that I developed in my research, but subsequently it is important that you get the chance in school ... to learn from and through each other and that’s just not the case here. So people do listen to my story, become enthusiastic and say: ‘Give me a copy of your handout. Very nice!’, and then it stops.

Master’s student and research supervisor: untapped potential

Figure 5 presents the networks of dyad 1 (MS1 and RS2), dyad 2 (MS2 and RS1) and dyad 3 (MS3 and RS2).

Figure 5. Dyad network in knowledge processes.

Notes: Dyad 1 refers to the combined ego networks of MS1 and RS2; dyad 2 refers to the combined ego networks of MS2 and RS2; dyad 3 refers to the combined ego networks of MS3 and RS2. Nodes are sized by degree centrality and shaped by role: up-triangle: master's student; Square: research supervisor; Circle: other. Lines are sized by reciprocity (Reciprocal ties: thick/black lines; Non-reciprocal ties: thin/grey lines).

Potential access

We found differences in network size among the three dyad networks. Dyad 3 was connected to more school colleagues (Number of network members of MS3/RS2=32; number of ties in MS3/RS2=219) than those of dyad 1 and dyad 2 (Number of network members of MS1/RS2 and MS2/RS1=19 and 17, respectively; number of ties in MS1/RS2 and MS2/RS1=96 and 105, respectively). The quality of the relationships in the three dyad networks was much more similar in terms of density and reciprocity. The three dyad networks were all densely connected (*Density* of MS1/RS2, MS2/RS1 and MS3/RS2=0.28, 0.39 and 0.22, respectively) and at least one-third of all possible ties that existed in each dyad network was reciprocated (*Reciprocity* of MS1/RS2, MS2/RS1 and MS3/RS2=0.41, 0.31 and 0.38, respectively). This suggests that, although MS3 and RS2 in dyad 3 were connected to the highest number of colleagues in school, the similar quality of the relationships in the three dyad networks provided each pair of MSEN student and research supervisor with the potential for engaging in interactive knowledge processes with other colleagues in school.

To further explore the features of these combined personal networks, we took each dyad network apart. Figure 6 displays the separate personal networks of the MSEN students and the research supervisors. It shows that MS3 had a larger number of colleagues he could reach ($n_3=31$) than MS1 and MS2 did ($n_1=14$; $n_2=14$). The quality of their relationships in terms of the number of reciprocal ties showed small differences. MS1 had slightly more reciprocal ties (*Ego Reciprocity*=0.45) than MS2 and MS3 did (*Ego Reciprocity*=0.34 and 0.38, respectively).

Figure 6. Individual ego network in knowledge processes.
Notes: Notes are sized by degree centrality and shaped by role: up-triangle: master's student; Square: research supervisor; Circle: other. Lines are sized by reciprocity (Reciprocal ties: thick/black lines; Non-reciprocal ties: thin/grey lines).

The personal networks of the research supervisors were much smaller and showed less variation. We noticed that both RS1 and RS2 had a similar, but limited number of school colleagues that they could reach ($n_{RS1} = 5$; $n_{RS2} = 7$). Furthermore, both RS1 and RS2 appeared to have a similar quality of relationships in terms of the number of reciprocal ties (*Ego Reciprocity* of RS1 and RS2 = 0.27 and 0.29, respectively).

In sum, the quality of the relationships in each dyad network revealed a potential for connecting to school colleagues during knowledge processes. When taking the three dyad networks apart the vast majority of the relationships with school colleagues appeared from the MSEN student's personal networks. This finding suggests that research supervisors have an opportunity to leverage the dyadic relationship with their MSEN students and get access to a larger number of school colleagues for the sake of further sharing and using knowledge.

Different foci

Interview analysis indicated that research supervisors had a different focus when supporting their MSEN students in continuing knowledge processes in the school–university research network.

