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### Citation

Rienties, Bart C. (2019). Powers and Limitations of MMSNA: Critical Reflections and Moving Forward. In: Froehlich, Dominik E.; Rehm, Martin and Rienties, Bart C. eds. Mixed Methods Approaches to Social Network Analysis: Theories and Methodologies in Learning and Education. Routledge.

### URL

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# 1 Powers and Limitations of MMSNA: Critical reflections and moving forwards

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## *Abstract*

As highlighted by the 20 chapters in this book, there is an increased call for SNA researchers to embrace and mix methods developed in qualitative research to understand the what, how, and why questions of social network relations. At the same time, several researchers in the qualitative domain have encouraged researchers to start to embrace some of the principles of SNA and theory. In this final chapter, I will reflect on the contributions of the authors of this book as well as my own twelve years of working with social network data and experimentations of quantitative and qualitative data methods and approaches, what has worked, and what has not. In particular, I will focus on how recent phenomena of learning analytics and big data allow researchers and practitioners tremendous opportunities to unpack the complexities of social relations and how people learn, while at the same time cautioning about potentially over-interpreting relations between people when not triangulating trace-data with attitudes, behavior, and cognition of human interaction. At the same time, I will discuss the potential limitations of SNA approaches, in particular given the complexities of mastering two ontologically different methods.

## 1.1 Introduction

“Yeah, well, you know, that’s just, like, your opinion, man.” Jeffrey “the Dude” Lebowski talking to Jesus Quintana in *The Big Lebowski*

For those who are familiar with the movie *The Big Lebowski*, this quote has put a smile on your face. For those unfamiliar with this movie, the moral of the story is that everything in life is perception, or “your opinion, man” in Dude language. When I first watched this cult movie around 2002, I was working at Maastricht University, and we just started to introduce this new amazing thing called “e-learning”. By working together in a small project team of young enthusiastic teachers to launch a learning management system called Blackboard, we coincidentally framed the e-learning strategy for the entire university for many years to follow (later on I discovered that in social network theory this was related to first-mover advantage, critical mass, knowledge spillover, and positive externalities).

While working on this Blackboard project I was also teaching with Professor Robin Cowan on a post-graduate course called Network Economics. This course used a then innovative interactive feature where students could write online messages to each other and collaborate together using a computer using a tool called online discussion board. While working together with dozens of students online, well before WIFI and smart phones were ubiquitous, I quickly noticed that some students were very active, while others were not (Rienties, Van Wesel, & Gijssels, 2008), which was also reported in this book (i.e., Rehm et al., 2020; Törnberg & Törnberg, 2020). Probably by discussing the notions of networks with my students and co-teachers, one or two seeds were planted

in my head that these mechanisms of networks in businesses, organizations and science (Barabási, 2002; Cowan & Jonard, 2004) might also work in education.

Eight years after watching the Big Lebowski (there is no intended correlation here) I finished a PhD that used a combination of SNA, content analysis, and academic motivation to better understand why some students became active contributors to higher cognitive discourse, while other students were more on the outer fringe of the network (Rienties, 2010; Rienties, Tempelaar, Giesbers, Segers, & Gijssels, 2014; Rienties, Tempelaar, Van den Bossche, Gijssels, & Segers, 2009). Prospective students from across the globe were working together from anywhere in the world on authentic economics problems before they started at Maastricht University, using the Blackboard system originally implemented in 2002.

In this Chapter, in line with the Participatory, Reflexive, Integrated, Critical, and Ethical (PRICE) model of Onwuegbuzie (2020) I aim to reflect upon the MMSNA book in general and using MMSNA in my daily practice. I will provide four relatively unique exemplars of mixing SNA with other methods that I aim to link with this common and unique narratives in this book. These four exemplars are positioned in a chronological manner, but no implicit order or hierarchy of insight is meant with this order.

## *1.2 Social Networks: why relations matter*

As highlighted throughout this book, SNA can be a powerful approach to understand the complex web of relations between people and objects (Froehlich, 2020; Längler, Brouwer, & Gruber, 2020; Onwuegbuzie, 2020; Palonen & Froehlich, 2020; Sarazin, 2020). At the same time, there is an increased recognition that social network approaches, which mostly rely on collecting “quantitative” social network data, might under- or over-estimate complex, dynamic, fluid, non-linear, and intangible relations and constructs within individual, groups, sub-communities, and social space in general (De Laat & Lally, 2004; Jindal-Snape & Rienties, 2016; Onwuegbuzie, 2020; Palonen & Froehlich, 2020; Rienties & Hosein, 2015; Rienties, Johan, & Jindal-Snape, 2015; Törnberg & Törnberg, 2020). As is evident from this book, and in particular by Froehlich (2020b), Palonen and Froehlich (2020), Sarazin (2020), and Thomas et al. (2020), a wealth of reasons are provided to consider mixing SNA methods with other methods.

