Abstract

A social network approach provides a valuable framework to assess and strengthen teacher collaboration, which is considered important in realizing inclusive education. However, to our knowledge, there is no research that has used a social network approach to measure and strengthen teacher collaboration in the context of inclusive education. Therefore, this study aims to develop and validate a social network instrument that provides teachers, school teams and researchers insight into teacher collaboration in the light of inclusive education. Regarding the development, specific issues that need to be taken into account in developing a network questionnaire are shown and applied. Regarding the validation, evidence on the content, response processes and internal structure of the instrument are provided. Additionally, the cognitive load to complete the instrument and the value of feedback after completing the instrument are studied. Data were gathered in three primary and two secondary schools through a mixed method design, using an online questionnaire (N = 91) and focus groups and interviews with a subset of the participants (N = 23). The findings suggest that our instrument is a valid tool to assess teacher collaboration, and to strengthen teacher collaboration by providing teachers and teams feedback on their networks.

Keywords: inclusive education; teacher collaboration; social network approach; instrument development; mixed method design

1 Introduction

Worldwide, a shift is taking place from segregated towards more inclusive education (Banks et al., 2007). Despite the tendency towards more inclusive education, there are various interpretations of the concept, varying from the inclusion of certain groups who share a history of segregation (e.g., students with a disability) in mainstream education, to a broader view of inclusion as a reform that appreciates and responds to the diversity of all learners (Ainscow & Miles, 2008). In implementing inclusive education teachers are central agents, by ensuring that the learning environment (LE) addresses the educational needs of all students. However, one cannot expect that a single teacher, working alone, is able to meet all students’ needs (Carroll, 2009). Teacher collaboration is therefore assumed to be a pivotal factor in realizing inclusive education (e.g., King-Sears, Janney, & Snell, 2015; Mitchell, 2014; Santoli, Sachs, Romey, & McClurg, 2008).

1.1 Teacher collaboration

In the current study, teacher collaboration is defined in a broad sense as “joint interaction in the group in all activities that are needed to perform a shared task” (Vangrieken, Dochy, Raes, & Kyndt, 2015, p. 23). If we apply this definition to the context of inclusive education, teacher collaboration concerns joint interaction between all actors involved in improving and adapting the LE to the educational needs of the student so that the student is truly included in mainstream education. The particularity of teacher collaboration in the context of inclusive education is that it pursues a specific objective, namely realising inclusive education, which implies that other and often more actors are involved. These actors
include school internal professionals (e.g., teachers, special educational needs (SEN) coordinators), as well as school external professionals (e.g., pedagogical counsellors, teachers from special schools), as well as parents and pupils (Alquraini & Gut, 2012; Hunt, Soto, Maier, Müller, & Goetz, 2002; Keay & Lloyd, 2011).

Despite the acknowledged importance of teacher collaboration in realizing inclusive education, there are some challenges in research and practice. First, previous research has mainly focused on formal teacher collaboration, for instance, on consultation sessions offered by special education teachers to general teachers, or on formally organised meetings (Hunt et al., 2002; Sundqvist, von Ahlefeldt Nisser, & Ström, 2014). Although teachers in inclusive education do not often work together (see below), if they do, they often collaborate in an informal way, for example discussing a student’s need in the hallway or lunchroom (Kugelmass, 2001; Nochasjki, 2002). However, this informal collaboration is less taken into account.

Second, little is known regarding how collaboration takes shape in the context of inclusive education, which is expected to be different from collaboration in other contexts given the challenges and complexity of inclusive education. Previous research has mainly focused on the prerequisites for successful collaboration such as teachers’ communication skills, working towards a shared goal (e.g., Alquraini & Gut, 2012; Hunt et al., 2002; Thousand & Villa, 2000), and teachers’ general experiences with and perception of their collaboration (e.g., Nel, Engelbrecht, Nel, & Tlale, 2014; Sandberg & Ottosson, 2010; Xu & Malinen, 2015). Although this research provides interesting findings on the preconditions for teacher collaboration, it gives little information on how collaboration is realised in daily practice, for example, with regard to frequency and actors involved.

Third, the image of the teacher working alone in his/her class is still prevalent (European Commission, 2013; Klassen & Durksen, 2012; Leonard & Leonard, 2003; Struyf et al., 2012). This is not surprising since teachers are not prepared to collaborate with their colleagues during teacher training and therefore do not feel competent to collaborate (EVALO, 2012; Malinen, Savolainen, & Xu, 2012; Zagona, Kurth, & Macfarland, 2017). Teachers’ self-efficacy in collaboration, however, seems to be the strongest predictor of attitudes towards inclusive education, which suggests that collaboration can be particularly important to improve attitudes towards inclusion (Malinen et al., 2012; Savolainen, Engelbrecht, Nel, & Malinen, 2012; Yada & Savolainen, 2017). Hence, there is an urgent need to strengthen teachers in establishing collaboration. As will be shown in the next section, a social network approach (SNA) offers opportunities to address these challenges.

