Steunpunt beleidsrelevant onderzoek 3de generatie Studie- en Schoolloopbanen

DE TOEPASSING VAN SOCIALE NETWERKMETHODOLOGIE IN ONDERWIJSKUNDIG ONDERZOEK

Een overzicht

C. Meredith, S. Gielen & C. Struyve

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Promotor: Prof. Dr. Sarah Gielen

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Voor meer informatie over deze publicatie chloe.meredith@ppw.kuleuven.be; charlotte.struyve@ppw.kuleuven.be; sarah.gielen@kuleuven-kulak.be

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Voorwoord

Dit intern rapport kadert binnen de derde generatie van het Steunpunt Studie- en Schoolloopbanen (2012-2015). Dit steunpunt omvat verschillende onderzoeksdomeinen, waarvan één betrekking heeft op loopbanen van leerkrachten. Deze onderzoekslijn omvat een contextuele analyse van de Vlaamse lerarenloopbanen.

In dit rapport wordt de toepassing van de sociale netwerkmethodologie in onderwijskundig onderzoek beschreven. Deze methodologie biedt de mogelijkheid om lerarenloopbanen te kaderen in de context van de school, meerbepaald in de sociale structuur van het schoolteam. In dit overzicht wordt geschetst welke onderzoeksobjecten en onderzoeksonderwerpen onderzocht werden, en welke onderzoeksdesigns, instrumenten en analyses hiervoor aangewend werden. Door middel van dit overzicht, trachten we zowel mogelijkheden als beperkingen van de methodologie te identificeren, om zo lessen te trekken voor het eigen onderzoeksproject.

Chloé Meredith
Sarah Gielen
Charlotte Struyve

Inhoud

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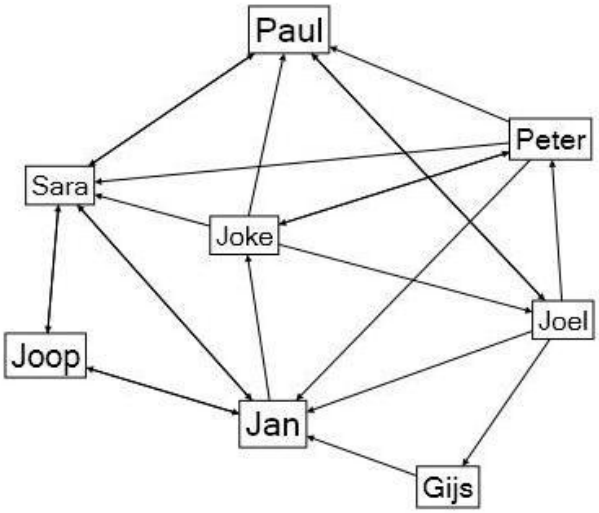
Nederlandstalige beleidssamenvatting

In dit rapport wordt de toepassing van de sociale netwerkmethodologie in onderwijskundig onderzoek beschreven. Deze methodologie biedt de mogelijkheid om lerarenloopbanen te kaderen in de context van de school, meerbepaald in de sociale structuur van het schoolteam. Deze sociale structuur reflecteert de onderlinge relaties tussen schoolteamleden en het sociaal kapitaal dat doorheen dit netwerk stroomt. Voorgaand onderzoek toonde reeds aan dat de sociale dimensie van de school als werkcontext een invloed uitoefent of de jobattitudes van leerkrachten en hun beslissing om al dan niet in het beroep te blijven (Aelterman, Engels, Van Petegem, & Verhaeghe, 2007; Burke, Greenglass, & Schwarzer, 1996; Caprara, Barbaranelli, Borgogni, Petitta, & Rubinacci, 2003; House, 1981; Russell, Altmaier, & Van Velzen, 1987; Skaalvik & Skaalvik, 2011). Desalniettemin werd tot nu toe weinig tot geen gebruik gemaakt van sociometrische data om individuele opvattingen en gedragingen van leerkrachten met betrekking tot hun beroep te kaderen binnen de sociale context van de school. Onderzoekslijn 3.2 wil hieraan tegemoet komen door gebruik te maken van de sociale netwerkmethodologie. Om het belang van deze methodologie voor lerarenonderzoek te duiden en tegelijk de mogelijkheden en beperkingen ervan te ontdekken, wordt in deze review een overzicht geboden van onderwijskundige studies die reeds gebruik maakten van deze benadering. In deze Nederlandstalige beleidssamenvatting wordt eerst ingegaan op de groei van de methodologie. Ten tweede wordt kort de aanpak van deze review toegelicht. Erna wordt een overzicht geboden van netwerkonderzoek bij leerlingen, leraren, schoolleiders en volledige schoolteams. Ten derde wordt ingegaan op hoe de netwerkmethodologie toegepast werd in deze studies. Ten slotte worden enkele tekortkomingen van het huidige onderzoeksveld geïdentificeerd en toekomstige beleidsrelevante onderzoeksperspectieven geformuleerd.

De groei van sociale netwerkmethodologie

In 1934 gebruikte Jacob Moreno voor het eerst sociometrie om de relaties binnen kleine groepen, zoals klasgroepen, te analyseren. Moreno vertrok vanuit de vooronderstelling dat de maatschappij geen optelsom van individuen en hun kenmerken is, maar eerder een verzameling van onderling samenhangende atomen die telkens bestaat uit een individu en zijn of haar sociale, economische en culture relaties (De Nooy, Mrvar, & Batagelj, 2011). Om de sociale structuur in kaart te brengen, ontwikkelde Moreno het sociogram. Het sociogram is een grafische representatie van de relaties tussen personen, zoals geïllustreerd in figuur 1.



Figuur 1. Voorbeeld van een sociogram

Overheen de jaren nam de nood aan meer geavanceerde analyses toe, waardoor de sociale netwerkmethodologie zich meer en meer ontwikkelde en sociale netwerkanalyse de standaardprocedure werd om deze complexe data te onderzoeken (Carrington, Scott, & Wasserman, 2005). De sociale netwerkmethodologie en het overkoepelende sociale netwerkperspectief verschillen dan ook op verschillende vlakken van andere onderzoeksbenaderingen (Wellman & Berkowitz, 1988). Het centrale kenmerk is dat er gefocust wordt op de relaties tussen sociale entiteiten en de patronen en gevolgen van deze relaties (Wasserman & Faust, 1994). Terwijl andere onderzoeksbenaderingen zich concentreren op individuele percepties, attitudes en opvattingen, kijkt het sociale netwerkperspectief ook naar de interacties tussen actoren. Een actor kan in dit geval zowel een persoon, organisatie of zelfs land zijn die betrokken is bij een sociale relatie (De Nooy et al., 2011). Op basis van Wasserman en Faust (1994, p.7) kunnen vier basisassumpties geformuleerd worden die betrekking hebben op zowel de actors, relaties en sociale structuur. Een eerste assumptie is dat actors en hun acties gezien worden als interdependent in plaats van onafhankelijke, afzonderlijke units. Ten tweede ziet deze benadering de sociale structuur als een patroon van relaties tussen actoren. Een derde assumptie is dat de relaties tussen individuen gezien worden als kanalen om zowel materiële als immateriële middelen door te geven. Ten slotte wordt de structurele omgeving gezien als een context waarbij zowel kansen als belemmeringen gecreëerd worden voor de individuele actor. Op basis van de derde en vierde assumptie wordt in sociale netwerkstudies dan ook vaak verwezen naar de sociaal kapitaal theorie van Bourdieu (Halpern, 2005; Moolenaar, 2012), waarin aangegeven wordt dat de sociale structuur die een individu omringd middelen voorziet en het mogelijk maakt om zowel individuele als organisatorische doelen te bereiken en daarom kan gezien worden als een vorm van kapitaal (Nahapiet & Ghoshal, 1998).

Overheen de jaren werd de sociale netwerkmethodologie toegepast in verschillende onderzoeksdomeinen, zoals sociologie, sociale psychologie, epidemiologie, sociale en politieke wetenschappen en economie. Het hoeft daarom geen verrassing te zijn dat ook in onderwijskundig onderzoek de interesse in de methodologie toegenomen is. Moolenaar, Sleegers, Karsten en Daly (2012) gaven recent aan dat het aantal publicaties in onderwijs met

'sociale netwerk' in de titel of het abstract exponentieel toegenomen is. Gezien deze studies verspreid zijn over een heel aantal tijdschriften, wordt in deze review een overzicht geboden van de toepassing van de sociale netwerkmethodologie in onderwijskundige studies. Vermits de methodologie toegepast werd in inhoudelijk sterk uiteenlopende onderzoeken, heeft deze review niet als bedoeling om deze inhoudelijke conclusies samen te vatten. Het doel van deze review is enerzijds een overzicht bieden van wie en wat reeds onderzocht werd met behulp van deze methodologie en anderzijds nagaan op welke manier voorgaand onderzoek de sociale netwerkmethodologie toegepast heeft. Hierdoor hopen we zowel mogelijkheden als limitaties voor het eigen onderzoeksproject te identificeren.

