Challenges related to the Analytical Process in Realist Evaluation and Latest Developments on the Use of NVivo from a Realist Perspective

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Abstract

Realist evaluation (RE) is a research design increasingly used in program evaluation, that aims to explore and understand the influence of context and underlying mechanisms on intervention or program outcomes. Several methodological challenges, however, are associated with this approach. This article summarizes RE key principles and examines some documented challenges and solutions when analyzing RE data, including the development of Context-Mechanism-Outcome configurations. An analytic method using NVivo features is also presented. This method makes it possible to respond to certain analytic difficulties associated with RE by facilitating the identification of patterns and ensuring transparency in the analytical process.

Keywords: realist evaluation; qualitative data analysis software; NVivo, C-M-O configuration

Introduction

Realist evaluation (RE), developed by Pawson and Tilley (1997), is increasingly used to evaluate interventions or programs in several disciplines. Through the use of qualitative and quantitative methods, RE aims to identify different elements of context and underlying mechanisms that explain positive and negative outcomes (Pawson & Sridharan, 2010; Pawson & Tilley, 1997). This theory-driven approach addresses the logic of an intervention or a program and interactions with individuals and the social milieu (Blaise, Marchal, Lefèvre, & Kegels, 2010; Linsley, Howard, & Owen, 2015; Robert & Ridde, 2013). RE makes it possible to understand better the complexity of the implementation of an intervention or a program (Van Belle, Rifkin, & Marchal, 2017).

Many scholars, however, have reported difficulties in operationalizing, conceptualizing, and differentiating specific constructs related to RE (Astbury & Leeuw, 2010; Dickinson, 2006; Marchal, Van Belle, Van Olmen, Hoerée, & Kegels, 2012; Ridde, Robert, Guichard, Blaise, & Van Olmen, 2012; Robert & Ridde, 2013; Salter & Kothari, 2014; Van Belle et al., 2017). In response, several authors have reflected on different issues related with RE and have proposed solutions to minimize the impact of these issues (Astbury & Leeuw, 2010; Dalkin, Greenhalgh, Jones, Cunningham, & Lhussier, 2015; de Souza, 2013; Jackson & Kolla, 2012; Lacouture, Breton, Guichard, & Ridde, 2015; Manzano, 2016; Pawson & Manzano-Santaella, 2012; Wong et al., 2016).

Despite widespread use, there is a lack of guidelines on the use of qualitative data analysis software (QDAS) for the analysis of RE-structured data (Dalkin, Forster, Hodgson, Lhussier, & Carr, 2015). As with many qualitative research designs (Paulus, Woods, Atkins, & Macklin, 2017), there is also minimal information among recent realist publications on how QDAS were used (Banks et al., 2017; Caffrey et al., 2016; Doi, Jepson, & Cheyne, 2015; Doi, Jepson, & Hardie,

2017; Jeffries et al., 2017; Mcgaughey, O'halloran, Porter, Trinder, & Blackwood, 2017; Reddy, Orpin, Herring, Mackie-Schneider, & Struber, 2017; Woodhead, Collins, Lomas, & Raine, 2017).

In reflecting on issues associated with a realist approach, this article reviews the main concepts and difficulties related to analysing RE data, and then summarizes potential solutions. Finally, in addressing issues related to the use of QDAS in realist research, we present a method to illustrate how it could be used to facilitate analysis and improve analytical rigour.

Main Concepts and Difficulties Associated with Analysing RE Data

RE "focuses on understanding programs, initiatives or interventions" in open social systems (Greenhalgh et al., 2017b) by identifying various patterns among elements of context, and underlying mechanisms that influence outcomes (Greenhalgh et al., 2017d; Pawson & Sridharan, 2010; Pawson & Tilley, 1997; Van Belle et al., 2017), A variety of conceptual tools and concepts may be used to identify those patterns (Table 1). First, initial program theory "reflects the realist understanding of causation" (Greenhalgh et al., 2017a) and is used as a tool *a priori* to map potential elements of context and underlying mechanisms (Greenhalgh et al., 2017d; Pawson, 2013; Robert & Ridde, 2013; Van Belle et al., 2017).