1.2 A social network approach to teacher collaboration
Before considering the opportunities offered by a SNA, we will briefly explain this approach. A SNA focuses on the social relationships between actors and the patterns of these social relationships (i.e., the social network structure; Wasserman & Faust, 1994). Three key assumptions characterize this approach (Degenne & Forsé, 2004). First, individuals are seen as interdependent, rather than independent, because of their embeddedness in a social structure (e.g., a teacher has a dyadic relationship with a close colleague, that is nested in a grade-level team within a school). Social network researchers therefore argue that changes at an individual level (e.g., a teacher’s attitude towards inclusion) will have effects on a higher-order level (e.g., school-level attitude towards inclusion). Second, social relationships are seen as ‘pipes’ for the exchange of resources, such as information or didactic materials. These resources are transferred through social interaction among individuals, for example, by asking a colleague for support. Third, a social structure may provide opportunities (e.g., exchange of successful instructional strategies for including students with SEN), but also constraints for individual and organizational performance (e.g., the lack of access to necessary or valuable
resources for creating an inclusive LE because teachers are disconnected). In sum, adopting a SNA implies that researchers go beyond the level of individual actors and their outcomes, but also take the interdependency and flow of resources into account.

A SNA provides opportunities to address the challenges noted above. First, this approach enables researchers to measure teacher collaboration without assuming formal boundaries, since both formal and informal interactions can be mapped (Penuel, Riel, Krause, & Frank, 2009). Second, it helps to produce a close understanding of how collaboration is shaped in inclusive education as it focuses on the patterns of social relationships that result from teachers’ (in)formal interactions in daily practice (Moolenaar, 2012). Third, a SNA can be considered as a tool to foster teacher collaboration in inclusive education. Its distinctive methodology, which takes into account the interdependency of individuals, allows researchers to capture and to visualize the ties and overall network structure in schools (Borgatti, Everett, & Johnson, 2013). Thus, the approach gives school teams insight into their network by making visible the patterns of relationships (Ooghe, Thomas, Tuytens, Devos, & Vanderlinde, 2016) and by giving information on network characteristics such as its density and diversity, which can help school teams to exploit relationships as resources for support in creating an inclusive LE. The underlying assumption is that actors who are aware of their network and the (dis)advantages of their network characteristics, interact more intentional with others (e.g., they actively reach out to colleagues to discuss their daily practice) (Borgatti & Cross, 2003; Moolenaar et al., 2014). Despite the great potential of a SNA to make teachers aware of their network and its characteristics, this approach is still only rarely applied in educational practice.

2 Objectives

A SNA is only recently introduced in educational research (Moolenaar, 2012; Moolenaar, Sleegers, Karsten, & Daly, 2012) and has already proven its value by, for example, showing the importance of teacher collaboration for school reforms (Penuel et al., 2009), instructional improvement in mathematics (Hopkins, Spillane, Jakopovic, & Heaton, 2013) and student achievement (Moolenaar, Sleegers, & Daly, 2012). However, to our knowledge, there is no research that has used a SNA to teacher collaboration in inclusive education. As a consequence, there is no social network instrument (SNI) to assess and strengthen teacher collaboration in inclusive education. If we aim to measure teacher collaboration in inclusive education, it is important to develop an instrument that focuses on this specific purpose, namely realizing an inclusive LE, as previous research has shown that the purpose of interaction, and consequently also the content of interaction, partly determines the network structure (Burt, 1997; Moolenaar, 2012). For example, if the purpose of interaction is to realize an inclusive LE, and the content of interaction is sharing ideas on how to adjust the LE to the SEN of a student, the SEN coordinator may play a central role in this network. Whereas when it comes to improving mathematical instruction, the SEN coordinator will probably not play a central role. Therefore, this study aims to develop and validate a SNI that provides school teams and researchers insight into social networks regarding the creation of an inclusive LE.

In developing a SNI some specific issues need to be taken into account, which are shown and applied in this study. First, social network studies can investigate various types of networks at different levels, for example, school internal collaboration or collaboration with external partners, at the level of a teacher (ego network) or the level of a school (whole network). A first step in developing a SNI is therefore deciding whether to use an ego or a whole network design and defining network boundaries. Next, it is critical to properly select the network questions and questionnaire format, and consider the way in which the questionnaire is administered, as this greatly influences the validity and reliability of responses due to issues such as question
clarity and cognitive demand (Borgatti et al., 2013). Finally, as we want to provide school teams insight into their network, the SNI should also provide feedback to respondents, which is new in the context of (inclusive) education.