Aanpak

Om studies te vinden die gebruik gemaakt hebben van de sociale netwerkmethodologie werden verschillende databases (ERIC, Web of Science, etc.) geraadpleegd. Er werden verschillende zoektermen, die gerelateerd kunnen worden aan het gebruik van deze benadering in onderwijskundig onderzoek, ingegeven zoals 'social network analysis in schools', 'network approach in education', 'network analysis and students'. Daarnaast maakten we gebruik van de sneeuwbalmethode, waarbij de gevonden artikels telkens gescand werden op bruikbare referenties om zo extra artikels te identificeren. Deze methode werd voortgezet tot er geen nieuwe artikels meer gevonden werden en saturatie bereikt werd. Om verder opgenomen te worden in het reviewproces, dienden de artikels aan drie criteria te voldoen. Een eerste criterium was vanzelfsprekend het gebruik van de sociale netwerkmethodologie, wat betekent dat sociometrische data en sociale netwerkanalyse tot op zekere hoogte gebruikt werden. Een tweede voorwaarde was het feit dat het om empirisch onderzoek diende te gaan, wat betekent dat theoretische beschouwingen niet verder meegenomen werden. Een derde criterium was dat de studie onderwijskundige onderzoeksvragen diende te beantwoorden en dat de getrokken conclusies relevant zijn en inzicht bieden in belangrijke onderwijskundige processen. In totaal werden 64 artikels meegenomen in het reviewproces. Tijdens dit proces werd ieder artikel verticaal geanalyseerd op verschillende kenmerken gerelateerd aan de inhoud en de toegepaste methodologie (zie bijlage 1 voor een voorbeeld van de informatiefiche die voor ieder artikel vervolledigd werd). Nadat alle artikels verticaal geanalyseerd werden, werd een horizontaal overzicht gecreëerd van alle studies waarin de auteur(s) en jaartal, de onderzoeksobjecten, het onderzoeksonderwerp, het onderzoeksdesign, de gebruikte instrumenten en de netwerkmaten en analyses vermeld worden. Dit overzicht kan teruggevonden in bijlage 2. In wat volgt wordt deze uitgebreide horizontaal analyse gereduceerd naar een kort, exemplarisch overzicht.

Overzicht van de studies

Onderzoeksobjecten en onderwerpen

Onderzoek naar belangrijke onderwijskundige processen blijkt zich op verschillende actoren in het onderwijs te richten, namelijk op studenten, leerkrachten, schoolleiders, scholen en zelfs scholengemeenschappen. In dit onderdeel wordt eerst ingegaan op de studies die focussen op leerlingen en studenten, om erna over te gaan naar onderzoek over leraren en schoolteams.

Een heel aantal studies hebben de sociale structuur in klassen en 'peer groups' onderzocht. Zowel sociale netwerken in de kleuter-, lagere en secundaire school, als de sociale structuur in het hoger onderwijs werden reeds geanalyseerd. Het overgrote deel van deze studies heeft zich dan ook gefocust op de relatie tussen netwerkkenmerken en de academische prestaties van leerlingen en studenten. Zo werd de relatie tussen de positie van een leerling of student in het klasnetwerk met zijn of haar prestaties reeds uitvoerig onderzocht (bijvoorbeeld door Blansky, Kavanaugh, Boothroyd, Benson, Gallagher & Endress, 2013; Calvó-Armengol, Patacchini, & Zenou, 2009; Ramirez Ortiz, Caballero Hoyos, & Ramirez Lopez, 2004; Yang & Tang, 2003). Ook kenmerken van het volledige klasnetwerk, zoals de densiteit (samenhang) werden reeds meegenomen ter verklaring van academische prestaties (Maroulis & Gomez, 2008). Een deel van deze studies heeft zich specifiek gefocust op de invloed van het vriendschapsnetwerk op academische prestaties (bijvoorbeeld Baldwin, Bedell & Johnson, 1997; Schwartz, Gorman, Nakamoto & McKay, 2006). Zo werd onderzocht of het hebben van (meerdere) vrienden gerelateerd kon worden aan hogere prestaties. Daarnaast werd tevens onderzocht of het hebben van een (uitgebreide) vriendenkring niet enkel van belang blijkt te zijn voor de prestaties van leerlingen en studenten, maar of ook de tevredenheid van leerlingen, hun motivatie om naar school te gaan en aanpassing aan de schoolcontext worden beïnvloed (Burk & Laursen, 2005; Ladd, 1990; Ladd, Kochenderfer & Coleman, 1997; Ladd & Price, 1987). Het hebben van weinig vrienden en tot zelfs volledig geïsoleerd zijn werden op hun beurt gelinkt aan lagere academische prestaties, een lagere betrokkenheid en hogere drop-out (Defour & Hirsch, 1990, Farmer, Estell, Leung, Troll, Bishop & Cairns, 2003; Ream & Rumberger, 2008; Thomas, 2002).

Naast studies die zich gefocust hebben op de gevolgen van de sociale structuur, werd in ander onderzoek gezocht naar de antecedenten van leerlingenrelaties met behulp van sociale selectiemodellen. Deze sociale selectiemodellen gingen bijvoorbeeld na of het geslacht, leeftijd en etnische afkomst (Farmer& Farmer, 1996) van een leerling een invloed hebben op het hebben van relaties. Ook meer specifieke kenmerken van leerlingen werden onderzocht. Zo werd nagegaan of het hebben van leerstoornissen en autisme een invloed heeft op de sociale integratie van leerlingen (bijvoorbeeld Chamberlain, Kasari, Rotherham, Fuller, 2007; Estell, Jones, Pearl & van Acker, 2009). Naast deze individuele kenmerken, werden ook dyadische kenmerken meegenomen in deze sociale selectiemodellen, zoals het hebben van hetzelfde geslacht, het afkomstig zijn uit dezelfde basisschool, etc. (Lubbers, 2003). Naast het onderzoek naar dyades, werd ook voor groepen van leeftijdsgenoten (peer groups) nagegaan of zij homogeen zijn op het vlak van betrokkenheid, motivatie, opvattingen over leren en of deze homogeniteit toeneemt over tijd door sociale invloed (bijvoorbeeld Altermatt & Pomerantz, 2003; Berndt & Keefe, 1995; Jones, Alexander & Estell, 2010; Kindermann, 2007; Kindermann & Gest, 2009). Samenvattend kunnen we stellen dat de sociale netwerkmethodologie reeds in een uitgebreid aantal onderwijskundige studies gebruikt werd om het sociale netwerk van leerlingen en studenten in kaart te brengen. Zowel de antecedenten van deze netwerken als de gevolgen ervan voor leerlingenprestaties, opvattingen over leren en school, en gedragingen werden reeds onderzocht.

Naast leerlingen en studenten, werden ook de sociale netwerken van schoolteamleden reeds onder de loep genomen. Ook hier werden een uitgebreid aantal onderzoeksonderwerpen onderzocht, grotendeels op het niveau van het kleuteronderwijs en de lagere school (bijvoorbeeld Bakkenes, Brabander & Imants, 1999; Moolenaar, 2012), maar ook beperkt bij schoolteams in de secundaire school (bijvoorbeeld de Lima, 2003; Hawe & Ghali, 2008; Kuo, Yang,

Yu, Yang & Sue, 2010) en in het hoger onderwijs (bijvoorbeeld Cornelissen, van Swet, Beijaard, & Bergen,2011). Een paar studies integreerden verschillende onderwijsniveaus zoals het onderzoek van Frank, Zhao en Borman (2004) en Supovitz, Sirides en May (2010). Maar niet enkel binnen scholen werd de sociale structuur in kaart gebracht, ook tussen en over scholen heen werden de sociale netwerken onderzocht, door bijvoorbeeld te focussen op de scholengemeenschap, professionele ontwikkelingsnetwerken, etc. (bijvoorbeeld Daly & Finnigan, 2010; Mullen & Kochan, 2000). Een belangrijke opmerking die Moolenaar, Sleegers, Karsten en Daly (2012) maakten bij het onderzoek naar netwerken binnen en overheen scholen, is het feit dat er een onderscheid gemaakt moet worden tussen instrumentele (werkgerelateerde) en expressieve (niet-werkgerelateerde) sociale netwerken. De meerderheid van de studies focust op de instrumentele netwerken, gezien deze vaak meer verwant zijn met de onderwijskundige processen, zoals professionele ontwikkeling en implementatie van verandering in de klaspraktijk, die onderzocht worden. Net zoals het onderzoek bij leerlingen en studenten, kan er een onderscheid gemaakt worden in studies die focussen op de antecedenten en studies die zich toespitsen op gevolgen van de sociale structuur.