[Table 1 near here]

RE is neutral with respect to data collection methods but the use of multiple methods (qualitative or quantitative) is encouraged, to identify elements of context (C), underlying mechanisms (M) and outcomes (O), and then to refine the initial program theory (Greenhalgh et al., 2017c; Pawson & Manzano-Santaella, 2012; Pawson & Sridharan, 2010). Conjectured Context-Mechanism-Outcome (C-M-O) configuration is another conceptual tool used in RE, to capture and highlights interrelationships among those various concepts (Marchal et al., 2012; Pawson, 2013; Pawson & Manzano-Santaella, 2012; Robert & Ridde, 2013). In short, the goal of C-M-O configuration is to gather and understand which elements of context favor triggering mechanisms

for an intervention to achieve its outcomes (Nielsen & Miraglia, 2017; Pawson, 2013). The process of developing of a C-M-O configuration ultimately allows refinement of an initial program theory (Marchal et al., 2012; Ridde et al., 2012) into a more abstract theory, that can facilitate generalization to other contexts (Blaise et al., 2010; Dickinson, 2006; Greenhalgh et al., 2017d; Marchal et al., 2012; Robert & Ridde, 2013) and can enable identification of various factors that influence interventions outcomes (Blaise et al., 2010). Refined program theories can take a number of different forms, including CMO configurations or a global model explaining how certain interventions result in their outcomes (Marchal et al., 2012; Ridde et al., 2012; Robert & Ridde, 2013). Data analysis in realist research is an iterative and global process, to identify underlying patterns explaining program outcomes (McEvoy & Richards, 2006; Robert & Ridde, 2013). It requires moving back and forth between the initial program theory and the data, to bring out elements of context and mechanisms that can explain outcomes. During this process C-M-O configurations are developed and thus the initial program theory is further refined (Pawson, 2013; Pawson & Sridharan, 2010; Robert & Ridde, 2013).

This process to refine program theory is not clear cut, because various interpretations of the key concepts of RE may initially complicate the operationalization of this approach (Robert & Ridde, 2013). Several authors have also pointed out difficulties differentiating elements of context from mechanisms (Marchal et al., 2012; Ridde et al., 2012; Robert & Ridde, 2013), mechanisms from interventions (Adams, Sedalia, McNab, & Sarker, 2016; Marchal et al., 2012; Ridde et al., 2012) and how to identify mechanisms precisely (Astbury & Leeuw, 2010; Ridde et al., 2012; Robert & Ridde, 2013). Some researchers report that the definitions of elements of context (Marchal et al., 2012; Salter & Kothari, 2014) and mechanisms (Adams et al., 2016; Astbury & Leeuw, 2010; Marchal et al., 2012; Robert & Ridde, 2013; Salter & Kothari, 2014; Van Belle et al., 2017) are too general, which makes it difficult to distinguish between the two in the data. This

difficulty may be related to the fact that there are multiple levels for elements of context (Alvarado et al., 2017; Astbury, 2013; de Souza, 2013; Pawson, 2015) and mechanisms (Astbury & Leeuw, 2010; de Souza, 2013; Dickinson, 2006; Robert & Ridde, 2013). Therefore, a context in a circumstance might be a mechanism or even an outcome into another configuration (Westhorp, 2018).

C-M-O configuration can be a powerful conceptual tool but it requires a period of iterative refinement to use it properly (Ridde et al., 2012; Van Belle et al., 2017). Many researchers use it in a linear and simple way, while in fact multiple elements of context and mechanisms can be associated with a configuration (Astbury, 2013; de Souza, 2013; Pawson, 2018). The presence of multiple elements of context and mechanisms, plus various levels of elements of contexts and mechanisms could be problematic in the development of the C-M-O schematic configuration (Alvarado et al., 2017; Jackson & Kolla, 2012; Marchal et al., 2012; Salter & Kothari, 2014). As a result, it is reported that some authors have been unable to configure C-M-O (Astbury, 2013; Maluka et al., 2011; Pawson & Manzano-Santaella, 2012) or to integrate outcomes (Marchal et al., 2012; Salter & Kothari, 2014). In practice, an abundance of elements of context and mechanisms are usually identified through the analytic process, making it difficult to explore and test all possible C-M-O configurations (Greenhalgh et al., 2017a; Marchal et al., 2012; Ridde et al., 2012).