RS1 focused mainly on university. RS1 attempted to build new relationships in her university network to continue knowledge processes based on the knowledge MS2 had developed in his research. Together with MS2 she used this knowledge for creating a teacher training course and creating relationships for MS2 at the university in which he could continue to share and use his knowledge by teaching this course:

When I'm there, I think: This is something for [MS2]! I connect him with that person who is doing the workshop and say: 'See what you can do for each other.' Subsequently, I say to the person who is organizing the workshops: 'I think ... [MS2] can do it' ... Those are opportunities in the university that I'm willing to provide.

RS2 focused mainly on school. RS2 focused on ways in which he could build productive relationships in school with school administrators and teachers to continue knowledge processes:

You come into that school and you notice the connections between studies and more people get to know you and know that you contribute to something that is important to them. So there is something happening in square ... when you come in that school and make connections ... and they also make connections.

Although the focus on school or university differed, both supervisors shared a focus on expanding their networks by developing their own new relationships with colleagues in the school or university network instead of accessing the relationships of their MSEN students.

Individuals: seeking opportunities to engage with colleagues in knowledge processes MSEN students

Figure 7 presents the pattern of the number of strong, 'high quality' ties each MSEN student had with school colleagues during knowledge processes originating from their research over the four time periods during which data was collected.

Seeking opportunities

Although the patterns in Figure 6 show unique trajectories, we noticed that the patterns for both MS1 and MS3 show a slight increase from time 1 to time 2, and then reduce to zero on time 4. Unlike these patterns, MS2's strong high-quality ties indicate a downward trajectory from time 1 to time 2, and then remain constant after time 2. These patterns suggest that after time 2 MSEN students did not increase the use of their strong ties for engaging in knowledge processes originating from their research and only MS2 maintained his use of strong ties until time 4. To gain a better understanding of these patterns, we examined the way MS1, MS2 and MS3 experienced these knowledge processes over time.

Interview analysis confirms the individual trajectories of MSEN students. Our analysis suggested that each student focused in his/her interview reports on a different knowledge process: (1) MS1 on developing (55.1% of the coded fragments); (2) MS2 on using (57.4% of the coded fragments); and (3) MS3 on sharing (69.1% of the coded fragments). Analysis indicated that regardless of the kind of knowledge process that was dominant in the reports, each MSEN student started in the next academic year (time 2–4) to seek for more opportunities to engage with colleagues and encourage them to adopt their research-based knowledge.

Figure 7. Strong ties in knowledge processes within school by MSEN student.

MS1 started to seek such opportunities when she was developing knowledge. She did not graduate at the end of the academic year (time 1) and as such continued her research activities in the next year (time 2, 3 and 4). At time 1, she mainly reported about the knowledge she developed about her research topic from a literature review that she did on her own. She noticed that during this time she felt insecure about her research topic and its usefulness to school practice. However, in the period afterwards (time 2–4) she began to increasingly report on positive emotions, and began seeking the feedback of her colleagues and they confirmed the value of her research for their school practice: ‘It gave me a kind of confirmation, because I was often in doubt when I looked at the topics of the other studies which were conducted in our school’. This confirmation gave her confidence and enthusiasm a boost; she started to seek for more ways to engage her colleagues in knowledge development and hoped that this would increase the future buy-in of the knowledge she was developing:

The more people know about your research and think along, the more people you make co-owner of your research, and this will enhance the chance that it will be used in school practice during the next years.

MS2 sought opportunities to engage with colleagues when he was using his knowledge. Unlike MS1, he did not seem to doubt the relevance or usefulness of his research topic to school practice. Right after he finished his research and writing (time 2–4) he started to use his knowledge in collaboration with his supervisor and a close colleague at school: (1) Together with RS1 he used his knowledge for developing and teaching a teacher training course in the university context; (2) Together with a school colleague he started a consultancy business and they used the knowledge he had developed for creating courses for teacher training at other schools. MS2 regretted that he found these collaborative opportunities only outside school, because he had also sought such opportunities inside his own school. At time 1 he

reported that he had conversations with school administrators about what the needs of the school were and if they considered that his research-based knowledge would be useful. In the next academic year after he had graduated (time 2–4) he tried to use his knowledge by proposing to the school administrators to provide training about his research topic to colleagues in school. However, he noticed that school administrators listened to his ideas, but that there was little active support. Disappointed, he remarked about the administrative response: ‘It remains with listening and I regret that. I’m thinking: Okay, I’m not going to invest anymore of my energy; they know what’s there and that I’m ready to use it’.