Bij het onderzoek naar de formatie van sociale relaties, werden niet enkel individuele kenmerken, zoals ervaring, geslacht, etc. van schoolteamleden onderzocht, vaak werden ook professionele kenmerken, zoals het hebben van een leiderschapspositie en in meerdere graden lesgeven, meegenomen in de analyses (Penuel, Riel, Joshi, Pearlman, Kim en Frank, 2010; Spillane & Frank, 2012). Daarnaast werden ook dyadische effecten onderzocht, zoals het deel uitmaken van dezelfde leeftijdscategorie, lesgeven in dezelfde graad, samen pauzes nemen en lesgeven op dezelfde gang (bijvoorbeeld Reagans, 2011), waarbij telkens een 'homofilie effect', met andere woorden een vergrote kans op het hebben van een relatie wanneer twee actoren hetzelfde kenmerk delen, gevonden werd. Ten slotte werd in verschillende studies ook rekening gehouden met het feit dat de sociale structuur in iedere school op een andere manier vorm krijgt door bepaalde schoolkenmerken, zoals schoolteamgrootte, het beleid van de school, de aangeboden onderwijsvormen, etc. Deze schoolkenmerken werden dan, samen met individuele en dyadische kenmerken, meegenomen in zogenaamde multiniveau sociale selectiemodellen (Coburn & Russel, 2008; Dorner, Spillane, Pustejovsky, 2011; Kärkkaïnen, 1999 & 2000).

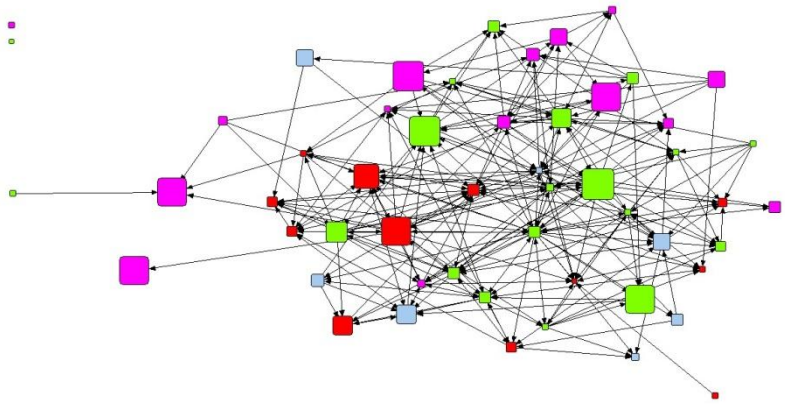
Ten tweede werd ook gekeken naar een heel aantal gevolgen van de sociale structuur van het schoolteam. Zo zou de positie van een schoolteamlid en de daarbij horende netwerkcontacten een invloed hebben op de professionele ontwikkeling (Penuel, Sun, Frank & Gallagher, 2012), de opvattingen over het optimaliseren van schoolprocessen (de Lima, 2007) en de implementatie van veranderingen (Frank, Zhao, Ellefson & Porter, 2011; Penuel, Frank & Krause, 2006). Ook de positie van de schooldirecteur werd reeds uitgelicht met behulp van sociale netwerkmethodologie en gerelateerd aan het belang ervan voor het innovatief klimaat van de school (Moolenaar, Daly & Sleegers, 2012) en leerlinguitkomsten (Friedkin & Slater, 1994; Leana & Pill, 2009; Moolenaar, Sleegers & Daly, 2012; Supovitz, Sirindes & May, 2010). Ook hier kan geconcludeerd worden dat een veelheid aan onderwerpen reeds verkend werden met behulp van sociale netwerkmethodologie. In wat volgt, wordt kort geschetst hoe de methodologie concreet toegepast werd in deze studies.

Toepassing van de methodologie

Op basis van deze review, kan vastgesteld worden dat de netwerkmethodologie reeds voor een uitgebreid aantal onderzoeksonderwerpen ingezet werd, wat geresulteerd heeft in een variëteit aan toepassingen. Hoewel een groot aantal studies cross-sectioneel van aard zijn, is er de laatste

jaren een toenemende aandacht voor een longitudinaal onderzoeksdesign waarbij de sociale structuur op een meer dynamische manier gevat wordt (bijvoorbeeld Altermatt & Pomerantz, 2005; Anderson, 2010; Spillane, 2005). Ook het aantal onderzoeksobjecten varieert sterk: van single case studies waarbij gefocust wordt op één actor tot grootschalig onderzoek waarbij meer dan 50 scholen betrokken zijn. Bij elk van deze studies is het verzamelen van betrouwbare sociometrische data een cruciale stap. Een groot deel van de onderwijskundige netwerkstudies maken gebruik van een survey die sociometrische vragen bevat. Gezien iedere studie geïnteresseerd is in een specifiek type netwerk, worden er vaak aangepaste sociometrische vragen ontwikkeld. Daarenboven zijn er verschillende antwoordformats voor deze vragen mogelijk. Vaak wordt gevraagd aan respondenten om in een namenrooster aan te duiden met wie ze een bepaalde relatie hebben (bijvoorbeeld Moolenaar et al., 2012; Wentzel, Barry & Caldwell, 2004). In een beperkt aantal onderzoeken wordt ook gebruik gemaakt van open vragen waarbij respondenten zelf de namen van hun sociale relaties dienen in te vullen, bijvoorbeeld in studies die gebruik maken van 'social cognitive maps' (SCM) (Farmer et al., 2003). Deze format werd tot nu toe enkel bij leerlingennetwerken gebruikt om 'peer groups' in het sociale netwerk van de klas in kaart te brengen (bijvoorbeeld Cairns, Cairns, Neckerman, Gest & Garépy, 1988; Farmer & Cairns, 1991; Kindermann, 1993) maar werd pas later door Cairns, Leung, Buchanan & Cairns (1995) expliciet benoemd als een vorm van sociale netwerkanalyse. Een groot deel van de studies die gebruik maken van vragenlijsten, analyseren deze gegevens dan ook op een kwantitatieve manier, hoewel recent de aandacht toegenomen is voor kwalitatief en mixed-method netwerkonderzoek (bijvoorbeeld Coburn & Russel, 2008; Daly, Moolenaar, Bolivar & Burke, 2010; Frank, Zhao, Ellefson & Porter, 2011). Het blijkt dus dat er nog heel wat keuzes te maken zijn over het specifieke design van een studie die gebruik wenst te maken van sociale netwerkanalyse.

Een laatste vaststelling van de reviewstudie is dat er na de verzameling van de sociometrische data nog een waaier aan analysetechnieken toegepast worden in het reeds voorhanden zijnde onderwijskundig onderzoek. Zo worden er sociale netwerktekeningen getekend die vervolgens vergeleken en/of geïnterpreteerd worden. In de netwerktekeningen worden ook keuzes gemaakt om naast de relaties ook bepaalde individuele kenmerken (zoals bv. de functie van een schoolteamlid, aantal jaren ervaring, etc.) of kenmerken van de relaties (zoals bv. intensiteit) nominaal of ordinaal weer te geven (zie figuur 2 ter illustratie).



Figuur 2. Voorbeeld van een sociale netwerktekening. De kleur van de node verwijst naar de functie van het schoolteamlid, terwijl de grootte van de node het aantal jaren ervaring in het onderwijs van het individu weergeeft.

Naast de netwerktekeningen worden er ook sociale netwerkmaten berekend. Deze maten worden enerzijds op het niveau van de 'node' (in dit geval de leerling, leerkracht, etc.) berekend, zoals de 'in- en outdegree' centraliteit, 'closeness' centraliteit, en 'betweenness' centraliteit (zie tabel 1 voor een uitgebreidere toelichting). Anderzijds worden op niveau van het volledige netwerk de netwerkmaten densiteit en centralisatie het frequentst gebruikt. Een beperkt aantal studies maakt gebruik van andere netwerkmaten, die op basis van de specifieke onderzoeksvragen ontwikkeld werden. Deze netwerkmaten werden bij het overgrote deel van de studies berekend aan de hand van de netwerksoftware UCINET (Borgatti, Everett & Freeman, 2002). Om de relatie tussen de sociale structuur en de gevolgen ervan in kaart te brengen, werden deze netwerkmaten meegenomen in meer geavanceerde statische modellen zoals regressiemodellen en structurele vergelijkingsmodellen. Echter, wanneer onderzoek de sociale structuur als afhankelijke variabele meenam, bijvoorbeeld in studies die gebruik maken van sociale selectiemodellen, werden lineaire regressieanalyses gebruikt die rekening houden met de interdependentie van de sociometrische data (Zijlstra, van Duijn & Snijders, 2006). Voorbeelden hiervan zijn P2 modellen en P* of 'exponential random graph models' (ERGM) (bijvoorbeeld Lubbers, 2003; Frank et al., 2004). Deze modellen werden echter tot nu toe slechts in een beperkt aantal studies binnen het onderwijskundige domein gebruikt.