Possible Solutions to Address Challenges Associated with RE

Several researchers have proposed ways to meet the challenges posed by RE, based on experimental and theoretical work. The following synthesis captures some experiences and guidelines for successful RE. To identify and distinguish elements of context and mechanisms, qualitative methods such as individual interviews and focus groups are particularly suitable (Adams et al., 2016; Astbury, 2016; Tan & Harvey, 2015; Van Belle, Marchal, Dubourg, & Kegels, 2010; Westhorp et al., 2011). This data collection method should be performed according to the

realist interview principles to: stimulate reflection among participants; encourage them to clarify their thoughts; and help them to funnel information to identify underlying mechanisms (Greenhalgh et al., 2017c; Manzano, 2016; Pawson, 1996). It is also necessary to explore the participant role, knowledge, and understanding of the program (Greenhalgh et al., 2017c; Manzano, 2016)

Start the research project with measurement of quantitative outcomes. These results should then be presented to stakeholders, to allow them to think retrospectively about the underlying elements of context and mechanisms which could explain these observations (Eastwood, Jalaludin, & Kemp, 2014; McEvoy & Richards, 2006). To ease this process, several researchers recommend presenting a visual overview of the program and its outcomes at the beginning of the interviews, in order to initiate reflection processes (Byng, Norman, & Redfern, 2005; Hamilton-Smith & Hopkins, 1998; Pawson, 1996; Rycroft-Malone et al., 2016; Shankardass, Renahy, Muntaner, & O'Campo, 2014; Staley, Buckland, Hayes, & Tarpey, 2014).

The interview guide used in RE research should stimulate reflection and reasoning among participants (Shankardass et al., 2014; Van Belle et al., 2010). Questions should be inspired by the elements of context and mechanisms identified in the initial program theory, without naming them precisely (Goicolea et al., 2015; Guichard & Ridde, 2010), and should allow the exploration of possible connections among those various factors (Staley et al., 2014). It is usually necessary to have a question for each element of the initial program theory under validation (Van Belle et al., 2010). The terminology used by the interviewers must be sufficiently precise and clear for participants (Maxwell, 2012; Van Belle et al., 2010) and adapted to each type of participant involved (Chouinard et al., 2013).

It is therefore important to pay attention to the training of interviewers so they can comply with the realist interview's principles (Shankardass et al., 2014; Staley et al., 2014; Van Belle et

al., 2010). It is imperative to conduct pilot interviews and pre-test data collection tools to ensure that they are adapted to the research context (Adams et al., 2016; Ridde & Haddad, 2013; Van Belle et al., 2010). Research team members must have a good understanding of the social organization where the research project is taking place to better understand the dynamics between the actors involved and thus facilitate the identification of mechanisms. (Greenhalgh et al., 2017c; Guichard & Ridde, 2010; Linsley et al., 2015). The analysts must be experienced enough in qualitative analysis to distinguish and efficiently identify RE core concepts (elements of context, mechanisms and outcomes) and different elements that are part of the initial program theory (Ridde et al., 2012). To do so, research staff carrying out analysis and those carrying out data collection concurrently must maintain constant communication to facilitate the development of C-M-O configurations and the refinement of initial program theory. This continuous communication will enhance data collection tools and refinement of different concepts identified during the data collection process (Goicolea et al., 2015; Rycroft-Malone et al., 2016).

To facilitate the development of C-M-O configurations, Jackson and Kolla (2012) propose identification of connections among elements of context, mechanisms and outcomes rapidly during the coding process. This approach should facilitate the emergence of dyads and triads of concepts which can be validated in subsequent stages of analysis. This work formed a basis for the development of the method we present in this article.

A Method to Use NVivo from a Realist Perspective

The use of QDAS such as NVivo can greatly increase the efficiency of qualitative analysis and facilitate the management and analysis of complex data (Dalkin, Forster, et al., 2015; Hutchison, Johnston, & Breckon, 2010; Robins & Eisen, 2017). Software does not, however, replace the process of human reflection on data (Hutchison et al., 2010). NVivo has features such as queries and matrix queries that can facilitate comparison and identification of different relationships in the

data (Hutchison et al., 2010). For RE, these features may help to code the key concepts, identify C-M-O configurations, and recognize patterns. The use of QDAS can, however, represent a challenge in realist research, to the necessary identification of multiple connections, in order to develop C-M-O configurations. To respond to this issue, we have developed a method which uses some of NVivo's features, and tested it in a two ongoing research projects from this research team. An article presenting the results from one of these research projects is now in press and will be available shortly as a worked example (Bergeron, Talbot, & Gaboury, in press). This method is divided in three stages.