MS3 sought opportunities to engage with colleagues during knowledge sharing. He reported that during his research and writing (time 1) he was completely focused on graduating and getting everything done on time: ‘I was so busy with getting my work done ..., because we had to finish those courses and the final thesis, so I’ve been very busy with that and I’ve been kind of intoxicated with all my activities’. After graduation (time 2–4), he began to find more time and opportunity to share the knowledge he had developed with colleagues during several meetings at school and his daily work. He appreciated the opportunity to write a chapter about his research in collaboration with RS2 and university staff right after his graduation (time 2). However, he also noted that writing the chapter represented extra work and this activity of sharing felt as an ‘add on’, somewhat disconnected from his everyday teaching practice:

We’ve been working for a long time at that chapter ... Yes, I completed my research and then this came along ... At a certain moment I thought: Well, it all has to be finished now. We have to continue with the regular things.

In comparing the experiences of the three MSEN students over time, we conclude that in the next academic year (time 2–4) each of them wanted to continue with developing, sharing or using their research-based knowledge in school practice and they increasingly sought for opportunities to engage with school colleagues in these knowledge processes. However, we found a discrepancy between MSEN students’ individual intentions/activities for connecting more to their school colleagues and the observed absence of an actual increase in the use of strong relationships with their school colleagues during knowledge processes (see Figure 7).

Research supervisors

Figure 8 presents the pattern of the number of strong ties each research supervisor had with their colleagues at the university during knowledge processes originating from their MSEN student’s research over the four time periods during which data was collected.

Exploring the network. We noticed that the two patterns of university supervisor were very different; in the period of the research of their MSEN students (time 1) RS1 used during knowledge processes a much larger number of her strong ties was with colleagues in university than with RS2. However, in the beginning of the next academic year (time 2 and 3) RS1 decreased the use of strong ties and only after a while she increased the use of her strong ties again (time 4). RS2’s number of strong ties remained zero and his pattern only showed an increase of the use of strong ties in the beginning of the next academic year (time 2).

Figure 8. Strong ties in knowledge processes within university by research supervisor.

The interview analysis confirms these differences in the way supervisors perceived the knowledge processes; RS1 referred most to knowledge-using (63.7% of the coded fragments), while RS2's reports focused on developing (47.7% of the coded fragments) and sharing (47.7% of the coded fragments) knowledge.

At time 1 RS1 explained that during her student's research she began to look around in her university network to explore who might need the instrument that her student was developing in his study:

We got a request ... I immediately see this as an opportunity for [MS2]. That's just the right place to use his instrument.

After her student finished his research (time 2–4) she changed her focus to supporting him to use the knowledge he had developed to create and teach a teacher training course at the university. Towards the end of this course (time 4) when she noticed that he succeeded in his teaching as a guest lecturer she started again to search in her network for more opportunities to continue to use this course in the future: 'We had a warm good bye ... he will still provide two more guest lectures for teacher assistants ... and you never know, in the mean time we might get new requests'.

In contrast to RS1, RS2 seemed to focus on supporting the development and sharing of the content knowledge that his students developed about their research topics, but also of the procedural knowledge about the collaborative process of research and development that they had gone through with their MSEN students' school. Right from the start of the next academic year (time 2) he edited together with colleagues from university a book in which they shared both kinds of knowledge that were developed. In this period, he also planned with his manager at the university to share and use this book for the benefit of their education:

This book is kind of evidence that research on a larger scale can make schools stronger ... and my manager and I are exploring opportunities to promote the book in such a way that other schools might get interested through reading or hearing about it.