Beleidsrelevant onderzoek?

Op basis van dit overzicht kan geconcludeerd worden dat de sociale netwerkmethodologie een veelzijdige onderzoeksbenadering is die voor een uitgebreid aantal onderwijskundige onderzoeksvragen kan ingezet worden. De benadering maakt het mogelijk om het relationele niveau van actoren in kaart te brengen, wat tot nu toe vaak over het hoofd gezien werd in onderwijskundig onderzoek. Hierdoor wordt de mogelijkheid gecreëerd om opvattingen en gedragingen van actoren binnen het onderwijsveld te kaderen binnen de sociale structuur. Gezien deze sociale structuur een modificeerbaar aspect is van de klas, school en het bredere systeem, kan de sociale netwerkmethodologie beleidsrelevante conclusies genereren die individuele leerlingen, schoolteamleden, scholen en zelfs het volledige onderwijssysteem ten goede kunnen komen. Binnen onderzoekslijn 3.2 worden alvast de eerste stappen gezet naar beleidsrelevant onderzoek door de jobattitudes en loopbaanbeslissingen van leraren contextueel te kaderen binnen de sociale netwerken van het schoolteam. Door de onderliggende mechanismes van de sociale structuur bloot te leggen, willen we concrete en werkbare suggesties voor zowel beleid, scholen als individuele onderwijsactoren formuleren die zowel de jobattitudes als professionele beslissingen van leraren kunnen beïnvloeden.

Introduction

In 1934, Jacob Moreno introduced sociometry, the predecessor of social network analysis, to study interpersonal relationships of small groups. The main assumption of sociometry is that society is not the aggregate of individuals and their characteristics, but rather interrelated groups of social atoms, who each consist of an individual and his or her social, economic and cultural ties (De Nooy, Mrvar, & Batagelj, 2011). Nevertheless, not society at large is the study object of sociometrists but rather the structure of small groups. The sociogram is their most important instrument originated and used to visualize the structure of ties within a group. Sociograms have proved to be important analytical tools that help to reveal structural features of social groups, however, more statistically advanced methods were needed to analyze these complex sociometric data (Carrington, Scott, & Wasserman, 2005). Over the years, social network analysis further developed and became the standard procedure to analyze these complex data. The contemporary social network perspective is characterized by several features and basic assumptions that distinguishes it from other research perspectives (Wellman & Berkowitz, 1988). The most distinguished feature of this perspective is that it focuses on relationships between social entities and on the patterns and implications of these relationships (Wasserman & Faust, 1994). Instead of analyzing individual behaviors, attitudes and beliefs, it focuses its attention on social entities or actors in interaction with one another and on how these interactions constitute a framework or structure that can be studies and analyzed in its own right (Galaskiewicz & Wasserman, 1993). An 'actor' in this context can be a person, organization or nation that is involved in a social relation (De Nooy et al., 2011). According to Wasserman and Faust (1994, p.7) four assumptions concerning actors, relations and their resulting structure can be formulated. A first assumption is that actors and their actions are viewed as interdependent rather than independent, autonomous units. Second, the network perspective conceptualizes the social structure as enduring patterns of relations among actors. A third assumption is that linkages between individuals are channels for transfer or flow of resources, both material and nonmaterial. Finally, the structural environment of the network is seen as a provider of opportunities for or constraints on individual action. Based on the latter two, social capital theory has often been used as a theoretical lens to analyze social structure (Moolenaar, 2012). This theory states that the social structure surrounding an individual provides resources that make it possible to achieve individual and organizational goals and is therefore a form of capital (Nahapiet & Ghoshal, 1998).

Over the years social network approach and related methodology has been used in several disciplines (Knoke & Yang, 2008). It has been extensively applied by sociologists since the 1970s, 1980s and 1990s to help researchers understand human behavior and social institutions (Galaskiewicz & Wasserman, 1993; Borgatti, Mehra, Brass, & Labianca, 2009). Since then, social network methodology was used in different research domains, such as the social psychology that focuses on feelings and affections (Cohen & Wills, 1985; Marsden & Friedkin, 1993), in epidemiology the method has been increasingly used to track the spread of diseases (Klovdahl et al., 1994; Morris, 1993; Sterling et al., 2000), social and political scientists have used it to study

power relations among people, organizations and even nations (Brass, Galaskiewicz, Greve, & Tsai, 2004), while economists have investigated trade and organization ties among firms (Granovetter, 1992; Smith & White, 1992). It is not surprising that this research method also found its entrance in educational sciences. Moolenaar, Sleegers, Karsten and Daly (2012) indicated that the number of peer-reviewed publications with social network and education in the title, abstract and or keywords has proliferated. However, the spread of these articles over different research journal makes it difficult to capture how this methodology has been applied in educational research. In this paper we therefore want to create clarity by reviewing the conducted studies in a systematic way and by focusing on the methodology used. As the research questions solved by the social network methodology address a wide range of research topics and subjects, it is not our intention to provide an extensive overview of the results and conclusions of these studies, however, exemplary conclusions will be used to illustrate the possibilities of the methodology.

1. Method of the review

1.1 Procedure

To find educational studies using social network analysis, a broad range of relevant databases (ERIC, Web of Science, etc.) were searched for publications containing several terms related to social network analysis in education (i.e. social network analysis in schools, social network approach in education, etc.). A second method was the snowball-method: we collected articles that were cited in our retrieved articles and reviewed the reference sections in an attempt to identify additional articles concerning this subject.

1.1.1 Inclusion criteria

To define whether an article could be included in our review, it had to match with the three inclusion criteria. A first criterion is the use of a social network methodology, meaning that social network data and social network analysis were to some extent used. Studies that focused on relationships, but only used attribute data, were excluded from the review. Also, studies describing the use of social network analysis in schools, for instance as an evaluation method (Penuel, Sussex, Korbak, & Hoadley, 2006), but not using it as a research methodology, were excluded. A second criterion is that it has to be empirical research published in a research journal, which implicates that theoretical considerations were lift out (Bidwell, 2001; de Lima, 2001; Penuel & Riel, 2007). The third criterion concerns the fact that the article had to make conclusions relevant to education and its' actors and contributing to the insight in important educational processes. For example, several studies on obesity (Valente, Fujimoto, Chou, & Spruijt-Metz, 2009), self-esteem (Hirsch & Rapkin, 1987) and smoking (Ennett et al., 2006) were conducted in the classroom setting, but were not included in this review as they do not address educational topics. Also articles on the job search of teachers and how their social capital helps this process were lift out (Cannata, 2011; Maier & Youngs, 2009), as these studies do not address educational processes within the school. In total we found 64 empirical articles using the social network approach to investigate educational processes in the school system. To systematically review them, we set up a coding system to capture the information embedded in these studies.

1.1.2 Coding the articles

First, each article was vertically analyzed on different characteristics concerning both the content of the study and the methodology used. To do this, a coding system was developed to extract the information needed for the review. For each study the authors, year, journal and impact factor, central research question(s), research design, respondents, instruments, used network measures, analyses, and results were filled out on the information sheet of each article. A version of this information sheet can be found in Appendix 1. We used this coded information to create a horizontal overview of all the studies. The characteristics were narrowed to on the one hand

general study characteristics, including name and year, research topic and subjects, educational level, and on the other hand method specific information, such as the research subjects, the research topic, the research design, instruments, the calculated network measure(s) and the analyses conducted. This horizontal overview can be found in Appendix 2.

2. Overview of the studies

2.1 Research topics and subjects

In this section, we review the research topics addressed in educational research using social network methodology. The research object(s) vary from 1 pupil, teacher or school to over 8000 pupils, 500 teachers and 60 schools. The main idea of using a social network approach is to capture (a part of) the social structure and to distinguish different networks both within and across the organization of the school (Daly, 2010). It is possible to discern networks within schools, such as student networks, teacher networks, leadership networks, but also across schools, such as school networks, professional development networks and networks within a school district.