Stage 1

First, data should be sorted and coded with NVivo using a directed content approach that aims to refine or validate the initial theory (Hsieh & Shannon, 2005). Codes should be defined before data analysis and a tree node can be developed. NVivo allows multiple codes for the same data (Robins & Eisen, 2017), permitting loose data coding wherein context- or outcomes-related extracts are part of mechanisms nodes are created, and vice versa (Figure 1). Co-coding should be performed to ensure credibility of the analytic process (Oliver, 2011; Tracy, 2010). This process will facilitate the development of matrix queries in stage 2.

[Figure 1 near here]

During data coding, linked memos are written on a regular basis to justify methodological choices, analytical processes, emergence of new codes, identification of connections among underlying factors present in the data, and refinement of the initial program theory (Hutchison et al., 2010; Woods, Macklin, & Lewis, 2016). Memos ensure transparency (Dalkin, Forster, et al., 2015; Tracy, 2010), and facilitate decision making in the development of C-M-O configurations and the validation of the initial program theory (Dalkin, Forster, et al., 2015). Memos are essential

when using this method, because the use of QDAS such as NVivo for the sole purpose of coding generally leads to "reordering data in terms in terms of particular categories" which can blind the analysis process, restrict the perception of alternative relationships in the data and neglect some contextual elements (Maxwell & Miller, 2008).

Stage 2

The matrix queries feature of NVivo facilitates the identification of connections among the concepts (Robins & Eisen, 2017). Two matrix queries must be performed to identify C-M-O configurations. A first matrix is created by crossing context and mechanism nodes (figure 2). The result of this first matrix highlights connections among the elements of contexts and mechanisms. Next, each non-empty cell of this matrix (which represents the intersection between a context and a mechanism) is manually coded into a new node (figure 3). These new nodes are crossed through another matrix query with the outcome nodes. The results of this second matrix can be used to visualize connections among different nodes associated with elements of context, mechanisms and outcomes (figure 4). Tables and graphs produced through matrix queries in NVivo facilitate the exploration of recurring patterns and enable the identification and construction of C-M-O configurations, which will be validated in stage 3.

[Figures 2, 3 and 4 near here]

This procedure presents two significant challenges. First, the matrices development process is time consuming, particularly the manual transformation of the first matrix into new nodes. Furthermore, the final matrix linking outcomes to the first matrix (contexts and mechanisms) cannot be updated automatically when a change is required in data coding. To update the final matrix, the query associating contexts and mechanism must be re-run and nodes from non-empty cells must be re-created.

Stage 3

Memos related to the identification of connections among concepts should be carefully reviewed and compared with the C-M-O configurations produced through matrix queries because used alone, matrices are too simplistic to capture all interconnections and complexity present in the data (Maxwell & Miller, 2008). This process enables the improvement and validation of C-M-O configurations developed via matrices. This validation process might bring to light complementary elements of context or mechanisms that did not emerge from the matrices. Whenever modifications are made, additional memos should be written to track and explain the development and the editing processes (Woods et al., 2016). It is important for results dissemination to describe in detail the analytical process; particularly the stages of analysis and various features used in NVivo (Paulus et al., 2017). This will ensure transparency of the research process (Paulus et al., 2017; Tracy, 2010).

Futures directions

NVivo is an interesting tool to use in RE because it provides more transparency to the analysis process, allows the integration of memos produced during the analysis process and offers the possibility to perform matrix queries that facilitate pattern recognition when developing C-M-O configurations. Matrix queries, however, only make it possible to identify interconnections between two categories of nodes, whereas to develop C-M-O chains, it is necessary to identify at least interconnections between three categories of nodes: elements of context, mechanisms and outcomes. The method presented in this paper can overcome the current limits of matrices in NVivo but this process is rather time consuming and requires the completion of several steps. To facilitate the analysis process for future RE, it would be interesting to use three-dimensional matrix queries in a later version of NVivo.