Subsequently, this book was presented during a symposium at school (time 3), but after that day RS2 felt that he had fully lost touch with school: 'It's just as if you've lost a limb'. Also in the university context he reported disappointed that in the next months (time 3 and 4) as he had not been able to engage with his colleagues in continuing to share and use the knowledge described in the book:

At first I was very happy when my manager said: 'Let's do it! This is important' ... Now it's slipping through my hands ... the work pressure I'm under ... apparently these kind of activities are not part of our job.

In comparing experiences of both research supervisors, we may conclude that they both created opportunities for their MSEN students to continue knowledge processes in the next academic year, but that RS1's support enabled knowledge processes to continue longer in the university network than RS2's support. We noticed that already during her student's research (time 1) RS1 began exploring her university network to sense if there was a need for the knowledge her student was developing and if she could find concrete opportunities to use it. In contrast, RS2 waited for actively exploring these concrete opportunities in his university network till the period after his MSEN students had finished developing knowledge (time 3 and 4). This difference in support strategy may have been an important factor in successfully continuing knowledge processes originating from student's research across the university network.

Conclusion

In this study, we examined knowledge processes originating from MSEN students' practice-oriented research in a school–university research network of a school-centred MSEN programme, which had an orientation toward collaboration and reciprocated relationships in research. Our analyses suggest four key findings:

- (1) *Network level.* The school network context enabled educators to access colleagues of the same grade level during knowledge processes, but provided limited opportunities for such connections with colleagues across the different grade levels in school;
- (2) *Dyad level.* For supporting the continuation of knowledge processes both research supervisors had the opportunity to connect to a much larger part of the school network by accessing the relationships that already existed between their MSEN students and their school colleagues. However, they did not tap into this potential for further sharing and using knowledge in the school network. Both supervisors focused on expanding their networks by developing their own new relationships with colleagues in the school or university network.
- (3) *Individual level.* Over time both supervisors explored their university network for opportunities to further share and use the knowledge that their MSEN students had developed. They applied different strategies: one supervisor started by exploring these opportunities while her student was still developing his knowledge in his research and the other supervisor waited for such exploration after the process of knowledge development was completed. The first strategy appeared more successful in supporting the continuation of knowledge processes.
- (4) *Individual level.* In the next academic year, MSEN students increasingly sought for opportunities to engage with school colleagues in further developing, sharing or using their research-based knowledge, but this pattern of engagement did not lead to an actual increase in the use of their strong relationships with school colleagues during knowledge processes.

Overall, we conclude that leveraging the potential of the research partnership relationship between school and university as well as between master's students and their research supervisors appeared a complex endeavour. It turned out to be difficult

for MSEN students to continue with developing, sharing or using their research-based knowledge with colleagues in the school–university network of this master’s programme. Although individual master’s students and research supervisors aimed for continuing knowledge processes in school or university, few actually did and only for a limited period of time. The context of this school network and the strategies of their research supervisors seemed to provide too little support in such continuation of knowledge processes.

Discussion

McLaughlin and Black-Hawkins (2004, 2007) noted that in order to establish collaborative partnership structures in which research can be effectively utilised, fundamental changes are needed in the relationships between schools and universities. Literature suggests that in the traditional university-centred structures, an important dimension of such change would be the change from one-way relationships to reciprocal relationships between school and university staff (see the fourth quadrant of Figure 1). This study showed the complexities and challenges that accompany such change on different network levels. Next, we will discuss our four key findings at each network level in relation to the knowledge processes.

Individual level: intentionally creating personal networks

We found that MSEN students and their research supervisors were intentionally seeking opportunities to engage with colleagues from their personal networks within school or university to continue knowledge processes after graduation. This observation seems to be related to outcomes of studies on personal networks, which suggest that people deliberately create and manage their own personal networks to achieve their individual purposes (Nardi, Whittaker, and Schwarz 2002; Baker-Doyle 2012). Evidence of such networks can be found in MS1’s report on intentionally involving colleagues to increase the future buy-in of the knowledge she was developing in her research. Based on this finding, we wonder if research networks of schools and universities that are successful in developing, sharing and using knowledge may benefit from network contexts that provide individual network members with the opportunities to create their own relationships and networks. When the contexts in schools and universities provide such opportunities, we consider that individual purposes and leadership activities of master’s students and their research supervisors may become a driving force of continuous knowledge processes in school–university research networks (Spillane 2006). In the next sections, we will discuss our main findings about the role of the student–supervisor connection and the network context in creating these opportunities to engage in knowledge processes.