Students and peer-groups

Since the central element in education are students, a great amount of social network studies focused on student networks. We found articles addressing the social networks and positions of students in both kindergarten (Ladd, 1990), elementary school (Jones, Alexander, & Estell, 2010), secondary school (Farmer et al., 2011; Stanton-Salazar & Dornbusch, 1995), and higher education (Baerveldt, Zijlstra, De Wolf, Van Rossem, & van Duijn, 2007; Cornelissen, van Swet, Beijaard, & Bergen, 2011).

2.1.1.1 Consequences of the social structure

A majority of these studies investigated the relation between characteristics of students' network and their educational achievements. For instance, several studies examined the relationship between several centrality measures of students in the class network and academic performance (Blansky, Kavanaugh, Boothroyd, Benson, Gallagher, & Endress 2013; Calvó-Armengol, Patacchini & Zenou, 2009; Ramírez Ortiz, Cabalerro Hoyos & Ramírez Lopez, 2004). Research of Yang & Tang (2003) indicated that the position in the advising network of the class mattered for student performance. The study of Maroulis and Gomez (2008) investigated whether the combination of network composition and network structure has a significant effect on student achievement, indicating that the effect of students' composition based on achievement is dependent on the overall density of the social structure. Wentzel and Caldwell (1997) found that belonging to a peer group is even a better predictor for grades than general peer acceptance, levels of antisocial behavior, and emotional well-being. Several of the studies on student achievement focused specifically on the influence of friendship relations (Schwartz, Gorman, Nakamoto & McKay, 2006; Tomada, de Domini, Greenman & Fonzi, 2005). For instance, Baldwin, Bedell and Johnson (1997) found that the friendship networks of first year MBA students not only had an influence on their grades, but also on their overall performance and student satisfaction, while other studies found an influence of friendship relations on school adjustment (Ladd & Price, 1987). The research of Ladd (1990) proved that children with a large number of classroom friends have more favorable school perceptions in kindergarten, while early peer rejection leads to less favorable school perceptions, higher levels of school avoidance and lower performance levels. According to this

study, making new friends even resulted in gains in school performance. The study of Ladd, Kochenderfer and Coleman (1997) in turn proved that friendship with high conflict leads to school disengagement, while Burk and Laursen (2005) found that high conflict in friendship relations lead to lower grades. When it comes to the social networks of students, the concept of social integration has often been used to investigate several outcomes such as achievement, well-being and dropout. In a study of Defour and Hirsch (1990) the social integration of black students and how this affected their performance, well-being and dropout at school was investigated. Also Thomas (2002) investigated social integration in relation with student persistence and found that various network characteristics had a differential effect on persistence through satisfaction, performance, commitment and intention. The research of Farmer, Estell, Lueng, Troll, Bishop and Cairns (2003) found that aggressive, isolated students more often leave school than aggressive, non-isolated students. Finally, Ream and Rumberger (2008) proved that school-oriented friendship networks among Latino students have the potential to reduce student dropout.

2.1.1.2 Antecedents of the social structure

A second group of studies focused on the antecedents of student networks in classrooms, so called social selection models. For example, Farmer and Farmer (1996) found that the characteristics of more central students differ between gender. Girls who are engaged into schoolwork and cooperative are more central, while with boys more antisocial behavior leads to a more central position. Also, specific characteristics of student were investigated. For instance, students with disabilities are more likely to be identified as peripheral and even isolated (Farmer et al., 2011), whereas Estell, Jones, Pearl and Acker (2009) found students with learning disabilities have an equal amount of reciprocated friendship relations but tend to keep less of these relations over time. Chamberlain, Kasari, Rotheram and Fuller (2007) found that children with autism experienced lower centrality, acceptance, companionship and reciprocity in elementary school. Next to individual characteristics, also dyadic features can be included in social selection models. Researchers are then often interested in so called homophily effect. Homophily can be described as the tendency for persons with similar attributes to connect with each other in the social network (Lazarsfeld & Merton, 1954). For example, Lubbers (2003) investigated whether dyadic attributes such as similarity in gender and coming from the same elementary school influenced the formation of linking and co-operation ties in secondary school. Often, researchers are not only interested in the homophily effect but also investigate contagion and social influence with socialization models. For instance, Kindermann (2007; Kindermann & Gest, 2009) investigated whether peer groups are homogeneous in engagement and if this predicted motivation over time. Altermatt and Pomerantz (2003; 2005) proved that peer membership often results in homophily concerning meeting academic standards, Jones, Alexander and Estell (2010) found evidence for a homophily effect of self-regulated learning and Berndt and Keefe (1995) proved that there is a peer influence effect for school adjustment. Finally, Kiuri, Aumola, Nurmi, Leskinen and Salmelo-Aro (2008) focused on burnout and found evidence for peer group influence, but not for peer group selection effect.

2.1.2 Teachers and school teams

A second major group of research units are teachers and schools. A wide variety of research subjects and topics have been addressed, both in kindergarten and primary school (Bakkenes, De Brabander, & Imants, 1999; Moolenaar, 2012) and secondary school (Anderson, 2010; de Lima, 2003; Hawe & Ghali, 2008; Kuo, Yang, Yu, Yang, & Sue, 2010). But not only within schools, the social networks have been analyzed: studies also focused on the networks across schools (Mullen & Kochan, 2000), on the level of professional development networks (de Lima, 2007; Baker Doyle & Yoon, 2010; Penuel, Sun, Kenneth, & Gallagher, 2012), school-university partnerships in teacher training (Cornelissen et al., 2011), and on in-service advancement education networks (Kuo et al., 2010). Finally, studies on district level and departmental structures also have been conducted (de Lima, 2003). For instance, Daly and Finnigan (2010; 2011) took a school district as research unit to investigate the implementation of change and reform by tracking leadership networks within the district. However, most of these studies were conducted in primary education. A couple of studies combined educational levels, examples are the research of Frank, Zhao and Borman (2004) who included kindergarten, elementary and secondary schools in their research on implementation of innovation, and the study of Supovitz, Sirides and May (2010) that included both elementary and high schools on their research on principal leadership. As in studies addressing student networks, both the antecedents and consequences of teachers' and schools' social networks have been addressed.

2.1.2.1 Antecendents of the social structure

For instance, Moolenaar, Sleegers, Karsten and Daly (2012) were interested in the social organization of schools and the nature of these social networks. They investigated seven types of social networks (discussing work, collaboration, asking advice, spending breaks, personal guidance, contact outside work and friendship) in elementary schools, with the conclusion that a distinction can be made between instrumental and expressive network. Also, the dimension of mutual in(ter)dependence can be used to explain differences in social interaction among teachers. Other research tried to hunt down which features of both teachers and schools have influence on the formation of different kinds of networks by using social selection models. For instance, Spillane, Kim and Frank (2012) examined the role of individual characteristics and formal organization structure in the formation of advice and information ties in two core elementary school subjects. Results proved that not only individual characteristics such as race and gender are significantly related with the formation of a tie. Aspects of the formal school organization, such as grade-level assignment, having a formally designated leadership position and teaching a single grade, have been found to have larger estimated effects than individual characteristics. The research of Frank and Zhao (2004) earlier proved that talk about curricular subjects, e.g. talk about technology, was concentrated within the formal organization of the school, such as grades, rather than informal subgroups. Also Penuel, Riel, Joshi, Pearlman, Kim and Frank (2010) tried to track the relative influence of formal and informal processes on patterns of advice giving in each school. Reagans (2011) found a homophily effect for several features: teachers who were more similar in age, who took breaks together, and who had classrooms on the same floor would more frequently communicate, feel emotionally attached and therefor have stronger ties. Finally, also school features and policies have been investigated, in so called multilevel selection models.

Kärkkaïnen (1999; 2000) investigated elementary school teams to hunt down under what preconditions a teacher team will make network contacts and under what preconditions the teamwork of the teachers will break the traditional work patterns of teachers as individual planners and implementers of the lessons. The social selection models they used made it clear that in each school there was a distinct pattern of advice giving. A study of Dorner, Spillane and Pustejovsky (2011) compared the structure of relationships across 11 schools within the same institutional environment and exposed to similar policies. The study examined their approaches to reform, focusing on the patterns and discontinuities across three organizational types of schools in the US: public, charter and catholic schools. The research concluded that organizing differed across public and choice schools: public schools were rather formal and professional in the organization of relationships, while choice schools were more organic and familial. But next to these patterns by school type, schools also had a lot in common: all schools reflected ties between external, institutional goals and the technical core of teaching. Coburn and Russell (2008) looked at the impact of district policies on teachers' professional relations in schools. They concluded that policy has an influence on which teachers seek out for discussion.