Considering that QDAS is increasingly recognized as a powerful tool for data screening, extraction and synthesis in literature reviews (Houghton et al., 2017; Onwuegbuzie, Leech, & Collins, 2012),

it would be relevant to assess whether the NVivo-based method we developed for RE is transferable for realist synthesis. We will soon test it.

Conclusion

RE is a research design that allows a better understanding of various factors influencing outcomes of complex interventions. This theory-driven approach presents several challenges, and requires time to manage the different constructs and conceptual tools associated with this design. This article presents some of those challenges and summarizes solutions.

While few guidelines have described how to optimize the use of QDAS in RE, none has reported on the development of C-M-O configurations. Here we describe a technique to facilitate the use of a QDAS (NVivo) for the development of C-M-O configurations. This process still presents some challenges inherent in realist research such as the time required to complete the various stages, but QDAS may facilitate the identification of patterns in data and improve both rigor and transparency in the analytical process.

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Competing interest

The authors declare that they have no competing interests.

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Table 1

Concepts and conceptual tools associated with RE

Concept	Definition
Program theory	Conceptual tool used a priori mapping of potential elements of context and underlying mechanisms that allow to explain the possible causation process of intervention or program outcomes. Program theory are refined trough RE process (Greenhalgh et al., 2017a, 2017d; Pawson, 2013; Robert & Ridde, 2013; Van Belle et al., 2017)
C-M-O configuration	Conceptual tool that connects some elements of context, mechanisms and outcomes of an intervention or a program. It enables the validation or refinement an initial program theory (Marchal et al., 2012; Pawson, 2013; Pawson & Manzano-Santaella, 2012; Robert & Ridde, 2013).
Element of context (C)	Pre-existing elements to a program or intervention that are present at different levels (individual, interpersonal, institutional and infrastructure) (de Souza, 2013; Pawson, 2013). They are dynamic, non-linear and, at the same time, inherent and independent to the program or intervention (Coldwell, 2019).
And Mechanism (M)	Underlying processes present at different levels (individual, group and institutional) that are triggered in a particular context and explain a pattern of outcomes (Westhorp, 2018). There are five constructs of mechanisms in realist evaluation: 1) reasoning, reactions and resources (Astbury & Leeuw, 2010; Dalkin, Greenhalgh, et al., 2015; de Souza, 2013; Lacouture et al., 2015; Westhorp, 2018), 2) powers and liabilities, 3) forces, 4) interactions (Pawson & Tilley, 1997; Westhorp, 2018) and 5) feedback and feedforward processes (Westhorp, 2018). They can be hidden,

	difficult to identify (Astbury & Leeuw, 2010; Lacouture et al., 2015) and operate "over different timescales" (Westhorp, 2018).
Outcome (O)	The result (expected or not, positive or negative) of multiple causes and depends on mobilized mechanisms and elements of the context in which an intervention or a program is carried out (Pawson, 2013; Ridde et al., 2012; Westhorp et al., 2011).