In terms of collecting SNA data, typically SNA researchers distinguish between objective and subjective SNA data (Scott, 2012). In objective data SNA researchers use actual trace data of interactions between nodes, such as email conversations (McCallum, Wang, & Corrada-Emmanuel, 2007), discussion threads (De Laat, Lally, Lipponen, & Simons, 2007), social media posts (Rehm et al., 2020; Törnberg & Törnberg, 2020), video-taped conversations (Bohle Carbonell et al., 2020), or Wikipedia feeds (Rehm, Littlejohn, & Rienties, 2018). These “objective” data allow researchers to determine for example who is central in the network, and whether there are potential sub-groups present within organizations, see also Längler et al. (2020).

Similarly, a large number of MMSNA researchers in this book have used “subjective” SNA data approaches, whereby in a closed (i.e., a clearly delineated group of participants: class room; department; village) or open network approach participants are asked SNA questions like “who are your friends”, “who do you go for advice”, “from whom have you learned in the last four weeks”. Some excellent examples of these closed approaches are provided by Längler et al. (2020) and Froehlich, Mamas & Schneider (2020), while some excellent examples of open approaches are provided in Törnberg & Törnberg (2020) and Van Waes & Van den Bossche (2020).

Obviously there are several methodological and ontological issues with objective and subjective SNA data (Moolenaar, 2012; Scott, 2012). For example, with subjective data there are obvious concerns about recall (Neal, 2008), and whether participants actually will remember certain social interactions,

and whether they are able to “correctly” position these. Similarly, even if objective SNA data identifies that a person is central in say an email network, this does not automatically imply that this person is also central in the organization (e.g., an administrator standardly included in conversation). For example, an analysis of a range of historical Wikipedia pages on the first women starting at Edinburgh University were uploaded by a couple of people in a Wiki event (Rehm et al., 2018), but in hindsight these were primarily people who had support roles, rather than the actual historians who just sent the information to the administrators. Furthermore, as highlighted in this book (Korir et al., 2020; Onwuegbuzie, 2020) there are several ethical issues when collecting and reporting on MMSNA studies.

In the remainder of this Chapter, I will provide four exemplars and perhaps more importantly reflect upon the lessons learned, what went well, and what I would have done differently if I would redo these studies. As highlighted by Winston Churchill, success consists of going from failure to failure without loss of enthusiasm.

### *1.3 Exemplar 1: Combining Objective SNA Data with Content Analysis*

In an online summer course run in Maastricht from 2005-2013 (Rienties, 2010; Rienties et al., 2014; Rienties et al., 2009), we were interested to know which types of motivated students were more inclined to contribute to online discourse and higher cognitive discourse in particular when working together in discussion forums. In this study from data of the summer course in 2005/2006 we analyzed data from 82 participants. In total, three different approaches were used to mix the various data into an MMSNA format.

First of all, we collected the objective SNA data from the interaction patterns in discussion forums, whereby we calculated both Freeman’s degree of Centrality (Wassermann & Faust, 1994) as well as ego network density of each individual within the network.

Second, we used content analysis to determine what students were actually talking about in the online summer course. The aim of content analysis techniques is to reveal evidence about learning and knowledge construction from online discussions (Rienties et al., 2009). Content analysis for evaluating discourse activities was based on the instrument of Veerman and Veldhuis-Diermanse (2001). Using these data, we measured the degree of centrality in “higher cognitive” discourse by linking content analysis data of theoretical ideas, explication and evaluation. Finally, individual motivation was measured by the Academic Motivation Scale by Vallerand et al. (1992), which distinguished between intrinsic, extrinsic and a-motivation.