To validate the SNI, evidence is provided on the content, response processes and internal structure, following the Standards for Educational and Psychological Testing (AERA, APA, NCME, 1999). Regarding the content, we examine whether the network questions are clear and comprehensive to participants and whether participants interpret the network questions in the intended way. With respect to the response processes, we explore how and why participants respond to the network questions the way they do. Concerning the internal structure, we investigate whether the network questions measure different aspects of teacher collaboration. Additionally, the cognitive load (i.e., how much effort it takes to complete the instrument) and experiences with the feedback are studied.

3 Developing the social network instrument

3.1 Network design

When researchers are interested in the network of a single actor, an ego network design is recommended. This network constitutes the central actor and his ties to others. In a whole network design, the ties among all pairs of actors in a bounded sample are investigated. This design enables researchers to create a picture of a whole network, and its structural features (e.g., density, centrality) (Borgatti et al., 2013). As inclusive education can only be achieved if all school team members work together (Booth & Ainscow, 2015; Mitchell, 2015), a whole network design has been applied. Collecting data through a whole network design starts with defining who comprises the network (Marin & Wellman, 2011). We decided to include every school staff member with a pedagogical and/or coordinative function.

3.2 Network questions

Since applying a whole network design has a high cost to the researcher (analysing this network takes a lot of time) and the respondent (responding one network question takes much longer than, for example, answering a question about one’s attributes), a SNI can only consist of a few network questions (Borgatti et al., 2013). The literature on inclusive education was explored to identify what types of teacher interaction are important in creating an inclusive LE, and to determine what should be the object of interaction (e.g., Ainscow & Miles, 2008; Van De Putte & De Schauwer, 2013; Wang et al., 2015). In addition, to enhance the content validity of the instrument, experts in the educational field (e.g., pedagogical counsellors, pre-service teacher educators, academics) contributed to the development and refinement of the questionnaire. Regarding the types of interaction, we decided to focus on (1) asking for support, and (2) giving support, since getting support of other teachers and professionals seems to be a prerequisite for successful inclusion (Sanahuja-Gavaldà, Olmos-Rueda, & Morón-Velasco, 2016; Van de Putte, 2013; Wang et al., 2015). Regarding the object of interaction, we tried to adhere to both visions of inclusive education (i.e., inclusion focused on certain groups who share a history of segregation, and inclusion focused on appreciating and responding to the diversity of all learners). As such, the two objects concern (1) support in order to adopt the LE to the SEN of an individual student, and (2) support in order to create a powerful and accessible LE for all students. Combining the types and objects of interaction resulted in the following four network questions:

(1) Who do you usually ask for support to adjust the LE to the SEN of an individual student?
(2) Who do you usually give support to adjust the LE to the SEN of an individual student?
(3) Who do you usually ask for support to create a powerful and accessible LE for all students?
Who do you usually give support to create a powerful and accessible LE for all students?

Next, information on the nature and quality of these interactions was gathered. For each person selected, respondents have to indicate the frequency of interaction ranging from at least once a year to daily, and which type(s) of support they ask or give, for instance, information, emotional support, super-/intervision. These options are based on an exploration of the literature on the most relevant types of support in the context of inclusive education (e.g., Bouillet, 2013; King-Sears et al., 2015; Knackendoffel, 2007; Milteniené & Venclovaitė, 2012), and were refined in close collaboration with educational experts. Third, for each person selected, respondents have to indicate to what extent the support they asked, effectively supports them in creating an inclusive LE, with seven options going from not supportive at all to very supportive. As shown by Van der Rijt et al. (2013), provided support is not necessarily helpful to a teacher, which underlines the importance of evaluating the effectiveness of support.

3.3 Questionnaire design

With regard to the format, a first issue to consider was whether to use an open- or closed-ended format. While in an open-ended format respondents are asked to freely recall any person with whom they interact, in a closed-ended format they are presented with a list of network members to answer the network questions. The main advantage of a closed-ended format is that respondents are less subject to recall error. Because a closed-ended format is preferred when the list of network members is not too large (Borgatti et al., 2013; Marsden, 2011), this format was chosen. A second issue concerns the structure of the questions and name list. The two main formats for closed-ended questions are multigrids and repeated rosters. A multigrid places the name list in a series of columns with each column associated with a network question, whereas in a repeated roster the same name list is repeated following each network question. As previous research shows that data is more reliable when a respondent answers one network question about the list of network members before moving on to the next network question (Vehovar, Lozar Manfreda, Koren, & Hlebec, 2008), the repeated rosters format was chosen. A third issue is whether respondents can indicate as many people as they want or whether the number of people a respondent can indicate is fixed. As the latter can bias the resulting networks (Borgatti et al., 2013), respondents can indicate an unlimited number of people in our instrument.

