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Exploiting Metacognitive Networks Embedded in Narrative Focus Group Interviews Using NodeXL

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Abstract

Development of metacognitive theory for changing pedagogy remains an essential research activity. A lack of sufficient clear-cut qualitative analysis procedures extracting embedded metacognitive constructs from qualitative data (e.g., narrative focus group interviews) can hinder development of theory. An approach is therefore needed to analyse qualitative metacognitive data exploiting embedded metacognitive constructs for theory development. In an undergraduate fourth-year mathematics education module, two groups of students (Group A: n = 6; Group B: n = 5) participated in a series of focus group interviews. Participants designed and refined mathematics lessons about the concept of place value. We identified metacognitive networks as an embedded construct in students' metacognitive processes. Findings indicate that metacognitive networks of an individual, social and socially shared metacognitive nature are embedded in qualitative data, and can be exploited to develop new metacognitive theory. We offer a novel three-step process in this methodology paper to extract metacognitive networks using Microsoft Office, ATLAS.ti and NodeXL.

Keywords

Metacognitive Networks, Focus Groups, NodeXL, Social Network Analysis, Qualitative Research Methodology, Metacognitive Locale

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Exploiting Metacognitive Networks Embedded in Narrative Focus Group Interviews Using NodeXL

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Development of metacognitive theory for changing pedagogy remains an essential research activity. A lack of sufficient clear-cut qualitative analysis procedures extracting embedded metacognitive constructs from qualitative data (e.g., narrative focus group interviews) can hinder development of theory. An approach is therefore needed to analyse qualitative metacognitive data exploiting embedded metacognitive constructs for theory development. In an undergraduate fourth-year mathematics education module, two groups of students (Group A: n = 6; Group B: n = 5) participated in a series of focus group interviews. Participants designed and refined mathematics lessons about the concept of place value. We identified metacognitive networks as an embedded construct in students' metacognitive processes. Findings indicate that metacognitive networks of an individual, social and socially shared metacognitive nature are embedded in qualitative data, and can be exploited to develop new metacognitive theory. We offer a novel three-step process in this methodology paper to extract metacognitive networks using Microsoft Office, ATLAS.ti and NodeXL. *Keywords: Metacognitive Networks, Focus Groups, NodeXL, Social Network Analysis, Qualitative Research Methodology, Metacognitive Locale*

Metacognitive theory development plays a crucial role in the understanding and development of new pedagogy. To develop theory, a collection, analysis, and interpretation of data is needed to determine how data inform theory. However, few publications elaborate on qualitative methodological considerations for researching metacognition and extracting its embedded constructs (e.g., metacognitive knowledge and metacognitive regulation). Qualitative data, such as narrative transcriptions from focus group interviews, may promise difficulty in contributing new metacognitive theory about these constructs if the approach is not theoretically grounded within the conceptual-theoretical framework of metacognition. Research methodology therefore remains an important focus for development of metacognitive theory and a lack of appropriate data analyses techniques can hinder theory development if the analysis overlooks underpinning metacognitive constructs embedded within the data. The authors agree with McKetcher, Gluesing, and Riopelle (2009) that scholars who wish to study the underlying structures hidden within qualitative data need to consider the issue of duality in data analysis. For example, Pasquali, Timmermans, and Cleeremans (2010) identified the concept of metacognitive networks as a neural construct embedded within categories of consciousness and awareness. This dual nature of the data suggests underlying metacognitive constructs necessary for theory development can be overlooked if data analysis techniques do not extract the data, identify and exploit the embedded constructs for theory development. By understanding how such constructs can be extracted, new metacognitive theory can be generated to inform new pedagogy.

To analyse qualitative data, to extract, explore and visualise these embedded metacognitive constructs, to generate new metacognitive theory, appropriate and sufficient qualitative data analysis techniques are needed. The current study offers a way through which embedded metacognitive constructs, such as metacognitive networks, can be exploited for theory development using social network analysis (SNA). However, SNA requires domain experts to use adequate programming language associated with software packages for manipulation and visualisation of these network types (Smith et al., 2009). Seeking a structured approach to convert qualitative data into network data, we have trialled network analysis software packages suggested by McKetcher et al. (2009) for use in a Windows 8.1 operating system. The aim was to discover, explore and visualise embedded network data, both social and conceptual in nature, within transcribed narrative data of focus group interviews in the context of metacognitive theory. Mainly, programmes such as Multinet, Pajek and UNICINET were considered as numerous sources (e.g., Bonsignore et al., 2009; McKetcher et al. 2009) report on successful implementation of social network analysis, using these and similar programmes. Yet, each package offered some difficulties that hindered the data analysis process and, for us, required knowledge and vocabulary associated with SNA that impose obstacles for those who are not familiar with network metrics or who lack the technical skills and experience associated with the programmes. As proletarians of SNA software, analysis became time consuming and affected the network analysis process. For this reason, a SNA package was sought to meet the conditions of SNA (e.g., node visibility, countable degrees, identifiable clusters and outliers) as stipulated by Bonsignore et al. (2009) and, at the same time, offer sophisticated, and fairly manageable network analysis without the obstacles of technical skills and experience experts in the field are familiar with.