As indicated in Figure 20.1, John and Catherina had a so-called “reciprocal” link, as they reacted both to each other’s contribution, and the arrow goes in both directions. However, John and Catherina did not have any direct link when looking at higher cognitive discourse in Figure 20.2. Second, some learners like Andre, Mark, Judith, and Rick were central in Figure 20.1 while others like Maria, Rick, and Tiffany were central in the higher cognitive network of Figure 20.2. In other words, not every learner who was central in the overall network (e.g., Andre, Judith) was also central in the higher cognitive network. Other learners who were not central in the overall network became central contributors to higher cognitive discourse (e.g., Maria and Tiffany). Hence, by integrating content analysis with SNA, we were able to distinguish multi-layered interaction patterns among learners based upon the type of discourse.

Figure 20.1

Figure 20.2

The results of Exemplar 1 indicated that learners contributed differently to discourse in online settings, depending on their type of motivation (Rienties et al., 2009). Some learners became active contributors to discourse, while other learners contributed only a limited amount to discourse. Although these results have already been found in other studies, this study was the first to empirically demonstrate that motivation was one of the determinants explaining the differences in the amount and quality of contributions to discourse in online settings. In other words, by combining two additional methodologies (psychometric instrument; content analysis) to objective SNA data, we were able to unpack complex, and perhaps hidden, social interactions between learners that were not visible by just analyzing objective SNA interaction data.

### 1.3.1 Lessons learned

This study is one of the most cited studies in CSCL using SNA (Cela, Sicilia, & Sánchez, 2015), and has encouraged me to look beyond pure SNA data to aim to understand what participants are actually talking about, and why. Although the content analysis could be regarded by some to be a qualitative approach, which of course is dependent on the coders and the respective coding scheme, in a way Exemplar 1 is probably an example of a mixed quantitative SNA approach (Froehlich, 2020a, Toraman & Plano Clark, 2020).. At the same time, analyzing over 2,000 messages by hand by three independent coders was a substantial amount of work, as well as integrating the various datasets. One wonders whether a simple closed network survey at the end of the module with a question like “from whom have you learned the most about economics during this online summer course” might have been easier. For example, using machine learning approaches to automatically mine text could be more efficient (Rehm et al., 2020). In addition, we did not specifically ask why some participants were more inclined to contribute to (higher cognitive) discourse, and why others were not contributing to discourse. Follow-up interviews based upon participants’ network positions would have provided interesting (counter)supportive perspectives, such as for example clearly illustrated by Thomas et al. (2020).

### 1.4 Exemplar 2: Closed SNA with interviews

Exemplar 2 took place in an elective post-graduate module of 207 students in Organizational Behaviour in the UK in 2011 (Rienties, Héliot, & Jindal-Snape, 2013). The primary aim of this study was to understand how 191 international students from 34 cultural backgrounds and 16 UK students built learning, working, and friendship relations over time. Students were enrolled in small groups and were expected to work face-2-face in discussion forums on case-studies before the next lecture.

First of all, we measured the pre-existing friendship, work, and learning relations using closed SNA in week 4, and repeated this at the end of the module at week 11. A range of matrixes were created to control for pre-existing networks (i.e., friend, learn, work at M1), as well as demographics (i.e., conationality, Chinese), and teaching related factors (i.e., group division, specialization). Second, we invited two teams for follow-up focus groups one month after the module was completed based upon the (lack of) interaction in the online team forums.

Figure 20.3

As illustrated by Figure 20.3 and our MRQAP analysis (Rienties, Héliot et al., 2013), in contrast to research in medium-sized classrooms (Rienties, Hernandez Nanclares, Jindal-Snape, & Alcott, 2013) and expectations raised by Hendrickson, Rosen, and Aune (2011), team work was not effective in crossing cultural boundaries. Nonetheless, the focus group interviews did indicate that some students did learn from their interactions in their cross-cultural groups.

Although some UK students developed substantial friendships with international students, most UK students formed a relatively separate subgroup of social learners. From the triangulation of the SNA with focus groups, when the international students came from smaller nationality groups, they were seen to integrate well with UK students or international students from other countries, as the need to develop links outside one's culture probably was stronger for these students (Rienties, Hernandez Nanclares et al., 2013).

#### 1.4.1 Lessons learned

In comparison to Exemplar 1, the amount of time required to collect and analyses data in this Exemplar 2 was relatively limited. First, a particular useful feature to ensure that we passed the response rate of > 80% was to distribute the pre- and post SNA in the actual lecture by the teacher, who actively encouraged students to participate. Furthermore, students received individualized (semi-automated) feedback on their network results and the results of the SNA were discussed during the next lecture, which was an additional incentive for students to participate.