Finally, we decided to collect network data by means of an online survey. Although online surveys typically have lower response rates, they are less emotionally sensitive as they are self-administered and they are very convenient for the researcher in terms of cost of administering and data management (Borgatti et al., 2013). Additionally, in this manner the data can be processed automatically to generate feedback for respondents (see below).

3.4 Feedback

To make school teams aware of their network and the associated benefits, and to facilitate their network intentionality, we developed a feedback tool. The feedback is automatically generated for every respondent and encompasses a picture of the school network, in which the respondent can see his/her own position in the network (see Appendix A for an example). The picture is interactive as there is the possibility to zoom in, and to generate a network for each type of support (e.g., information, emotional support) separately. Although Cross, Borgatti, and Parker (2002) argue that putting people’s names on a network picture can be a powerful diagnostic tool and a catalyst for change, this may harm respondents, for instance if information about the isolation of teachers is revealed (Penuel, Sussex, Korbak, & Hoadley, 2006). Therefore, only if all respondents of a school agree to include their names in the network picture, the names are visible. Otherwise, an anonymous network picture is shown. Furthermore, an overview of the types
of support present in a school, and the frequency and perceived effectiveness of support is presented. Although we focus on the whole school network in this study, we also gave feedback to a teacher on his/her personal network, in which a picture of one’s personal network is shown and several network concepts (e.g., the strength of ties, network diversity) are introduced and applied. After developing the SNI, this instrument was tested in a pilot study by using a mixed method design consisting of an online questionnaire, focus groups and interviews.

4 Testing the social network instrument

4.1 Sample
Data for this study were collected in three primary and two secondary schools in Flanders. A total of 75 teachers, 11 principals or coordinators and 5 student counsellors or special needs coordinators completed the SNI, reflecting a return rate of 42.5%. The participants had on average 18.2 years of experience and 71.8% of them were female. A subset of participants, more specifically 15 teachers, 5 principals or coordinators and 3 student counsellors were interviewed or participated in a focus group. Additional school demographics and the number of participants in each school are presented in Table 1. One primary (school 1) and one secondary school (school 4) were excluded in the quantitative network analysis (see section 4.3) as the response rates were too low (less than 30%) to reliably explore the school network (however, these two schools are still included for the analysis of the cognitive load and/or the interviews and focus groups). The average response rate of the schools included in the quantitative network analysis was 70.4%. To control for potential nonresponse bias, we compared respondents and non-respondents concerning their indegree, i.e., the number of ties they receive, by using t-tests. The results of these tests revealed no significant differences between respondents and non-respondents.

4.2 Data collection
The SNI was administered to collect social network data. Additionally, a cognitive load scale, developed by Paas, Van Merriënboer, and Adam (1994), was administered. In this one-item scale participants were asked how much effort it takes to complete the SNI. Next, we implemented three focus groups (in schools 3, 4 and 5), and conducted six semi-structured interviews with primary school teachers (in school 2). The focus groups lasted between 40 and 90 minutes, while the interviews lasted between 15 and 35 minutes. In the focus groups we conducted a collective interview, directed by the researcher, who moderated the discussion. The purpose was to

<table>
<thead>
<tr>
<th>Educational level</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
<th>School 4</th>
<th>School 5</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team size</td>
<td>Primary</td>
<td>Primary</td>
<td>Primary</td>
<td>Secondary</td>
<td>Secondary</td>
<td>214</td>
</tr>
<tr>
<td>Average years of experience</td>
<td>14.75</td>
<td>20.72</td>
<td>18.64</td>
<td>18.22</td>
<td>16.67</td>
<td>18.22</td>
</tr>
<tr>
<td>Gender ratio¹</td>
<td>100.00</td>
<td>66.67</td>
<td>92.86</td>
<td>72.22</td>
<td>58.33</td>
<td>71.79</td>
</tr>
<tr>
<td>Participants SNI</td>
<td>6</td>
<td>17</td>
<td>15</td>
<td>20</td>
<td>33</td>
<td>91</td>
</tr>
<tr>
<td>Response rate SNI</td>
<td>26.09²</td>
<td>54.84</td>
<td>93.75</td>
<td>21.51²</td>
<td>64.71</td>
<td>42.52</td>
</tr>
<tr>
<td>Participants focus groups/interviews</td>
<td>0</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>23</td>
</tr>
</tbody>
</table>

¹Gender ratio is calculated as the percentage of female team members.
²School was excluded in the quantitative network analysis.
(1) assess whether the network questions were clear and comprehensive to the participants, (2) explore whether the participants interpreted the network questions in the intended way, (3) examine how and why they responded to the network questions the way they do, (4) investigate how much effort it takes to complete the network questionnaire, and (5) explore experiences with the feedback. The same objectives apply to the interviews.