Network analysis through NodeXL was conducted to show both data of a social and conceptual nature could be extracted. In analysing the focus group interviews, a three-step set of procedures were identified and implemented. Specifically, the study set out to determine how metacognitive constructs, such as metacognitive networks, could be extracted from qualitative data narrative focus group interviews. The approach offered here is considered particularly useful for researchers, practitioners and analysts using network analysis to reveal embedded networks in qualitative data. The findings are contextualised in the theory of metacognition and social network analysis through an interpretivistic-hermeneutic effort. The networks were then illustrated as maps of the metacognitive knowledge and regulatory architecture of an individual or group's metacognitive processes. Analysis through NodeXL revealed metacognitive networks embedded within qualitative data, which can be exploited for theory development.

Conceptual-Theoretical Framework

Qualitative research methodology enables researchers to gather, explore and extract constructs or themes, interpret data and produce new understandings (Bowen, 2005). Mainly, qualitative research methodology follows five distinct traditions to build theory including biography, case study, ethnography, grounded theory and phenomenology. These traditions usually involve interviews, observations, narratives and archival documents as methods to extract data. To reveal and define possible relationships between data sets, researchers often make use of qualitative methods such as narratives of individual and focus group interviews to illuminate participants' experiences and their views (Rymal, Martin, & Ste-Marie, 2010). In doing so, the qualitative nature of the research encourages participants to reflect on their experiences through conversations and discourse analysis. These methods include content analysis of the narratives of transcribed interviews to generate emerging theory (Shah & Corley, 2006). This narrative account can be useful for metacognitive theory building as reflection kindles metacognition and requires a way in which qualitative data can be analysed. To do so, the qualitative researcher must engage analysis procedures with data collection methods, ensuring academic depth and rigor in the process (e.g., Tracy, 2010; Hoon, 2013). Rigor in data analysis suggests the process of sorting, identifying and organising data must be accompanied by a credible account of the social, individual and contextual nature of the study (Tracy, 2010). Only then can new and creative types of data analysis emerge through improvisation and originality in the research process. This development promises practical usefulness by closing the theory and practice gap and producing new pedagogy. One way this can be done is using computer assisted qualitative data analysis software.

Qualitative Analysis through ATLAS.ti in Metacognition Research

ATLAS.ti is one example of computer assisted qualitative data analysis software and can be used as an analytical tool to inductively code and analyse qualitative data. We favour ATLAS.ti because the program is suited for dealing with and managing large quantities of data (Veronese et al., 2015), which is useful in research with follow-up focus group interview sessions (e.g., in educational design-based research studies). Typically, the process of data analysis using these software packages requires researchers to create a set of codes collected through themes or categories linked to words, phrases or segments in the data, relating to theory building (Bowen, 2005). The purpose of the analysis process is to identify the constructs to, ultimately, produce a logical definition and explanation of the relationship between them. The codes through which this analysis can be conducted must therefore be contextualised in the conceptual-theoretical framework within which the study resides (Shah & Corley, 2006). In this case, a-priori analysis allows researchers to code possible products from the data before the analysis begins (Rodriguez & Bosch, 2008). This is often a heuristic process as researchers (1) import the transcribed interview narratives as texts into the program, (2) develop a coding scheme (3) constantly compare different coded sections to ensure quality (Tracy, 2010) and (4) conduct pattern matching whereby results are captured and organised in a matrix or visual display (Hoon, 2013). It seems that qualitative metacognition researchers, almost regularly, follow this process as the examples in Table 1 show.

Table 1: Examples of Metacognition Research in Which Qualitative Analysis was Conducted Using ATLAS.ti.