Second, although the triangulation of the SNA with data from the focus groups was useful, one of the drawbacks of inviting all participants of the respective group was that individual voices at times were lost. In particular UK students and international students with strong English language mastery often contributed during the semi-structured focus groups, even though specific attempts were made to be inclusive.

Third, as we only asked about students' network relations within the module, and not within other modules, or outside the classroom environment, we might have missed potential other network support structures of learners, as for example illustrated by Thomas et al. (2020) and Van Waes & Van den Bossche (2020). For example, around 20 participants indicated not to have learned from anyone in Figure 20.3 (and none of the 187 participants learned from these students), but perhaps these students had strong networks to discuss their practice outside the formal boundaries of the classroom (Akkerman & Bakker, 2011; Hommes et al., 2014).

An additional issue that may explain this rather surprising finding is that many Confucian Asian students used Westernized names (e.g., Brenda) in class, while the list of names included only their official names (e.g., Wang). In the pre-test students could indicate their preferred name if this was different from their official registered name, which was afterwards updated in the post-test. Informal discussions with students indicated mixed reactions to this approach, as some Chinese students knew Brenda only as Wang, while other students knew Wang only as Brenda. Another obvious issue is that many Confucian Asian names start with a C, W, X, Y, Z, which might negatively position this group (i.e., at the end of a SNA survey, when questionnaire fatigue might be an issue).

#### 1.5 Exemplar 3 Closed SNA with case-studies

Exemplar 3 took place in a third year undergraduate module with 81 students at a UK university in 2013 (Rienties et al., 2015). Like Exemplar 2, first we used a closed network approach of pre-test at Day 1 and post-test after 11 weeks. Second, we used an embedded case study (Yin, 2009) whereby we selected five potential cross-cultural bridge builders based upon their relative position at the pre-test, and we interviewed these five students one months after the post-test. We developed a

thematic analysis around eleven key themes that reflected the meanings attributed to internationalization (Hendrickson et al., 2011; Jindal-Snape & Rienties, 2016) and social network literature (Borgatti, Mehra, Brass, & Labianca, 2009; Moolenaar, 2012; Rienties, Héliot et al., 2013).

We found that students developed complex, and dynamic, strategies to work in mixed groups. In Table 20.1, the key characteristics of how these five students coped with the module and learned together with different students are illustrated. While all five students were academically average-to-highly-able students, how they coped with the challenging mixed group environment differed substantially. For example, host student Jennifer and international student Misaki met nine out of eleven bridge building concepts in an international classroom, while Eyah illustrated only four of these concepts.

Table 20.1 Characteristics list of bridge builders: summary of five case study participants

| Characteristics  | CS1      | CS2    | CS3    | CS4       | CS5  |
|--|----------|--------|--------|-----------|------|
|  | Jennifer | Misaki | Fatima | Magdalena | Eyah |
| Cultural sensitivity   | √        | √      | √      |           |      |
| Motivation to do well  | √        | √      | √      | √         |      |
| Positive about sharing and learning from others                    | √        | √      | √      |           | √    |
| Positive about differences in practical and theoretical experience | √        |        |        |           |      |
| Positive about different styles of learning                        | √        |        | √      |           | √    |
| Conscious strategies for conflict resolution                       | √        | √      | √      |           |      |
| Leadership skills  |          | √      |        |           |      |
| Adaptability   |          | √      |        |           | √    |
| Respecting other people's choices                                  | √        | √      | √      | √         |      |
| Good communication skills and willingness to communicate           | √        | √      | √      |           |      |
| Academically able  | √        | √      | √      | √         | √    |

Note that if response is not ticked, this does not imply that a student does not have this characteristic, but that during the interview this characteristic was not made explicit.

Source: Rienties et al. (2015)

In contrast to Jennifer and Misaki, the other three potential bridge builders became relatively more isolated from their assigned group and positioned more closely to peers with similar cultural backgrounds. For Fatima and Magdalena this move away from the center was a conscious choice, while for Eyah the focus toward Confucian Asian students was a result of her extremely negative (perceived) experiences when working in a group with only UK students (Rienties et al., 2015).