4.3 Data analysis
We calculated Quadric Assignment Procedure (QAP) correlations in UCINET to determine whether the four network questions measure different aspects of teacher collaboration (Borgatti, Everett, & Freeman, 2002). The QAP is a technique to estimate correlations between social networks, as it takes into account the interdependence of observations. To calculate QAP correlations, we first constructed matrices for each network question for each school. If teacher i nominated teacher j in the network question, a 1 was entered in cell $X_{ij}$. If teacher i did not nominate teacher j, a 0 was entered in cell $X_{ij}$. Then a Pearson correlation is calculated for two corresponding cells of two matrices of a school (i.e., the observed correlation). To calculate the significance of the observed correlation, the observed correlation is compared to the correlations between thousands of pairs of matrices, which are constructed by randomly rearranging the rows (and matching columns) of one of the observed matrices (Borgatti et al., 2013). We calculated QAP correlations for the four networks (one for each network question) within each school and then aggregated these correlations by computing the mean correlation among the four networks, over the three sample schools included for this analysis. In addition, a descriptive analysis was conducted on the cognitive load scale.

The interviews and focus groups were recorded and transcribed. The transcriptions were thematically analysed in four steps, based on the guidelines of Braun and Clarke (2006). First, each sentence was provided with a code which describes the content of that sentence, resulting in 69 codes. This coding process was partially guided by the research framework (e.g., the validation standards) used in this study. When the initial-coding stage was completed, all sentences with the same codes were put together. Second, the codes were categorized into meaningful groups of codes, called themes (e.g., evidence based on content and response processes, experiences with feedback on school network). Third, these themes were examined against the original data by putting together all sentences which relate to the same theme. We checked whether the themes appear to form a coherent pattern. Fourth, the themes were refined, labelled and precisely defined in consultation with another researcher. The final themes are presented in the results section.

4.4 Results

Evidence based on content
Most participants indicated that the questions were clear and comprehensive. However, some concepts in the network questions (e.g., SEN) or in the additional question on the types of support (e.g., co-teaching) required further explanation. Furthermore, the majority of participants interpreted the network questions in the intended way. Some teachers, however, reported that they interpreted adjusting the LE to the SEN of an individual student (SEN of a student) and creating a powerful and accessible LE for all students (LE for all students) similarly.

Evidence based on response processes
The majority of participants, in particular teachers, tended to select the same colleagues when it comes to SEN of a student, as when it comes to LE for all students. Furthermore, several participants indicated that the questionnaire was insufficiently introduced. For example, to some it was unclear that instead of simply reporting the support relationship with one teacher as a representative of a group of teachers with whom they have support relationships, they had to identify all the people whom they ask for or give support. Only by giving a full overview of the people in their personal network, a comprehensive picture of the
whole school network can be constructed. Finally, the questionnaire was perceived to be very personal and sensitive because they were asked to indicate names of their colleagues and because to some it was unclear who of their school members would have access to which results. To some, this was a threshold to complete the questionnaire.

**Evidence based on internal structure**

Table 2 summarizes the QAP correlations between the four networks within each school and the average QAP correlations over the three sample schools. The results indicate that there is a strong and significant correlation between the network around *asking support - SEN of a student* and the network around *asking support - LE for all students*. In addition, the network around *giving support - SEN of a student* is strongly and significantly correlated to the network around *giving support - LE for all students*. The other correlations appear to be weak to moderate (between .17 and .49).

<table>
<thead>
<tr>
<th></th>
<th>School 2</th>
<th>School 3</th>
<th>School 5</th>
<th>Overall</th>
</tr>
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<tbody>
<tr>
<td>QAP correlation Q1-Q2</td>
<td>0.27</td>
<td>0.42***</td>
<td>0.24***</td>
<td>0.31</td>
</tr>
<tr>
<td>QAP correlation Q1-Q3</td>
<td>0.49***</td>
<td>0.65***</td>
<td>0.58***</td>
<td>0.58</td>
</tr>
<tr>
<td>QAP correlation Q1-Q4</td>
<td>0.17</td>
<td>0.41***</td>
<td>0.29***</td>
<td>0.29</td>
</tr>
<tr>
<td>QAP correlation Q2-Q3</td>
<td>0.26***</td>
<td>0.44***</td>
<td>0.25***</td>
<td>0.32</td>
</tr>
<tr>
<td>QAP correlation Q2-Q4</td>
<td>0.67***</td>
<td>0.71***</td>
<td>0.71***</td>
<td>0.69</td>
</tr>
<tr>
<td>QAP correlation Q3-Q4</td>
<td>0.24**</td>
<td>0.49***</td>
<td>0.43***</td>
<td>0.39</td>
</tr>
</tbody>
</table>

*Note. Q1 = asking support - SEN of a student; Q2 = giving support - SEN of a student; Q3 = asking support - LE for all students; Q4 = giving support - LE for all students***

**p<.001, **p<.01

![Bar chart of cognitive load](image-url)
Cognitive load
For most participants it did not take much effort to complete the network questionnaire (see Figure 1). However, the interviews and focus groups revealed that for some participants the sub-questions related to the frequency, type of support, and perceived effectiveness of support, made it difficult to fill out the questionnaire, as there were, for example, too many answer options. The majority of participants took 20 minutes to complete the network questionnaire. However, several participants in the context of secondary education (especially coordinators and student counsellors) purposefully selected only a few people in the network questionnaire when they noticed it would take more time to fill out the questionnaire if they selected more people.