2.1.2.2 Consequences of the social structure

Second, also the influence of the social structure on several school processes has been investigated. In a research of Penuel, Sun, Frank and Gallagher (2012) the results indicated that both organizational development and interactions with colleagues who gained instructional expertise from participating in prior professional development were associated with the extent to which teachers changed their writing processes instruction. De Lima (2007) analyzed the social networks of two departments in the same school and the teachers within those departments were compared in perceptions on the school's needs for improvement and how the institution and department impacted upon their professional development. Results proved that the two organizational subunits differed radically in their interpersonal relationships, their experiences of professional development and in their perceptions on school improvement. The social structure of a school or subunit does not only seem to have an influence on the perceptions on school improvement, it also has an influence on processes involving school improvement, such as the implementation of innovation, reform or change. Frank, Zhao and Borman (2004) tried to unravel the processes for implementing new practices. By using social capital as theoretical framework, they found that informal access to expertise, which is considered as a manifestation of social capital, were central in the implementation of innovation. This was confirmed in the longitudinal research of Frank, Zhao, Penuel, Ellefson and Porter (2011) where it was concluded that the more an individual accessed the knowledge of others, the higher the level of implementation was. Penuel, Frank and Krause (2006) suggested that interactions with colleagues function as continually changing resources that help individuals interpret and apply the demands of initiatives for their own practice. Teachers who received help from their colleagues who already had been implementing the innovation, were significantly more willing to change their practice. Pitts and Spillane (2009) indicated that social network methodology is increasingly used in the study of policy implementation and school leadership. A research of Moolenaar, Daly and Sleegers (2011) analyzed the relationship between principals' positions in their schools' social networks in combination with transformational leadership and schools' innovative climate. In this study, the centrality of the principal was related to the schools' innovative climate as well as

transformational leadership. Teachers were more willing to invest in change and the creation of knowledge and practices if the principal was more closely connected to them and if he or she was more sought out for professional and personal advice.
Next to the importance for the implementation of change and reform, Supovitz, Sirinides and May (2010) pointed to the importance of a principals position for student learning since they have an indirect influence on teachers' practices through fostering collaboration and communication around instruction. The study of Friedkin and Slater (1994) also focused on the social-structural position of the principal, but focused on the performance, in the form of student results, of the school. When it comes to performance, also the social-structural position has been subject of research. For example, the study of Leana and Pil (2009) found that tie strength and density moderate the relationship between teacher ability and student performance. Moolenaar, Sleegers and Daly (2012) investigated the relationship between the collaboration networks and student achievement, and found a moderating role of collective efficacy.

Nevertheless empirical research on social networks in schools is rather scarce, especially when it comes to the consequences of the social network structure (Moolenaar, 2010).

2.2 Application of the Social Network Methodology

As we overlook the research topics that have been investigated it is clear that the social network methodology is applicable for a wide variety of research questions. In this second part, we provide an overview on how this methodology has been applied. Although a majority of educational studies used a cross-sectional research design, longitudinal studies are increasing in this field of study, both for student networks (Altermatt & Pomerantz, 2005), as teacher and school networks (Anderson, 2010; Frank, Zhao, & Borman, 2004; Spillane, 2005). In this section, we will further elaborate on the data collection for social network data and how these data have been analyzed.

2.2.1 Research Instruments

One of the crucial steps of conducting a social network study, is gathering sociometric data on the research subjects. A great extent of social network studies used a survey to collect data using sociometric questions. These questions address the specific types of social networks that concern the research interest. A wide variety of network types can be investigated, such as advice, collaboration, spending breaks, friendship networks, and numerous others. Since every study is often interested in a specific type of network, new research questions are often developed to collect the appropriate data, leading to a wide variety of sociometric questions resulting in little validation of existing sociometric questions. Moreover, reliability and validity checks, such as split-half method and Cronbach's alfa are difficult to applicate on sociometric questions, as a slight change in the formulation of the question can implicate that it addresses a different network type (Wasserman & Faust, 1994). Therefore, it is crucial to conduct a pilotstudy and to ascertain that the research subjects interpret the sociometric question(s) as intended by the researchers.

Although most studies have used a paper version of the survey, interest also began to rise for online surveys (Maroulis & Gomez, 2008). Several question formats have been used to collect

these data. Surveys can use a name roster, whereby all network members are listed and respondents have to indicate who they have a relation with. In the research of Wentzel, Barry and, Caldwell (2004) students had to indicate from a list who their best friends were. In the research of Moolenaar et al. (2012) all teachers from the school were enumerated. Another way to collect sociometric data is by free-call questions. These are open ended questions whereby the respondent has to fill out the names of his or her relations. A procedure that uses free recall and has been extensively used in research on students networks is social cognitive maps (SCM) (Farmer et al., 2003). Cairns, Leung, Buchanan and Cairns (1995) developed this method to identify peer groups within a social network. This procedure had been used before, however, earlier studies such as Cairns, Cairns, Neckerman, Gest, and Gariépy (1988); Farmer and Cairns (1991) and Kindermann (1993) didn't explicitly mention they made use of social network analysis. Most of these studies using sociometric surveys, adopted a solely quantitative approach. However, the use of mixed-method studies has been rising and researchers started combining surveys with interviews and/or observations. For instance; the studies of Daly and Finnigan (2010; 2011) combined both survey data with interviews. Several other studies also combined these instruments to investigate the social networks of teachers (Daly, Moolenaar, Bolivar, & Burke, 2010; Penuel et al., 2010; Dorner, Spillane, & Pustejovsky, 2011; Frank, Zhao, Penuel, Ellefson, & Porter, 2011). A small amount of studies adopted a solely qualitative approach, using interviews and observations to retrieve information about the social networks of the research subjects (Coburn & Russell, 2008). Once these data were gathered, a wide range of analyses have been conducted to find answers to the relevant research questions.

2.2.2 Analyses

As mentioned in the introduction, social network analysis stems from sociometry and one of the most important instrument of sociometrics were sociograms. In contemporary network analysis, network drawings still are important instruments in the interpretation and analyzation of the social structure.

A great amount of studies used social network analysis to retrieve basic network measures on the level of the node (the actor), referred to as ego-networks, and the level of the whole network. Often, studies used reciprocal friendship nominations or peer group membership solely to identify wether and to what extent an actor has social relations (e.g. Blansky et al., 2013). A limited amount of studies also account for tie strength, often measured in frequency of the relation (e.g. Coburn & Russel). More advanced calculations of these social network measures are often based on graph theory (Scott & Carrington, 2011). The study of graphs focuses on the mathematical structures that model pairwise relations between objects (Bondy & Murty, 1976). Graph theory is used to represent networks of communication, data organization, molecules and people and has been applied in a wide variety of research domains such as computer science, chemistry, physics, and biology. Also in sociology, graph theory has been applied, mostly under the flag of the social network methodology. In educational research, both on the level of the node and whole network, several measures have been used to investigate outcomes with students, teachers and school leaders. In table 1, an overview of the most commonly used network measures in educational research is provided.

Table 1. overview of the most commonly used network measures

	Measure	Description
Node-level	Indegree/outdegree	the number of direct ties a person receives from/sends out to other nodes in the network (Wasserman & Faust, 1994)
	Closeness centrality	the mean length of the shortest paths between a node and all its reachable alters (Freeman, 1978);
	Betweenness centrality	the amount of times a node is on a geodesic path between other nodes (Borgatti, Everett, & Johnson, 2013)
	Reciprocity	the degree of mutual ties of an actor (Scott & Carrington, 2011)
Whole network level	Density	the degree of connectivity within a network (Scott & Carrington, 2011) and is calculated by dividing the number actual ties by the number of all possible ties in the network (Wasserman & Faust, 1994).
	Centralization	the extent to which a network is centralized around one or more actors (Borgatti et al., 2013).
	Reciprocity	the extent to which the relations in a network are mutual connections (Scott & Carrington, 2011)

A limited amount of the studies used other centrality measures such as Katz-Bonacich centrality (Calvó-Armengol et al., 2009), Stephenson and Zelen centrality (Baldwin, Bedell, & Johnson, 1997), two-step reach (Hawe & Ghali, 2008), brokerage (Moolenaar, Daly, & Sleegers, 2010), and eigenvector centrality (Ramírez-Ortiz et al., 2004). Often, these measures are adapted to the specific research question and the calculation only differs slightly from other standard measures mentioned in table 1. All these network measures are almost always calculated in UCINET (Borgatti, Everett, & Freeman, 2002), which is a special software packet for sociometric data.