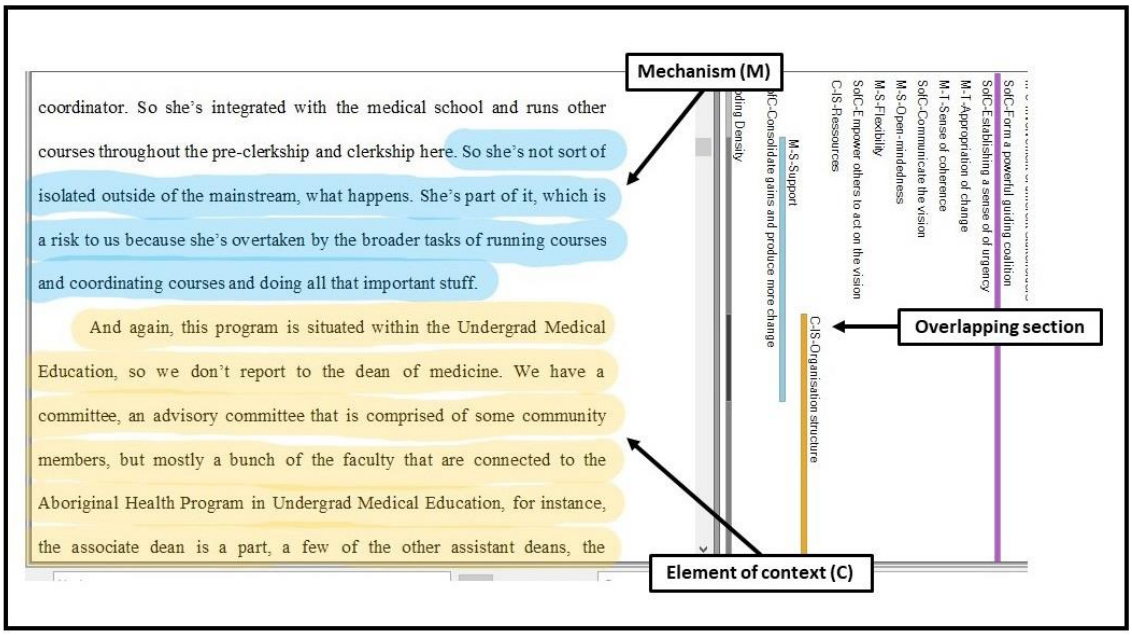

Figure 1: Loose data coding of mechanisms (M) and elements of context (C)

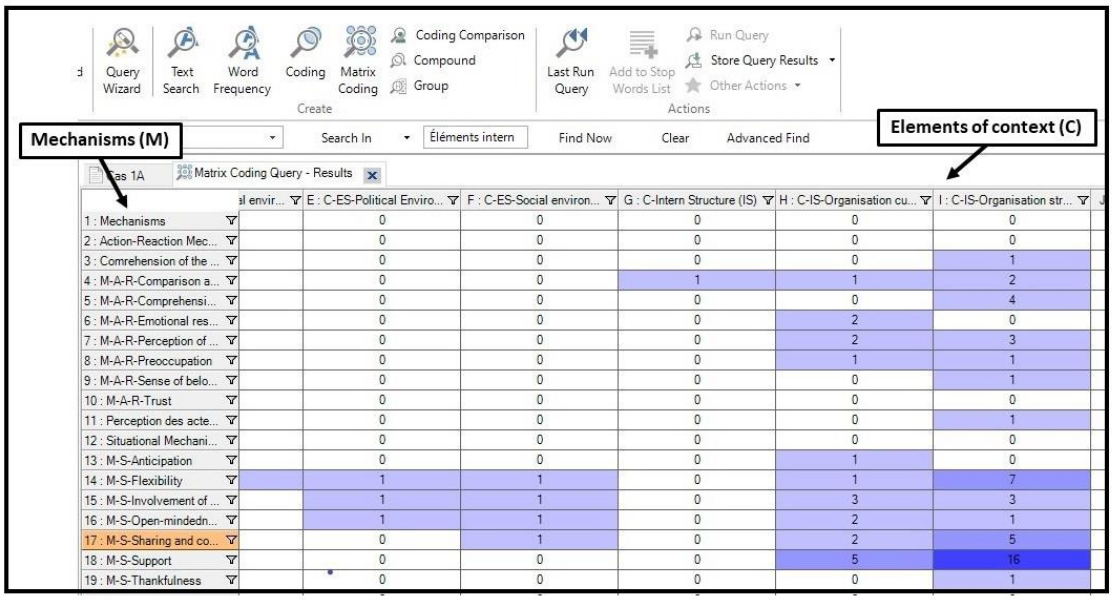

Figure 2: Results of a matrix query for mechanisms (M) and elements of context (C)