Data analysis technique used in example	**Metacognitive domain associated with keywords**	**Embedded constructs of metacognition**	**Coded schema used**	**Pattern matching technique**	**Source**
Content analysis	Metacognitive knowledge	Self-esteem and social belonging	Semantic nodes are ascribed to families (or clusters)	Network map of codes and associations with categories	(Veronese et al., 2015)
Online network discussions	Metacognitive regulation	Individual and social regulatory processes	Interpretive coding and inter-coder reliability	Matrix of coded data and network visualisation using symbolic indicators as threads between the data	(Iiskala et al., 2015)
Observational notes	Metacognitive knowledge	Social support in the classroom based on the task and individual needs	Comparing, contrasting, ordering and establishing linkages		(Ader, 2013)
Textual analysis		Social influences and the sharing of individual responsibilities			(Rodriguez & Bosch, 2008)
Network discussions		Individual and social responsibilities in problem solving			(Hurme, Palonen, & Järvelä, 2006)

The examples indicate a conspicuously linear path of qualitative data analysis in metacognition research. Even so, two enduring concepts appear embedded within the qualitative data as the authors report on metacognition's association with *individual* and *social* processes of metacognitive thinking, and have attempted to exhibit these processes and their relationships as constructs in ATLAS.ti's network view. ATLAS.ti's network manager offers researchers the opportunity to display the coded data segments as a semantic map or network visualising the association between constructs and their clusters (Bringer et al., 2006). However, these visualisations are manually distributed whereby the researcher determines (through paradigmatic assumptions) if, when and what constructs should be aligned (or linked) and where it should be placed in the network view. The network view is believed to reveal the interconnectedness of the data restricted by the coded schema, researchers' assumptions and their conceptual-theoretical dispositions. Therefore, qualitative analysis produces an ideological (often 2-dimensional) semantic map (or network) of the constructs that emerged from the data. Researchers who have noticed this have attempted to manipulate ATLAS.ti's powers in qualitative analysis (e.g., Veronese et al., 2015; McKetcher et al., 2009) by importing the coded data into other programs (e.g., SPSS & Multinet) for further statistical or qualitative network analysis. In so doing, they provide what, appears to be, the methodological shifts needed for metacognitive theory development.

McKetcher et al. (2009) argue the need for clear and explicit descriptions to convert narrative interview data into appropriate formats to reveal the results as constructs within the framework of the theory. In one such an attempt, McKetcher et al. (2009) offer a five step approach revealing social networks embedded in narrative focus group data following the use of five software programs (Microsoft Word, Excel, ATLAS.ti, SPSS and Multinet). Reflecting on the scarcity of similar attempts, particularly in metacognition research, we reviewed and adapted McKetcher et al. (2009)'s process in this study to reveal embedded metacognitive constructs in focus group data. Narratives of the focus group, predominantly, serve as a corpus of individual and social reflections which, Table 1 shows, can associate with metacognition's constructs. Since theory explains the relationship between constructs, individual and social reflections require a social analytical approach to reveal and define the embedded relationships. Hurme et al. (2006) argue social network analysis can serve as a theoretical framework to guide such explanations.

Social Network Analysis in Metacognition Research

According to Hurme et al. (2006) metacognitive processes (e.g., metacognitive knowledge and regulation) are products of social interaction. For instance, Iiskala et al. (2015) introduce the concept of socially shared metacognitive regulation through a SNA approach to qualitatively analyse online network discussions. Individually, students participate in online discussions and monitor or evaluate other's ideas as they share metacognitive responsibilities by regulating each other's contributions. When reflecting on their statements, they can judge whether the contributed knowledge can be part of their planning or application of subject matter. Similarly, Hurme et al. (2006) introduced SNA to metacognition research by examining the patterns of such interactions and explain the social aspect of metacognition by graphically displaying the patterns through a multidimensional scaling technique – using the concept of space and distance between the various data points, called nodes. These network maps can also be created using ATLAS.ti, however ATLAS.ti's interface lacks the ability to generate network views not semantically or manually coupled (McKetcher et al., 2009). This calls for the use of SNA software and (often) requires a language and understanding of both the program and theory of SNA. Conceptually, the nodes can directly or in-directly, via another node, be tied or linked. A pattern emerges illustrating the position of the nodes and their relationship to the rest of the network. For example, each node can represent an individual (Bonsignore et al., 2009), an organisation (McKetcher et al., 2009), a note (Iiskala et al., 2015) or concept (Borgatti & Halgin, 2011) in the network. Network maps can then be created to visualise structures of individuals (or concepts) and the relationship(s) between them. Since individual and social metacognitive processes impact on metacognitive theory (Hurme et al., 2006; Iiskala et al., 2015), social network analysis seems to provide a lens through which new insight into these metacognitive constructs can be developed.