Dyad level: brokering student’s research-based knowledge

We found that research supervisors had different strategies in creating opportunities for their students to engage in knowledge processes in the university network context. Results suggest that RS1’s strategy of exploring such opportunities while her student was still developing knowledge in his research was most successful for continuing knowledge processes in the university network. This early exploration of the university network enabled the supervisor to act as a ‘broker’ between school

and university through connecting the needs from her network in the university to the individual purposes, and developed knowledge of her student (cf. Burt 2005; Fielding et al. 2005; Hadfield 2005; Muijs, West, and Ainscow 2010). In this way, she was able to create opportunities for her student to share the developed knowledge in the student's school back to RS1's university context and start using it right after graduation. As such, RS1 played an important role in fostering reciprocal knowledge processes between her student's school and her university.

We wonder if RS1's strategy and her broker role might have applied in a similar way for supporting knowledge processes in her student's own school context. Our results show that only RS2, for a very limited extent and timeframe, was able to engage in such a broker role within his students' school. Other studies suggest that this broker role seems to benefit from a greater embeddedness of supervisors in their students' school network (e.g. Zeichner 2010; Cuenca et al. 2011; Martin, Snow, and Franklin Torrez 2011). When supervisors are able to work closer to the school environment of their students they are better able to take up the described broker role for supporting knowledge processes in school. However, it seems that not only research supervisors, but also the school network context itself should provide these opportunities for sharing and using student's research-based knowledge in school.

Network level: social fabric of school walls

Our findings indicate that MSEN students tried to continue knowledge processes and engage with school colleagues, but they sometimes felt as if they were 'running into the walls' of the school context. The network analysis showed some of the social fabric of which these walls were made. Our outcomes confirm results of other studies that show that network structures with a tendency to centralisation and dispersion inhibit knowledge processes between network members (Reagans and McEvily 2003; Henneberg et al. 2009; Daly and Finnigan 2010a, 2010b). As became evident from the individual and dyad analysis, neither the individual network members nor the pairs of master's students and research supervisors convincingly succeeded in breaking down these 'structural walls'. We suspect that the school's inexperience with supporting teacher research and related knowledge processes could have played a role. We consider that the intended bottom-up change in the school network and knowledge processes needs other strategies and might take more time (see for example Daly 2010), an aspect that goes beyond the scope of our study.

Limitations and implications

This study has some limitations. We used a mixed-method approach in which we focused on participants' perceptions to gain a deeper insight in the knowledge processes at each level. Although this approach provided us with rich data, we acknowledge that participants' perceptions might have been influenced by other factors not accounted for in this study, such as gender, culture and personal characteristics. Moreover, we acknowledge that the small scale of this study limits the generalisability of its outcomes. Follow-up studies could extend the scope of this study on a larger scale. Furthermore, we also recommend to use in future studies the typology that we applied (Figure 2) and to study other types of school-university research networks in master's programmes.

This study has implications for the practice and design of teacher education programmes. It draws attention to the important role of university staff in supporting ongoing, reciprocal knowledge processes in the school–university research network. In this network, university staff not only support master’s students in practice-oriented research – to develop knowledge for their own practice during the master’s programme – but also in further sharing of this knowledge after graduation. This might require another role and competences of the research supervisors, which are more directed to fostering knowledge processes and maintaining productive relationships in master’s students’ schools (Cuenca et al. 2011; Martin, Snow, and Franklin Torrez 2011). Subsequently, it will also imply changes in the design of master’s programmes that will facilitate research supervisors to fulfil such roles and become more embedded in school communities. Ultimately, universities that design their master’s programmes from a ‘school–university research network’ perspective may leverage the partnership potential of the relationships with their students’ schools as well as between their research supervisors and master’s students.

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