Several studies used these network measures in more advanced statistical analyses such as regression models and structural equation models. For instance, the research of Defour and Hirsch (1990) used regression models to investigate the influence on academic performance,

while Baldwin, Bedell and Johnson (1997) incorporated the Stephenson and Zelen centrality and indegree in a structural equation model to study the relationship between x, y and z. Other studies applied these network measures in hierarchical linear modelling (Yasumoto, Uekawa, & Bidwell, 2001) and multivariate regression analysis (Bakkenes et al., 1999) to take into account attributes of entities in which respondents are nested, or to model several outcome variables simultaneously. Also, several studies identified clique group affiliations by using the K means cluster analysis to investigate the influence of the peer group (Nichols & White, 2001; Frank & Zhao, 2004). The study of Ryan (2001) first identified peer groups, using social network analysis. Once peer groups were identified, they were used in multilevel analyses and assuming that students are nested in peer groups. Of course, these advanced models make it possible to analyze the influence of network measures on other (attribute) outcomes. However, to analyze social selection, it is impossible to use the 'classical' statistical analyses, as the basic assumption of independence of data is harmed (Borgatti et al., 2013). To investigate social networks as a dependent variable, analyses need to be conducted that take into account the interdependence of the data. For instance, the Quadratic Assignment Procedure (QAP) makes it possible to investigate the correlation between several network types (Scott & Carrington, 2011). In the study of Moolenaar et al. (2012) QAP-correlations were used to investigate whether several types of networks can be distinguished in school teams.

To determine which individual, dyadic and school characteristics influence the formation of ties and to test the social selection processes, often p2 models are used. Those models are related to general linear models that are used in classic statistical analyses but deal with the interdependence of the data (Borgatti et al., 2013; Zijlstra, van Duijn, & Snijders, 2006;) and allow the investigation of complex dependence structures (Robins, Elliott, & Pattison, 2001). For example, in a study of Baerveldt, Van Duijn, Vermeij, and Van Hemert (2004) and Baerveldt, Zijlstra, De Wolf, Van Rossem and Van Duijn (2007) p2 models were used to determine if there were ethnic boundaries in student networks. Also for school teams, p2 models were used (Spillane, Kim, & Frank, 2012). Penuel et al. (2010) used p2 models to compare the social selection mechanisms in two schools to reveal distinct patterns that helped explain why one school had been successful and another school unsuccessful in developing a shared vision for change. Frank et al. (2004) used multilevel cross-nested models to investigate the social selection models in one school. Recently, more advanced p2 models were developed under the name of p* models or exponential random graph models (ERGM) (Robins, Pattison, Kalish, & Lusher, 2007; Snijders, Pattison, Robins, & Handcock, 2006). While p2 models are able to look at dyadic structures, p* models can also higher order configurations such as triads and stars (Borgatti et al., 2013). In the research of Lubbers (2003) a multilevel p* model was used to trace the group composition and social structure of school classes. However, few studies in the educational research domain used these advanced models.

3. Future perspectives

Based on this review, it can be concluded that the social network approach has been used in a wide variety of studies addressing networks of students, teachers and schools, in kindergarten, primary, secondary and higher education. It is a versatile research method that can be used from exploratory case-designs to large scale cross-sectional and longitudinal designs, and to look at both antecedents and consequences of the social structure. In a short time a huge amount of conclusions concerning social networks and education have been drawn, but few studies have been replicated to contest or confirm the results. Although this promising method makes it possible to contextualize educational processes, there are several limitations and therefore suggestions for further research to identify, based on this review.

First, it was already indicated that research with teachers and school teams mainly focused on primary schools. In network research, a response rate of 80 percent is a minimum to conduct reliable whole network analysis (Wasserman & Faust, 1994). As school teams in elementary education are smaller, consequently, it is easier to collect reliable data. A first suggestion for future research is therefore to further investigate the social networks of secondary school teams and higher education teams. Also, studies on cross-level networks, such as student-teacher networks, and across school networks are utterly scarce and could provide insight in important relational dynamics that contribute to several educational processes.

Second, the majority of the studies are cross-sectional implicating that both attribute and social network data are collected at the same time. This makes it difficult to distinguish social selection and social influence processes and to draw causal conclusions (Borgatti & Cross, 2003). Longitudinal data make it possible to analyze dynamic networks and create the possibility to study the evolvement of networks and attributes over time (Kossinets & Watts, 2006). Additionally, more advanced statistical models such as stochastic-oriented models (Snijders, 1996) and autocorrelation models (Leenders, 2002) which make it possible to model social influence and contagion, could provide further insight in the consequential order and the change of networks of time. Also for cross-sectional data, more statistical advanced models could be used to explore more advanced social network structures, such as exponential random graph models (ERGM) (Robins, Snijders, Wang, Handcock, & Pattison, 2007), which make it possible to test multilevel and multitheoretical hypotheses concerning ties, nodes and the whole network (Contractor, Wasserman, & Faust, 2006).

Finally, only a limited amount of these studies used a mixed-method design. The past years, the interest in the combination of both quantitative and qualitative data has been growing (Small, 2011). In a mixed method design, qualitative data can take on different tasks (Fuhse & Mützel, 2011). First, qualitative data can explore and describe social networks concerning their structure and composition; second it can provide insights in the meaning of these networks for the actors in it and thirdly, it can confirm or contradict the quantitative findings. Therefore, the combination

of quantitative and qualitative data can be a soil for both theory development as theory testing, hence could provide an extensive contribution to the educational research field.

The social network methodology has made it possible to provide valuable answers to a wide range of research questions concerning educational processes, however, much more work needs to be done if we want to further reveal the social structures in educational settings.

BIJLAGEN

Bijlage 1 Information sheet vertical analysis

Author(s) (Year):
Journal (impact factor): **Citations:** **Country:**
Research Subjects & topic:
Methodology: - **Respondents:** - **Quantitative/qualitative** - **Instrument(s):** - **Network measures:** - **Analysis:**
Results:

Bijlage 2 Horizontal overview

Author (Year)	Research subject(s)	Research topic	Research design	Research instrument(s)	Network measures/analyses
Altermatt & Pomerantz (2003)	Students	Social selection and social influence in student friendship networks on competence-related and motivational beliefs	Longitudinal	Survey	Reciprocity Social influence
Altermatt & Pomerantz (2005)	Students	Social influence of high achieving versus low achieving friends on student achievement	Longitudinal	Survey	Reciprocal ties
Anderson (2010)	Teachers	Support seeking and teacher agency in urban, high-needs schools	Longitudinal	Survey and observations	Outdegree & Frequency
Baerveldt, Van Duijn, Vermeij & Van Hemert (2004)	High school students	Social selection (ethnic choice and personal choice) in pupils networks	Cross-sectional	Survey	Indegree Outdegree Social selection (p2)
Baerveldt, Zijlstra, De Wolf, Van Rossem, van Duijn (2007)	High school students	Social selection in high school students' networks	Cross-sectional	Survey	Indegree Outdegree Social selection (p2)
Baker Doyle & Yoon (2010)	Teachers	Teacher collaboration in a professional development program	Cross-sectional	Survey	Indegree
Bakkenes, De Brabander, Imants (1999)	Primary school teachers	Teacher isolation in primary schools	Cross-sectional	Survey	Density Degree centrality
Baldwin, Bedell & Johnson (1997)	M.B.A Students	Effect of social networks on student satisfaction and achievement	Cross-sectional	Survey	Stephenson-Zelen centrality
Berndt & Keefe (1995)	High school students	Influence friends networks on school adjustment	Longitudinal	Survey	Friendship nominations Reciprocity
Author (Year)	Research subject(s)	Research topic	Research design	Research	Network

				instrument(s)	measures/analyses
Blansky, Kavanaugh, Boothroyd, Benson, Gallagher, Endress (2013)	High school students	Social influence of academic success	Longitudinal	Survey	Friendship nominations Reciprocity
Calvó- Armengol, Patacchini & Zenou (2009)	Students	Peer effects in education	Cross-sectional	Survey	Katz-Bonacich centrality measure
Cannata (2011)	Teachers	The role of social networks in the teacher job search process	Longitudinal	Survey Interview	Outdegree
Chamberlain, Kasari, Rotheram-Fuller (2007)	Students	Social selection in classrooms & the networks of children with autism	Cross-sectional	Survey	Centrality Reciprocity Cluster analysis
Coburn & Russel (2008)	District & teachers	Social selection: the influence of district policy on teachers' social networks	Cross-sectional	Interviews Classroom observations	Tie span Tie strength
Cornelissen, van Swet, Beijaard & Bergen (2011)	Schools & universities	School-university research networks in the development, sharing and using of knowledge	Cross-sectional	Semistructured group-interviews	Network membership
Daly & Finnigan (2010)	District leaders School district	Network structure to understand school change	Cross-sectional	Surveys Interviews	Density Centrality E-I Index (cohesion) Core-Periphery
Daly & Finnigan (2011)	Disrict leaders School district	The social network ties between district leaders	Longitudinal case study	Surveys Interviews	Density Centrality E-I Index CP
Author (Year)	Research subject(s)	Research topic	Research design	Research instrument(s)	Network measures/analyses