Experiences with the feedback based on the network questionnaire
Some teachers reported that the feedback on the school network was mainly useful for management staff to gain insight into the school network. However, for them as teachers it was very interesting to see their own position in the school network. Finally, participants reported both advantages of making names visible (e.g., it is useful to know the central people in the network, so their time can be made available to support others), and disadvantages (e.g., it can be harmful when everyone knows you are isolated). All schools, however, received an anonymous network picture, as there was at least one staff member in each school who disagreed to visualize names in the network picture.

As to the feedback on their personal network, most participants reported that the picture of their personal network had no added value. They argued that it would be interesting to compare the four networks (e.g., Is there a difference between my networks concerning asking for support versus giving support?). Moreover, some participants indicated that the feedback contained too much text and that the wording was too complex. Finally, some participants thought that this feedback could help one to reflect on one’s functioning and that it would be interesting to discuss this with each other.

4.5 Adjustments in response to the results
The network questionnaire was adjusted based on the findings in this study. First, we combined the network questions related to SEN of a student and the network questions related to LE for all students. The distinction between asking support and giving support was maintained, resulting in the following two network questions: (1) Who do you usually ask for support to create a powerful and accessible LE for one or more student(s) with SEN? and (2) Who do you usually give support to create a powerful and accessible LE for one or more student(s) with SEN?. In order to make the concepts (e.g., SEN) clearer, additional explanations and examples were given. Second, an instruction video was developed to clarify the purpose of the instrument, how to fill out the questionnaire, and how and to whom feedback is provided. Lastly, the format of the questionnaire was changed into a multigrid so that participants only have to go through the whole list of names once at the beginning of the questionnaire. This way, it is unlikely that participants purposefully select fewer people to have less work. Additionally, a multigrid makes the questionnaire appear shorter, which may have a beneficial psychological effect on participants (Borgatti et al., 2013). An overview of the adjusted network questionnaire is offered in Appendix B.

Also the feedback module was optimized based on the results. With respect to the school network, extra tools on how to interpret the network picture were offered and it was shown how to look at the picture from different perspectives. Concerning the personal network, we presented less text, we simplified the wording and we changed the picture into a textual overview so that the networks can be compared.

5 Discussion
A social network approach (SNA) offers a valuable framework to assess teacher
collaboration in the context of inclusive education, as this approach allows researchers to map a combination of formal and informal interactions and to get a close understanding of how collaboration takes shape in inclusive education. Moreover, this approach enables school teams to gain insight into, and to be more aware of their networks, in order to strengthen their collaboration. A SNA is only recently introduced in educational research, and to our knowledge no social network instrument (SNI) exists to assess and strengthen teacher collaboration in inclusive education. Therefore, a SNI was developed based upon existing literature and in close consultation with experts in the educational field. Next, the SNI was tested to guarantee the validity of the instrument. Concerning the validation, evidence was provided on the content, response processes and internal structure.

To provide evidence on the content and response processes, interviews and focus groups were conducted, which revealed that the questions were clear and comprehensive to most participants. Moreover, the majority of participants interpreted the network questions in the intended way. Some participants, however, interpreted adjusting the learning environment (LE) to the special educational needs (SEN) of an individual student and creating a powerful and accessible LE for all students similarly. Partly due to the latter finding, there was a tendency to select the same colleagues when it comes to adjusting the LE to the SEN of an individual student, as when it comes to creating a powerful and accessible LE for all students similarly.

The pattern of Quadric Assignment Procedure (QAP) correlations, which provides evidence on the internal structure of the instrument, confirmed the above findings. The correlational data suggest that there is a large overlap between the networks concerning adjusting the LE to the SEN of an individual student and the networks concerning creating a powerful and accessible LE for all students. The overlap seems to indicate that although these constructs are theoretically different, they are inherently intertwined in practice. For example, when a teacher visualises the daily routine for a student with autism spectrum disorder, all classmates can benefit from the structure that is offered. This intertwining is also underlying Universal Design for Learning: a LE that is accessible for students with SEN from the outset tends to yield benefits that make all students’ learning experiences better (Hall, Meyer, & Rose, 2012). On the other hand, there seems to be a difference between the networks around asking for support and the networks around giving support, as the correlations between these networks are weak to moderate. This suggests that teachers ask other colleagues for support than the people they give support themselves. The difference might indicate that they ask support from colleagues that they view as experts in creating an inclusive LE, and as these colleagues are viewed as experts, they do not give them support. It would be interesting to study more closely why teachers ask other people for support than the people they give support themselves.