A study by Veronese et al. (2015) (see Table 1) suggests awareness, a construct of metacognition, typifies a sense of social belonging. This consciousness between self and others is the result of subjective awareness and indirectly affects metacognitive processes. Awareness, therefore, constructs new knowledge. New knowledge *in* the network must not stand on its own, as in the case of constructivism, but should become knowledge *for* the network to enact socio-constructivist pedagogy. Networks can therefore exhibit different types of metacognitive knowledge about oneself and others, as Iisakala et al. (2015) and Hurme et al. (2006) claim, to promote collaborative metacognitive regulation towards a socially shared metacognitive pedagogy. Even so, to develop metacognitive theory about these metacognitive processes requires a novel qualitative data analysis procedure enabling researchers to explore individual and socially constructed metacognitive knowledge and regulatory networks with their embedded nature to define their relationship in the social network. These metacognitive networks can then be explored inductively and illustrated through uniting qualitative data analysis software (e.g., ATLAS.ti) and social network analysis package, such as NodeXL.

NodeXL as a Tool for Network Analysis in Metacognition Research

NodeXL, an open-source add-in toolkit for network analysis within Microsoft Excel can be used to discover, explore and visualise network data (Smith et al., 2009). NodeXL was identified as an appropriate alternative for network analysis software as it offers a flexible, interactive and effective exploratory interface for network analysis. In particular, NodeXL was regarded particularly useful for studies involving complex ecosystems such as those underpinning focus group interviews or longitudinal studies across different social groups. NodeXL ads network metrics (e.g., degree, centrality measures, clustering and network visualisation) to Microsoft Excel, promising a familiar environment to work with to those who have already experienced Excel.

The conceptual-theoretical framework above argues for a need to produce a novel approach in the qualitative analysis of metacognitive data. Emerging from the theory of metacognition and SNA, the patterns between constructs of individual and social metacognitive knowledge and regulation were conceptualised as metacognitive networks. We employed the following research design to explore the construct of metacognitive networks and offer three qualitative analysis procedures for extracting metacognitive networks embedded in qualitative data.

Methodology

The qualitative data collection and analysis methods were conducted using a blend of interpretivistic and hermeneutic perspectives. An educational design-based research approach (Voogt et al., 2015) was employed to explore, extract and illustrate embedded metacognitive networks in undergraduate students' metacognitive processes across two design cycles. A longitudinal study was followed stretching across two semesters during which participants gathered bi-weekly for design focus group sessions. Since this study takes place within the context of an undergraduate university mathematics education course for intermediate phase pre-service teachers, the focus group sessions served as design sessions structured around the mathematics education module's outcomes. The outcomes required participants to plan, present and observe, reflect, refine and re-present a mathematics lesson plan (therefore design) for the topic of place value in a primary school context.

The purpose of the study was to identify a qualitative data analysis set of procedures we could use to extract embedded metacognitive networks as a construct of students' metacognitive knowledge and regulation to exploit these networks for metacognitive theory development. Data were collected by verbatim transcriptions of the video-recorded design sessions. Transcriptions served as qualitative narrative data of focus group interviews that were analysed. The procedure and software identified for analysis were instigated by Mcketcher et al. (2009; e.g., Microsoft Office & ATLAS.ti) for the transcribing and coding of the narrative data as well as Veronese et al. (2015) and Smith et al. (2009) for importing the coded qualitative data sets into a SNA program (e.g., NodeXL).

Sample

The population of this study consisted of fourth-year mathematics education intermediate phase pre-service teachers at one rural university in the North West province, South Africa. A purposive sampling method was used which limits the generalisability of the results. However, ease of access and participants' voluntary willingness to partake in this study made it possible to do an in-depth analysis of their metacognitive networks over a long period, ensuring trustworthiness in the findings. During the first class meeting, students (N = 60) were invited to participate, being assured they will have the opportunity to also practice what they have learned about the mathematics education module through the collaborative planning of a lesson for a nearby primary school's Grade 6 class on the topic of place value. Two groups of participants volunteered (Group A: n = 6 & Group B: n = 5) and committed themselves to attend all the design sessions for two semesters. Each participant was assigned a unique pseudonym (e.g., Student 1 - S1) incorporated in a dialogue format when transcribing.

Participants have had mathematics as a major for two years and had taught and observed mathematics lessons for the intermediate phase on six occasions since their registration for the degree in their first year. Participants' enrolment for the module, the preparation they received and notes (which covered metacognition) made these students suitable candidates to identify and extract possible metacognitive networks embedded in the data and to develop a procedure for qualitative analysis of these networks.