### 1.5.1 Lessons learned

This was the first time we used an embedded case-study where we specifically sampled students based upon pre-determined conceptualizations of cross-cultural bridge builders. This provided profound and deep insights why some students indeed became cross-cultural bridge builders over time, while others did not. At the same time, in line with recommendations by Shannon-Baker & Hilpert (2020) and Palonen & Froehlich (2020) by visualizing the SNAs back to the five students this induced both positive and negative feelings of students. For Misaki it was a rewarding experience as she received confirmation of her wide cross-cultural network, and was pleased to see how well she was connected across the different cultural groups. In contrast, for Eyah the interview was rather traumatic, as she was clearly distressed by the negative experiences of her UK group members, who ignored her inputs into group discussions. This was further accentuated by seeing the SNA visualizations of a lack of reciprocity by her group members. Although the second interviewer and I received a warm email message after the interview, this was clearly a negative experience for this student. This issue is also linked with ethical concerns of conducting MMSNA, as described in Korir et al. (2020).

### 1.6 Exemplar 4 SNA of digital data

In line with more recent explorations of digital data to uncover complex interactions between people and artefacts (Froehlich, Mama et al., 2020; Rehm et al., 2020; Törnberg & Törnberg, 2020), the fourth and final exemplar took place at the Open University UK in 2017, whereby we linked the learning design of modules with the specific learning activities that students were expected to do (Nguyen, Rienties, & Toetenel, 2017). For a detailed description of the learning design approach used, I refer to Rienties and Toetenel (2016). In particular, we explored fine-grained engagement patterns of 267 assimilative activities (i.e., audio, figure, photo, table video, word) in one social science module. In a way, this study is representative of a new wave of opportunities using learning analytics and big data (Ferguson et al., 2016; Rienties, Nguyen, Holmes, & Reedy, 2017; Rienties & Toetenel, 2016; Saqr, Fors, & Nouri, 2018). By combining learning design data with fine-grained activity-type data, we were able to link what students were expected to do on a week-by-week basis. As illustrated in Figure 20.4, a combination of assimilative, assessment, productive, and finding information activities were combined over time in this social science module. The majority of learning activities were assimilative, with six formative assessments over time and a final assessment.

Using SNA analyses, we found that assimilative and productive activities were often co-occurring over time. The majority of assimilative activities took forms of words, which indicated that teachers primarily designed reading materials, interspersed with other media. There were strong connections between the use of words with photos, tables, and figures, in line with the multi-media principle of Mayer (2003). Furthermore, videos were often used in combination with finding information activities and productive activities. For example, students were asked to watch a short video, and answer some questions using the information from the video. As illustrated in Figure 2.5, there were two local networks, in which the right hand side mainly contained assimilative activities, whereas the left hand side consisted of more “interactive” activities. The connection between words and productive activities acted as a bridge between these two local networks.

Figure 20.4

Figure 20.5

### 1.6.1 Lessons learned

Over the last four years I spent a considerable amount of time linking how teachers design blended and online distance courses with how students are actually engaging with these learning designs (Rienties et al., 2017). While most of our research has focused on individual trajectories of students and aggregating learning activities data (Rienties & Toeteneel, 2016), the SNA approach to visualize how different types of learning activities are commonly linked by teachers provided some interesting new insights. Of course, being able to determine common design patterns of how teachers combine particular learning activities is extremely insightful, in particular if this could help new teachers to learn from well-established good practice, as well as experienced teachers who might need some support to create sustainable but innovative practice.

One obvious limitation is that these common design patterns arising from learning analytics analyses do not necessarily provide insight why some teachers used common design pattern X, while others used common design pattern Y or Z. At the moment Quan Nguyen is interviewing teachers from a range of diverse learning designs to get an in-depth understanding how and why teachers are making substantially different learning design decisions.

Another obvious limitation of this approach is that we currently do not know how individual students make decisions in when, how, where, and with whom to engage with these learning designs. Initial research seems to indicate that many students do not necessarily follow the intended learning designs (Nguyen, Huptych, & Rienties, 2018), but why this is the case and how social relations might influence individual decisions to engage have not yet been explored.

### 1.7 Discussion and moving forwards

As evidenced throughout this book there is an increased call for researchers to embrace and mix methods developed in quantitative and qualitative research to understand the what, how, and why questions of social network relations. This book highlights some of the potential MMSNA approaches researchers and practitioners could take to explore the complex social interaction processes in education. Whatever mixed method social network analysis (MMSNA) method one adopts, as also highlighted elsewhere in this book (Onwuegbuzie, 2020; Shannon-Baker & Hilpert, 2020; Toraman & Plano Clark, 2020) we have to be mindful that the interpretation of these networks and related data are just our unique interpretations of reality, which are strongly influenced by our chosen methods, our analyses, and our own lenses and perspectives.