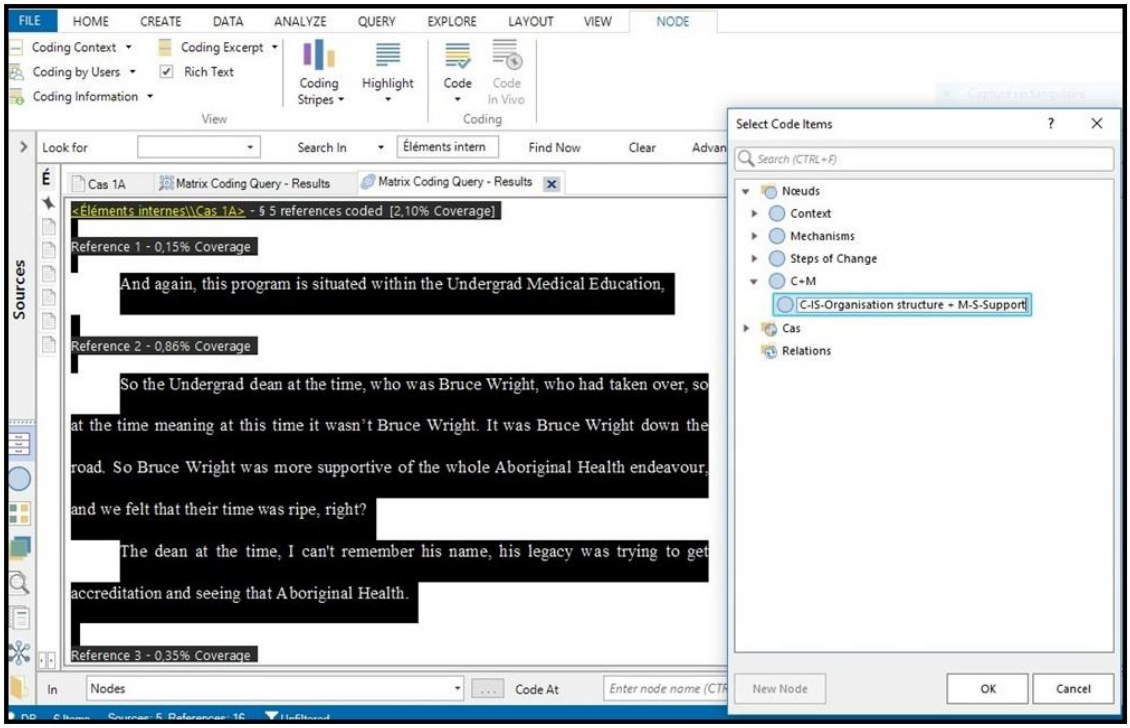

Figure 3: Manual coding of matrix query results for mechanisms (M) and elements of context (C)

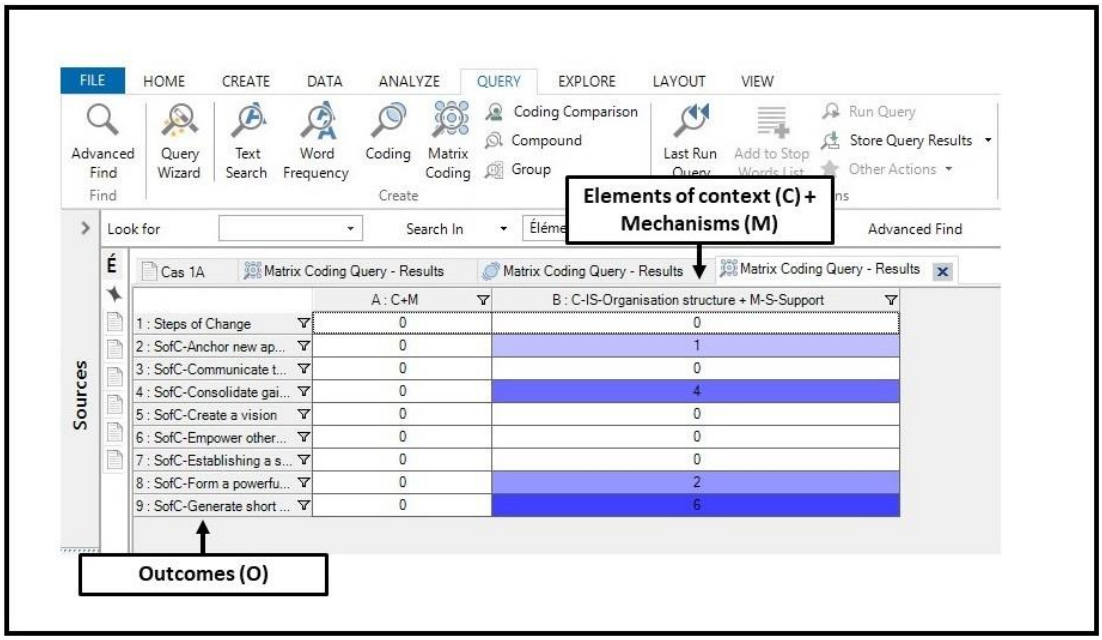

Figure 4: Results of the second matrix query for elements of context (C), mechanisms (M) and outcomes (O)