Data Collection

For the purpose of this research, focus group interviews were used to collect data about students' metacognitive processes during collaborative learning opportunities. This seemed appropriate since they engaged in design sessions where participants' metacognitive knowledge and regulatory processes could be explored. This was done to develop a procedure for analysis of embedded metacognitive networks in qualitative data. The design group sessions were video recorded for analysis. Each session was transcribed in and saved as a separate Microsoft Word File (e.g., Group A – session 1) indicating the group's name and session. The pseudonyms also acted as codes for identifying the network's nodes. This served a dual purpose as participants' pseudonyms were used to identify them in the transcriptions and made the data accessible and participants identifiable in NodeXL, particularly in the output image files of the networks. After transcribing the design group sessions, a thematic method of analysis was employed by coding metacognitive knowledge and regulation in terms of the metacognitive knowledge or regulatory processes students exhibited.

Data Analysis

Social network data were analysed through interpretivism, interpersonal metacognitive network data through hermeneutics and socially shared metacognitive network data through interpretivism and hermeneutics. Transcriptions were therefore analysed three times, each time considering a possible social, interpersonal and socially shared metacognitive network within the data. To answer the research question, the embedded networks were extracted, the set of procedures to follow for qualitative analysis of these networks were developed to produce metacognitive theory. The findings obtained from the steps followed for analyses as well as the nature of the extracted metacognitive networks are reported on below.

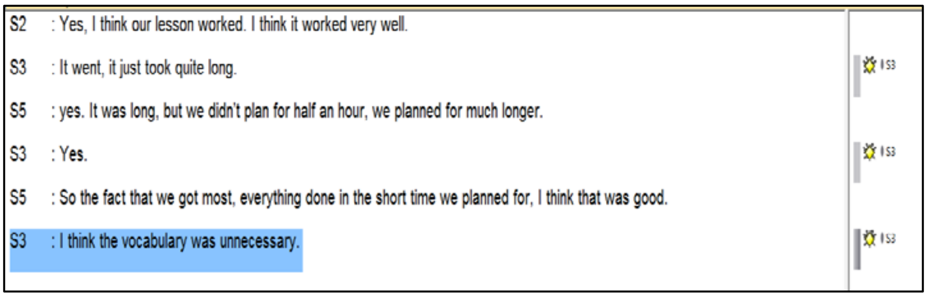
Findings

Because the design sessions allowed for planning, managing and reflection, we expected the data to be metacognitive in nature. The findings showcase the three steps employed to extract metacognitive networks embedded in qualitative narrative data. First, narratives of the focus group interviews were imported into ATLAS.ti, and coded automatically and manually. Second, coded data sets were exported to Excel to prepare them for analysis in NodeXL. Third, network data obtained from the Excel file were imported into NodeXL to reveal the embedded metacognitive networks. The networks extracted suggest that social, interpersonal and socially shared metacognitive networks are embedded within qualitative data.

Step 1 – Data Input and Coding in ATLAS.ti

The narratives were transcribed in Microsoft Word and imported into ATLAS.ti as primary documents. The greatest challenge for us was to develop codes to indicate what sentences, words or phrases were used to express metacognitive processes. For this, a comprehensive conceptual-theoretical framework of metacognition in group settings was needed. We decided to approach the analysis in consecutive "smaller" steps by reading and re-reading the narratives to get a gist of what the content is about. We then developed a set of social codes (e.g., S1, S2, S3, etc.) indicating participants automatically or manually, viewing them as members in a social network. Figure 1 shows a sample of this process.

Figure 1: Sample Extract of the Auto Coded Data



When a participant contributed to the group, that participant's pseudonym was used to automatically code him or her to create a network data base for use in the third step. If a participant commented on another's input, they were allocated the contributor's code manually. For example, Student 2 expressed thoughts on the lesson's effectiveness. Student 2 was therefore coded automatically as S2. Student 3 then explained a problem (e.g., "it just took quite long") and received S3 as an auto code, and S2 as a manual code since Student 3 remarked on something that S2 said. We also manually coded statements used to express metacognitive knowledge and regulatory processes. ATLAS.ti's quotation manager was opened and the output option selected to configure the coded data in a Web browser.

Step 2 – Exporting and Preparing Coded Data in Excel

We copied the entire table (from the Web browser), after completing Step 1, into a new Microsoft Excel document. For the purpose of identifying possible metacognitive networks, the columns that we suspected to be in excess were deleted (e.g., ID, size, density, author, created & modified). The contents of column B were also cleared. The four remaining columns were renamed as A (Vertex 1), B (Quotation), C (Vertex 2) and D (Line number). Renaming the columns was not essential, yet provided us with some familiarity when importing data into NodeXL, which uses similar headings in its template.

Step 3 – Extracting Metacognitive Networks Using NodeXL

A NodeXL template was created and the contents of Vertex 1 and Vertex 2's columns were copied from Excel into NodeXL's Edge sheet. Figure 2 shows sample sheets for NodeXL.