The analysis of the cognitive load scale, interviews and focus groups revealed that for most participants it did not take much effort to complete the instrument. However, a remarkable finding is that several participants in the context of secondary education purposefully selected only a few people in the network questionnaire when they noticed it would take more time to fill out the questionnaire if they selected more people. Thus, it seems probable that fatigue effects were present in the questionnaire, which may have led to a diminished average out-degree, a bias that would be of concern when researchers aim to compare the density (i.e., the number of ties divided by the total number of possible ties) of different networks (Pustejovsky & Spillane, 2009).

Finally, experiences with the feedback on one’s school and personal network were explored by implementing interviews and focus groups. Although there were some aspects for improvement, the results show that the SNI can be a valuable tool to foster reflection on one’s collaboration and to gain insight into one’s network, which are
important steps in facilitating effective teacher collaboration (Baker-Doyle & Yoon, 2011).

5.1 Contributions
The development and validation of our SNI contributes to research in two ways. First, the instrument offers a novel approach to assess teacher collaboration in inclusive education, mapping a combination of formal and informal interactions. Our SNI can be applied to fully grasp the nature of teacher collaboration in inclusive education. For example, it can be examined how the type of interaction (i.e., asking for support and giving support) and the type of support (e.g., information, emotional support) shape social network structure in school teams. Second, this study shows some considerations that researchers need to take into account when developing and validating a network questionnaire. Since a wide variety of network types can be investigated (e.g., asking support, spending breaks, friendship) and every study is generally interested in a specific type of network, new network questionnaires are often developed to collect the appropriate data (Meredith, Struyve, & Gielen, 2014). By showing the different steps that need to be taken in developing a network questionnaire, this study can help researchers to develop high-quality network questionnaires. Additionally, our research demonstrated how a network questionnaire can be validated, which may be valuable and inspiring for researchers as validation of social network questionnaires is scarce and generally used reliability and validity checks, such as Cronbach’s alfa and convergent validity, are difficult to apply to network questionnaires (Meredith et al., 2014).

The current study also adds to educational practice by providing a feedback tool, which is new in the context of (inclusive) education. Individual teachers can use the SNI to map and reflect on their network, what can be a first step in strengthening their collaboration. Principals can use the instrument to get an overview of collaboration in their school team (e.g., the cohesion and central actors in one’s team) and then use these results in their policy making. E.g., to engage in dialogue with their team about what collaboration looks like ideally and about how to improve their collaboration in order to promote a more inclusive LE. The instrument can also be used in the context of professionalization, for example to explore whether there is sufficient interaction between team members to disseminate the new information and expertise across the network, or whether there are subgroups that hinder the dissemination of expertise (Daly, Moolenaar, Bolivar, & Burke, 2010; Penuel et al., 2009)

5.2 Limitations and future directions
In addition to these contributions, some limitations that suggest additional paths for future research should be considered. Firstly, in defining the network boundaries, we decided to include only school staff members. Although external partners, parents and students are also important actors in realizing inclusive education (Baglieri & Shapiro, 2012; Hornby & Witte, 2010), they are not included because of practical and methodological considerations. A first issue is that it would be hard to clearly define the network boundaries if these actors are included. Additionally, in order to apply a whole network design every network member needs to fill out the questionnaire and a high response rate is needed to reliably analyse the network structure (Wasserman & Faust, 1994). These requirements would be cumbersome to meet if external partners, parents and pupils were members of the network. A final practical concern is that the name list offered to respondents would become very long, which increases the cost fill in the questionnaire. It would be valuable for future research on teacher collaboration in inclusive education to include external partners, parents and students by adopting an ego-network design, in which respondents are allowed to mention any person they like.

Secondly, some participants interpreted adjusting the LE to the SEN of an individual student and creating a powerful and accessible LE for all students, similarly. It might be that this would not be the case if the order of the questions was changed, as a
respondent relies on contextual clues from a previous question to understand the meaning of a following question (i.e., question-scope redefinition) (Pustejovsky & Spillane, 2009). We have not explicitly investigated whether question scope redefinition could play a role here. However, the interviews and focus groups suggest that some participants interpreted the constructs similarly, irrespective of the question order. Future research might take into account question order effects by randomizing the order in which questions are posed and examine the effect of the order on networks (e.g., similarity between networks).