Daly, Moolenaar, Bolivar & Burke (2010)	Teachers	teachers' social networks: relationships in reforms	Exploraty case study	Surveys Interviews	Density Centrality
de Lima (2003)	Teachers	The impact of departemental cultures on student teacher views' and practices of collaboration	Cross-sectional	Surveys Interviews	Sociogram
de Lima (2007)	Teachers	Teachers' professional development in departimentalized, loosely coupled organisations	Cross-sectional (Case-study)	Surveys Interviews	Density Tie strength Frequency
DeFour & Hirsch (1990)	Students	The adaptation of black graduate students	Cross-sectional	Survey	Density
Dorner, Spillane & Pustejovsky (2011)	Teachers	A comparison of the networks in public, charter and Catholic schools	Cross-sectional	Surveys Interviews	Outdegree Indegree Density
Estell, Jones, Pearl & Van Acker (2009)	Elementary students	The networks of children with learning dissabilities	Longitudinal	Survey	Friendship nominations Reciprocity
Farmer, Estell, Leung, Trott, Bishop & Cairns (2003)	High school students	The influence of individual characteristics, peer affiliations and school dropout	Longitudinal	Survey	Friendship nominations (SCM)
Farmer & Farmer (1996)	Elementary students	Social selection in classrooms	Cross-sectional	Survey	Peer group identification (SCM)

Author (Year)	Research subject(s)	Research topic	Research design	Research instrument(s)	Network measures/analyses
Farmer, Leung, Weiss, Irvin, Meece & Hutchins (2011)	High school students	Social network position of rural secondary students with disabilities	Cross-sectional	survey	Centrality

Frank & Zhao (2004)	Subgroups of teachers in elementary schools	Subgroups as meso-level entities in the social organization of schools	Longitudinal	Survey	Subgroups (Cliques)
Frank, Zhao & Boman (2004)	Schools & teachers	The diffusion of innovations within schools	Longitudinal	Survey	Adapted measure of social capital
Frank, Zhao, Penuel, Ellefson & Porter (2011)	Elementary schools & teachers	The implementation of innovations	Longitudinal	Survey Interviews	Adapted measure of social capital
Friedkin & Slater (1994)	School leaders	School leadership from a social network perspective	Cross-sectional	Survey	Centrality Density
Hawe & Ghali (2008)	Teachers	The social relationships of staff and teachers at school	Cross-sectional	Survey	Centrality Density
Jones, Alexander & Estell (2010)	Students	Social selection (and influence) on perceived self-reguated learning	Cross-sectional	Survey	Peer group membership (SCM)
Kärkkäinen (1999)	Elementary school teams	planning and implementing curriculum inuts in elementary school teams	Longitudinal	Interviews Discourse data Observations	Centrality
Kärkkäinen (2000)	Elementary school teams	Analysing network contacts in elementary schools	Cross-sectional	Interviews Discourse data Observations	Centrality Density

Author (Year)	Research subject(s)	Research topic	Research design	Research instrument(s)	Network measures/analyses
Kindermann (1993)	Peer groups & students	Peer group as a context for motivation in school	Longitudinal	Interviews Teacher reports	Peer group membership (SCM) Social selection
Kindermann (2007)	Peer groups & students	Peer group and academic engagement (sixth grade)	Longitudinal	surveys	Peer group membership (SCM)

Kiuru, Aunola, Nurmi, Leskinen & Salmela-Aro (2008)	Peer groups & students	Peer group influence and selection in relation to adolescents' school burnout	Longitudinal	Survey	Peer group membership
Kuo, Yang, Yang & Sue (2010)	Teachers	The social network structure of in-service advancement education for the English literature teachers in high school	Cross-sectional	Survey	Centrality Cutpoints Blockmodels Subgroups
Ladd (1990)	Students	Friendship networks and early school adjustement	Longitudinal	Survey	Reciprocal friendship ties
Ladd, Kochenderfer & Coleman (1997)	Students	classroom peer acceptance, Friendship and victimization and school adjustement	Longitudinal	Survey Interview	Reciprocal friendship ties
Ladd & Price (1987)	Preschool-kindergarten children	Children's social and school adjustment, following the transition from Preschool to Kindergarten	Longitudinal	Survey Interview Teacher & Parent report	Peer sociometric measures (peer ratings, positive and negative nominations)

Author (Year)	Research subject(s)	Research topic	Research design	Research instrument(s)	Network measures/analyses
Lubbers (2003)	School classes	Group composition and social structure in school classes	Cross-sectional	Survey	Indegree Outdegree Social selection (p* model)
Maier & Youngs (2009)	Teachers	Teacher preparation programs & teacher labor market: teachers' social capital and their career choices	Cross-sectional	Interview	Sociograms

Maroulis & Gomez (2008)	Teachers	Connectedness in Small-school reform	Cross-sectional	Survey	Density
Moolenaar, Daly & Sleegers (2010)	Principals	Relation between transformational leadership, network position and schools' innovative climate	Cross-sectional	Survey	Degree centrality Closeness centrality Betweenness centrality
Moolenaar, Daly & Sleegers (2011)	Elementary school teams	Social network structure & innovative climate	Cross-sectional	Survey	Centrality
Moolenaar, Sleegers & Daly (2012)	Elementary school teams	Collaboration networks, collective efficacy and student achievement	Cross-sectional	Survey	Density Centralization
Moolenaar, Sleegers, Karsten & Daly (2012)	Elementary school teams	A network typology of social interaction among teachers	Cross-sectional	Survey	Sociograms QAP-correlations Multidimensional scaling
Mullen & Kochan (2000)	School leaders	Collaborative leadership networks	Cross-sectional	Document Observation Interview	Network involvement

Author (Year)	Research subject(s)	Research topic	Research design	Research instrument(s)	Network measures/analyses
Nichols & White (2001)	High school students	Influence of peer networks on Algebra achievement	Cross-sectional	Survey	Clique group affiliation(SCM)
Penuel, Frank & Krause (2006)	Elementary school teams & teachers	Distribution of resources and expertise and the implementation of schoolwide reform initiatives	Longitudinal	Interview Survey	Density
Penuel, Riel, Joshi, Pearlman, Kim & Frank (2010)	Elementary school teams	Informal and formal organizational support for reform and improving teaching in school	Cross-sectional	Interview Survey	Density
Penuel, Sun, Kenneth &	Elementary school	Collegial interactions and the augmentation of	Longitudinal	Survey	Adapted network

Gallagher (2012)	teams and teachers	teacher learning from external professional development			measure: exposure to colleagues' estimated expertise
Pil & Leana (2009)	Teachers & students	The effect of teacher human and social capital on student performance	Cross-sectional	Survey	Adapted measure social capital
Ramirez Ortiz, Caballero Hoyos, Ramirez Lopez (2004)	Students	The networks of academic performance in a student context of poverty in Mexico	Cross-sectional	Survey	Density Closeness centrality Betweenness centrality Eigenvector centrality
Reagans (2011)	Elementary and middle school teachers	The influence of social similarity and propinquity	Cross-sectional	Survey	Tie strength

Author (Year)	Research subject(s)	Research topic	Research design	Research instrument(s)	Network measures/analyses
Ream & Rumberger (2008)	Students	Student engagement, peer social capital and school dropout	Longitudinal	Survey	Adapted measure social capital
Ryan (2001)	Students Peer groups	Peer group as a context for motivation and achievement	Cross-sectional	Survey	Identifying peer groups
Schwartz, Gorman, Nakamoto & McKay (2006)	High school students	Popularity, social acceptance and aggression in peer groups: link with academic performance and school attendance	Longitudinal	Survey	Reciprocal friendship ties
Spillane (2005)	Elementary school leader	Leadership practice: how the subject matters	Longitudinal	Survey Observations Interviews	Density Centrality Cut-points
Spillane, Kim & Frank (2012)	Elementary school teachers	Tie formation of instructional advice and information providing and receiving behaviour in	Cross-sectional	Survey	Indegree Outdegree

		elementary schools			Social selection (p2)
Stanton-Salazar & Dornbusch (1995)	High school students	Information networks among high-school students	Cross-sectional	Survey Interviews	Outdegree
Supovitz, Sirinides & May (2010)	Principals & students	How principals and peers influence teaching and learning	Cross-sectional	Survey	Outdegree
Yasumoto, Uekawa & Bidwell (2001)	Teachers and students	The collegial focus and high school student' achievement	Longitudinal	Survey	Density

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