Figure 2: Samples of the Edge and Vertex Sheets in NodeXL

Sample Edge sheet

1		
2	Vertex 1	Vertex 2
3	S11	S8
4	S8	S11
5	S11	S10
6	S10	S8
7	S8	S9
8	S9	S11
9	S11	S8
10	S8	S11
11	S11	S8
12	S8	S11
13	S11	S10
14	S10	S11

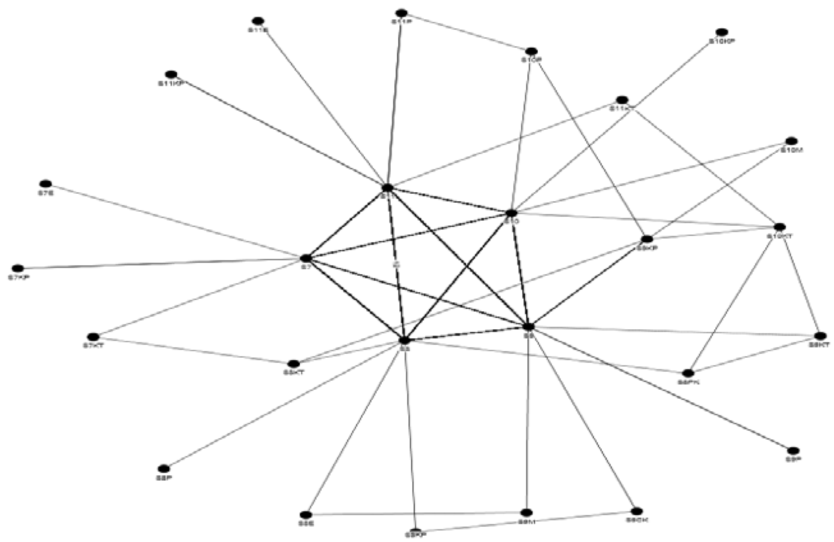
Sample Vertex sheet

1		Visual Properties						Labels
2	Vertex	Color	Shape	Size	Opacity	Image File	Visibility	Label
3	S11							S11
4	S8							S8
5	S10							S10
6	S9							S9
7	S7							S7
8	S7KP							S7KP
9	S7E							S7E
10	S7KT							S7KT
11	S8E							S8E
12	S8P							S8P
13	S9KP							S9KP
14	S9P							S9P
15	S10KP							S10KP
16	S11KP							S11KP

In the edge sheet, each auto and manual code served as an edge (or node) in the network. The Vertex sheet shows the vertices (or links) between two or more nodes. We found the sheets update on automatically as the Edge sheet is edited. However, as the networks became larger and more complex, we suggest the labels be predetermined in order to "read" the networks easier. We kept the vertex sheet's labels the same as the vertices'. In the Edge sheet, we used line numbers to show how two or more nodes are connected. The NodeXL template has the function to filter data in the Vertex and Edge sheets in each column. In doing so, we identified interpersonal and social metacognitive networks. We selected the Harel-Koren Fast Multiscale formula to produce a decluttered network display.

By filtering the automatic codes for participants and manual codes for the metacognitive processes, we revealed embedded metacognitive networks after refreshing the graph. This extraction shows three types of networks, including social, interpersonal metacognitive and socially shared metacognitive networks embedded in the qualitative data. In Figure 3, Group B's social and metacognitive networks are mapped. At the centre of the network lies the social structure of the group, surrounded by the interpersonal metacognitive networks which, in some cases, connect, revealing socially shared metacognitive networks.

Figure 3: Network View of the Social and Metacognitive Networks



Discussion

The purpose of this study was to identify a set of qualitative data analysis procedures to extract embedded metacognitive constructs within qualitative narrative data to inform theory development. Both the concept of metacognitive networks and possible procedures for its analysis received little research attention. Through social network analysis, the methodological considerations for the extraction of embedded metacognitive constructs remain a scarce topic and thus impede the development and contribution of metacognitive theory. Embedded metacognitive constructs such as metacognitive networks can be extracted and analysed for theory development, using a three-step set of analysis procedures. The attempt we offer here is in line with the needs of McKetcher et al. (2009) and Veronese et al. (2015). Furthermore, the construct of metacognitive networks appears individually and socially mediated, as hinted upon by Iskala et al. (2015) and Hurme et al. (2006). Although metacognitive networks is a term first used to refer to the neural conduct of metacognition (Pasquali et al., 2010), we offer a glimpse of this construct in the context of focus group interviews in mathematics education. The procedures used for data analysis of the extracted construct of metacognitive networks therefore contribute to the development of metacognitive theory through (first) the approach and (second) the value of the construct aimed at pedagogy for metacognition.