In particular, in line with the PRICE framework of Onwuegbuzie (2020) the primary lesson I learned is to continuously engage the stakeholders in the design, implementation, and evaluation of the research (De Laat & Lally, 2004; Hommes et al., 2014). By discussing initial trends and visualizations of SNA with the rich narratives from the qualitative approaches some interesting and unexpected findings emerged over time. At the same time, while great care was taken to code data with multiple coders, each with their own unique lenses, a major limitation of all four exemplars was that the interpretations of these findings were primarily reliant on the respective research teams. As suggested by Toraman & Plano Clark (2020), future research should aim to not only triangulate quantitative SNA with other quantitative and qualitative data, but also to go back to the main stakeholders to determine whether (or not) the “emergent” findings resonate with the actual lived experiences of students, teachers, and senior management.

In the movie *The Big Lebowski*, in one of the classic scenes the Dude looks into a mirror framed as Time magazine of “Man of the Year: Are you a Lebowski achiever?”, and shrugs this off with a smile.

Although all four exemplars in this chapter have been published in leading journals and conferences, and I still firmly stand behind the rigor of these studies and its respective findings, as a continuously evolving researcher at times I wanted to have a Back-to-the-Future time machine and redo some of my analyses with the benefit of 20-20 hind-sight. Therefore, I hope that social network and MM researchers will continuously look into their own mirror, and ask whether the proposed approach is the best approach to address the respective research question(s). Perhaps more importantly, once the data has been collected, following the excellent PRICE recommendations by Onwuegbuzie (2020) I would encourage researchers and practitioners to be critical and reflexive, and investigate whether (or not) there are alternative interpretations possible.

On behalf of the three editors of this book, I hope that this book has inspired you to potentially explore SNA, MM, and where possible MMSNA approaches. We are looking forward to hear from you and have created a twitter handle #MMSNA\_ed and account (@EdMMSNA) to share insights and perspectives. By sharing your latest research, wild ideas, queries, or random thoughts on MMSNA, we hope to keep in touch to think about how we can continue to understand the complex world around us using MMSNA.