6 Conclusion

Teacher collaboration is considered essential in realizing inclusive education. As Carroll (2009) argues, “The idea that a single teacher, working alone, can know and do everything to meet the diverse learning needs of 30 students every day throughout the school year has rarely worked, and it certainly won’t meet the needs of learners in years to come.” (p. 13). This study opens new avenues by drawing on a SNA to assess and strengthen teacher collaboration in the light of inclusive education. The findings suggest that our SNI is a valid tool to assess teacher collaboration. Moreover, the instrument can be used to strengthen teacher collaboration by providing school teams insight into their social networks and by stimulating their network intentionality.

Notes

1 This research was supported by Flanders Innovation and Entrepreneurship [grant 150011].
2 The authors gratefully acknowledge the support of the POTENTIAL research and valorisation project (www.potentialproject.be). Furthermore, we would like to thank the stakeholders for their collaboration in developing the instrument. Additionally, we worked closely with IMEC, since they were responsible for technical aspects regarding the implementation of the instrument in an online environment. Lastly, we want to express our gratitude to the participants.

References


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Samenvatting

Ontwikkeling en validering van een sociaal netwerk instrument om de samenwerking van leerkrachten in het kader van inclusief onderwijs te meten en versterken

Een sociale netwerk benadering biedt een waardevol en innovatief kader om de samenwerking van leerkrachten in het licht van inclusief onderwijs in kaart te brengen en versterken. Het doel van deze studie is daarom het ontwikkelen en valideren van een sociaal netwerk instrument dat leerkrachten, schoolteams en onderzoekers inzicht verschaf in de samenwerking van leerkrachten in het kader van inclusief onderwijs. Betreffende de ontwikkeling, worden specifieke aandachtspunten in het ontwikkelen van een netwerkvragenlijst aangehaald en toegepast. Betreffende de validering, worden de inhoud, responsprocessen en interne structuur van het instrument onderzocht. Daarnaast worden de cognitieve belasting om de netwerkvragenlijst in te vullen en de meerwaarde van feedback op basis van deze netwerkvragenlijst bestudeerd. Data werden verzameld in drie lagere en twee secundaire scholen aan de hand van een mixed method design. De resultaten suggereren dat ons instrument een valide tool is om de samenwerking van leerkrachten te meten en versterken.

Kernwoorden: inclusief onderwijs; samenwerking van leerkrachten; sociale netwerk benadering; mixed method design
Appendix A

Example of a network picture of a school

Below you can see a network picture of your school about asking for support.

You are the red dot. Your colleagues are the grey dots.

If you ask a colleague for support, an arrow is signed from you to your colleague. If the arrow is two directional, you ask your colleague for support and your colleague also asks you for support.

The more colleagues you ask for support (in other words, there are a lot of arrows coming to you), the bigger your dot is.

The line colour indicates how often you ask for support. The darker the colour, the more often you ask for support (see legend).

When you click on the tabs above the network picture, you will only see the ties that are characterized by that type of support. For example, if you click on information, you will only see the ties where information is asked.
### Adjusted network questionnaire

<table>
<thead>
<tr>
<th>Type of interaction</th>
<th>Network question</th>
<th>Answer format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking support</td>
<td>Who do you usually ask for support to create a powerful and accessible LE for one or more student(s) with SEN?</td>
<td>Name list – multigrid</td>
</tr>
<tr>
<td></td>
<td>On average, how often do you ask this (these) person(s) for support?</td>
<td>Frequency scale with 4 options:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Once or several times a year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Monthly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Weekly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• (Almost) Daily</td>
</tr>
<tr>
<td></td>
<td>To what extent does this effectively support you to create a powerful and accessible LE for one or more student(s) with SEN?</td>
<td>5-point Likert scale (not supportive at all – very supportive)</td>
</tr>
<tr>
<td></td>
<td>What type(s) of support do you ask exactly?</td>
<td>Closed question with 9 options (multiple answers possible):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Didactic material</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Emotional support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Information</td>
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<tr>
<td></td>
<td></td>
<td>• Observation and feedback</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Super-/intervention</td>
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<tr>
<td></td>
<td></td>
<td>• Co-/team teaching</td>
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<tr>
<td></td>
<td></td>
<td>• Individual student support in class</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Student(s) support outside class</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Other</td>
</tr>
<tr>
<td>Giving support</td>
<td>Who do you usually give support to create a powerful and accessible LE for one or more student(s) with SEN?</td>
<td>Name list – multigrid</td>
</tr>
<tr>
<td></td>
<td>On average, how often do you give this (these) person(s) support?</td>
<td>Frequency scale with 4 options:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Once or several times a year</td>
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<tr>
<td></td>
<td></td>
<td>• (Almost) Daily</td>
</tr>
<tr>
<td></td>
<td>What type(s) of support do you give exactly?</td>
<td>Closed question with 9 options (multiple answers possible):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Didactic material</td>
</tr>
<tr>
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