The Three Step Set of Qualitative Analysis Procedures

The three steps followed in the analysis facilitated a process to extract embedded metacognitive networks in qualitative data. These steps include (1) data input and coding in ATLAS.ti, (2) exporting and preparing coded data in Excel and (3) extracting metacognitive networks using NodeXL. We agree with Bringer et al. (2006), however, that it is not the computer doing the analysis. The researcher still has to pose the necessary questions, code the data interpretively and, as we suggest, use appropriate software packages to explore the embedded constructs with exploited effectiveness towards theory development.

The first step resembles the typical linear path predicted by Saldaña (2012). We made use of both auto and manual coding because the dual nature of the narrative data implied social and individual relationships within the data. This confirmed that qualitative focus group interview data is metacognitive in nature. By coding the participants, thus breaking the linear path, we allocated pseudonyms, as codes, to each group member using ATLAS.ti's auto code function. This ensured that we did not overlook participants' statements in the coding process and revealed the social structure of the network. We needed to capture all the coded data (social and metacognitive) in terms of the codes (auto and manual) with line numbers (or sections) coded to make it easier to refer back to any particular quotation when interpreting the results in the context of the discussions. We also exported the quotations managers' table from the Web browser view into Excel. Contrary to McKetcher et al. (2009), who used separate node and link codes, we anticipated, based on Smith et al. (2009)'s description of NodeXL's functionality, that all codes are automatically part of the vertices in the network view in NodeXL's template. We did not expect, before this step, that the first set (auto) and second set (manual) of codes were separated via vertex 1 and vertex 2's columns. We also did not anticipate including the quotations in the network views as this crowded the network in the final display (e.g., quotations of every coded individual) making it difficult to read and interpret the network. We decided to "clean" the table up first by removing all irrelevant information, as was also the case with McKetcher et al. (2009). In so doing, the Excel table offered four columns from which we could import data into NodeXL. Only the codes and their associating line numbers were regarded sufficient to show the location of the coded text within the narrative, revealing the association of parts of the text with other codes. The idea is not to follow these steps too prescriptively, as it might force an emerging theory (Bringer et al., 2006), but rather guide a possible route to extract constructs from data.

The Pedagogical Value of Metacognitive Networks

By following the three steps outlined above, we revealed embedded patterns of participants' metacognitive networks. Social patterns for each group were identified and illustrated using NodeXL. These patterns were similar to Hurme et al. (2006)'s joint patterns of networked interaction between student pairs. However, our social patterns symbolised the nature of participants' interaction with the whole group and not only a few individuals. We also extracted individual metacognitive networks as interpersonal processes as individual metacognitive contributions to the group, manifesting as participants contribute knowledge about the task, person or strategy. They also reflected on their own and each other's' contributions by planning, monitoring and evaluating inputs. Social, interpersonal and socially shared metacognitive networks can inform the development of new metacognitive theory through SNA. Similarly, Iiskala et al. (2015) explain socially shared metacognition as individuals' regulations in group settings to share knowledge and discuss common goals.

Bringing it All Together: Towards Building Metacognitive Theory

We advise, first, that these steps can be followed to extract embedded constructs to, for example, generate new metacognitive theory. However, computer analysis software does not automatically guarantee theory. Since we made use of a-priori coding, the three steps could not produce grounded theory directly. Instead, using a-priori analysis, we revealed how networks can emerge and, therefore indirectly, serve as codes for grounded theory. This allowed us to move, as Bringer et al. (2006) suggest, from mere reporting to emerging theory. We therefore theorise about metacognitive networks by explaining the relationship between the constructs using standard theories (e.g., metacognition and SNA) and/or meta-theory (e.g., social constructivism).