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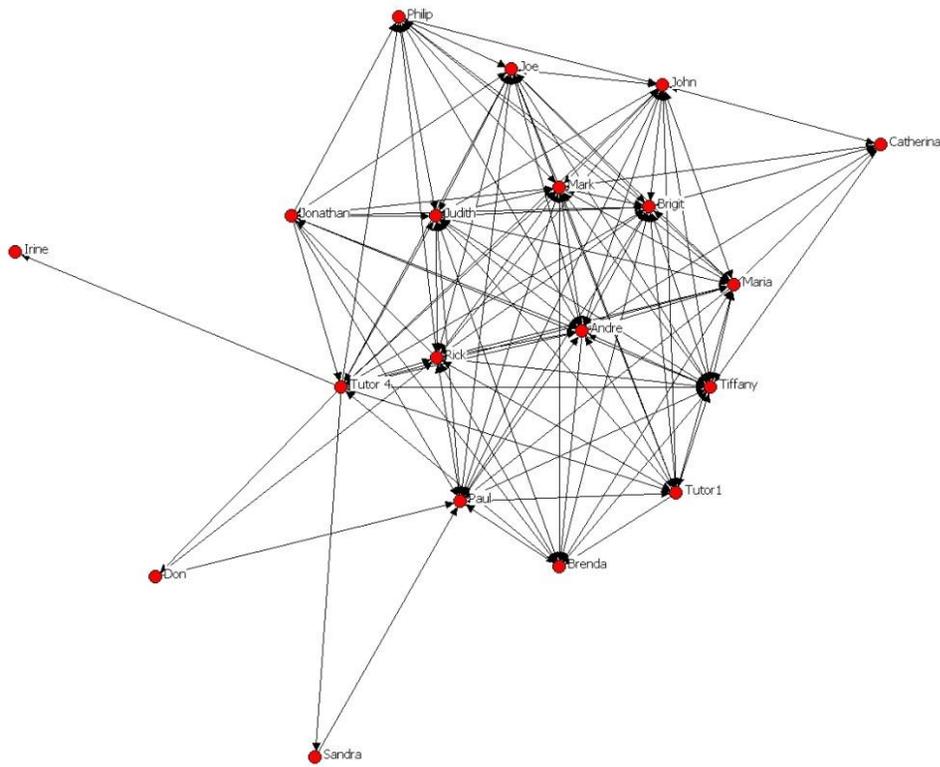
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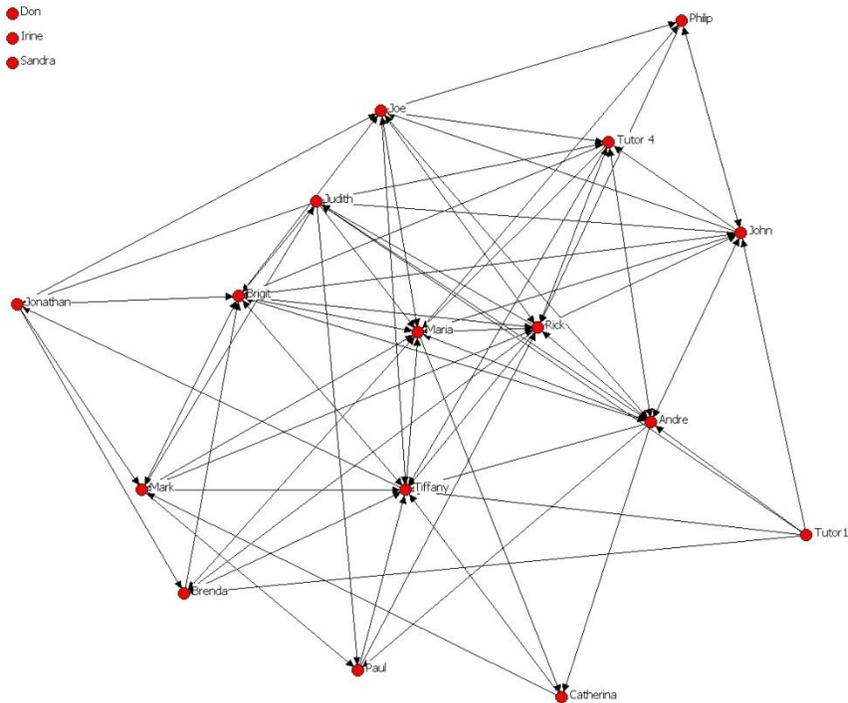


Figure 20.1 Social Network of all discourse activity



Source: Rienties et al. (2009)

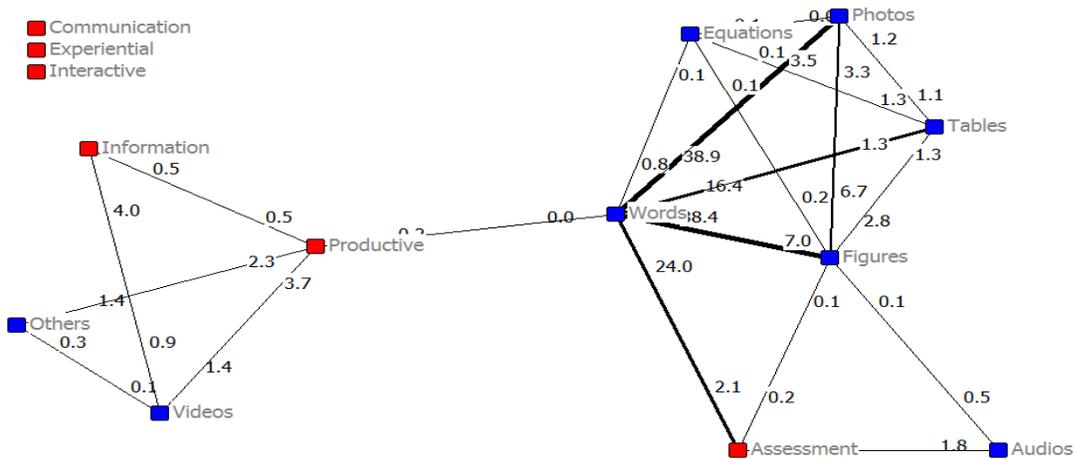
Figure 2.2 Social Network of higher cognitive discourse





Source: Nguyen et al. (2017)

Figure 20.5 Inter-relationships between assimilative activities and other activities of an exemplar module in Social sciences



Note: Blue nodes represent assimilative activities, red nodes represent other activities

Source: Nguyen et al. (2017)