Future Directions

The findings suggest metacognitive networks reveal the architecture of individual and socially shared metacognitive processes. Since metacognition's introduction (Flavell, 1979), the idea of its embedded metacognitive networks has only recently surfaced (Hurme et al., 2006; Iiskala et al., 2015; Pasquali et al., 2010) suggesting the construct of metacognitive networks has been overlooked in theory development for far too long. Qualitative analysis of network-related metacognition research, therefore, remains a scarce topic. The steps offered here can allow users to do complex analysis without the necessary knowledge and skills usually needed in computer analysis software. Since network visualisation is considered a complex field with no limits to its directions for use (Smith et al., 2009), a clear understanding of how metacognitive processes function and how individual metacognitive knowledge and regulatory processes relate to, and cater for, socially shared metacognition, remains a priority. The findings suggest a need for novel qualitative data analysis procedures follows the development of new theory and requires further exploration and innovation in metacognition research, if we want to understand all its facets. The qualitative analysis procedure offered in this paper is only one example of how a metacognitive construct embedded within qualitative metacognitive data can be used to exploit the construct for theory development. We still need a design for other qualitative approaches (or quantitative for that matter) endorsed by other research paradigms and assumptions to encourage critical use and development of metacognition’s methodology. The steps, offered here, promise a useful approach in exploring the network aspects of metacognition. However, we need to grasp the full use of this construct (e.g., metacognitive network data metrics) to enable us to understand metacognition in its entirety, if we aim to develop pedagogy for metacognition. This is especially true in an era where social media and educational technology prevails in more and more university classrooms. Through metacognition research we can develop new pedagogy, if we understand and apply a proper methodology. We can then exploit the embedded constructs and offer a glimpse of pedagogy for metacognition.

References

Ader, E. (2013). A framework for understanding teachers' promotion of students' metacognition. *International Journal of Mathematics Teaching and Learning.* Retrieved from http://www.cimt.org.uk/journal/ader.pdf.

Bonsignore, E. M., Dunne, C., Rotman, D., Smith, M., Capone, T., Hansen, D. L., & Shneiderman, B. (2015). First steps to NetViz Nirvana: Evaluating social network analysis with nodeXL. *Computational Science and Engineering*, *4*, 332-339. doi:10.1109/CSE.2009.120

Bowen, G. A. (2005). Preparing a qualitative research-based dissertation: Lessons learned. *The Qualitative Report, 10*(2), 208-222. Retrieved from http://nsuworks.nova.edu/tqr/vol10/iss2/2

Bringer, J., Lynne, D., Johnston, H., & Brackenridge, C. H. (2006). Using computer assisted data analysis software to develop a grounded theory project. *Field Methods*, *18*(3), 245-266.

Hoon, C. (2013). Meta-synthesis of qualitative case studies: An approach to theory building. *Organizational Research Methods, 16*(4), 522-556.

Hurme, T., Palonen, T., & Jarvela, S. (2006). Metacognition in joint discussions: An analysis of the patterns of interaction and the metacognitive content of the networked discussions in mathematics. *Metacognition Learning*, *1*, 181-200.

Iiskala, T., Volet, S., Lehtinen, E., & Vauras, M. (2015). Socially shared metacognitive regulation in asynchronous CSCL in science: Functions, evolution and participation. *Frontline Learning Research, 3*(1), 78-11.

McKetcher, W., Julia, L., Gluesing, C., & Riopelle, K. (2009). From interviews to social network analysis: An approach for revealing social networks embedded in narrative data. *Field Methods, 21*(2), 154-180.

Pasquali, A., Timmermans, B., & Cleeremans, A. (2010). Know thyself: Metacognitive networks and measures of consciousness. *Cognition*, *117*(2), 182-190.

Rodriguez, E., Bosch, M., & Gascon, J. (2008). A networking method to compare theories: Metacognition in problem solving reformulated within the anthropological theory of the didactic. *ZDM*, *40*(2), 287-301.

Rymal, A. M., Martini, R., & Ste-Marie, D. M. (2010). Self-Regulatory processes employed during self-modeling: A qualitative analysis. *The Sport Psychologist*, *24*, 1-15.

Saldana, J. (2012). *The coding manual for qualitative researchers*. London, UK: SAGE Publications.

Shah, S. K., & Corley, K. G. (2006). Building better theory by bridging the quantitative-qualitative divide. *Journal of Management Studies*, *43*(8), 1821-1835.

Smith, M., Shneiderman, B., Milic-Frayling, N., Rodrigues, E. M., Barash, V., Dunne , C., ... Gleave, E. (2009). Proceedings from C&T '09: Fourth International Conference on Communities and Technologies: *Analyzing (social media) networks with NodeXL*. New York, NY: Active Media Technology.

Tracy, S. J. (2010). Qualitative quality: Eight "big-tent" criteria for excellent qualitative research. *Qualitative Inquiry, 16*(10), 837-851.

Veronese, G., Procaccia, R., Ruggiero, G. M., Sassaroli, S., & Castiglioni, M. (2015). Narcissism and defending self-esteem. An exploratory study based on self-characterizations. *The Open Psychology Journal*, *8*, 28-43.

Voogt, J., Lafferiere, T., Breuleux, A., Itow, R. C., Hickey, D. T., & McKenney, S. (2015). Collaborative design as a form of professional development. *Instructional Science*, *43*, 259-82.

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