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Rethinking the connection between theory and methodology: a question of mutual affordances

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Theory and methodology are key considerations in research design. Different ways of conceptualising their connection can characterise differences in research practice. This paper examines connections between theory and methodology and the concomitant implications for ontology and epistemology associated with conducting research in a laboratory classroom applying a multi-theoretic research design. Using the Social Unit of Learning project as a case example, we argue that the relationship between theory and methodology is not one of “prescription” in either direction, but rather of mutual “affordance,” both regarding the analyses afforded by the complex data set and the extent to which each theory affords analytical consideration of specific constructs of relevance to the setting and the interactions recorded there. These constructs shape the way in which the multimodal material is reconstructed as data amenable to particular forms of analysis.

Keywords: Classroom research, research design, research methodology, social interaction.

Connection between theory and methodology

Pick up any textbooks on educational research, and you will usually find the words *theory* and *methodology*. The fundamental issues of whether theory or methodology should take priority in the process of research design, or how theory and methodology should be connected in the research process, can polarise researchers, with the views on the issues being used to characterise different research paradigms or approaches (see Guba & Lincoln, 1989; Strauss & Corbin, 1990). In this paper, we address connections between theory and methodology and the concomitant implications for ontology and epistemology associated with conducting research in a laboratory classroom when employing a multi-theoretic research design. We argue that in our research design, and in educational research in general, the relationship between theory and methodology need not be one of “prescription” in either direction, but rather of mutual “affordance,”¹ both regarding the theoretical analyses afforded by the complex data set (i.e., generated by the methodology) and the extent to which each theory affords consideration of specific constructs of relevance to the setting and the interactions recorded there (via the methodology). We first consider a few different possible relationships between theory and methodology.

¹ The word *affordance* was coined by Gibson (1986) in ecological psychology to describe the possibilities that the environment *offers* to an animal as the animal inhabits and interacts with the environment. We use the term to refer to the investigative options made possible (and also constrained) by the choice of theory or methodology.

Theory can be thought of as “a coherent system of logically consistent and interconnected ideas used to condense and organise knowledge” (Neuman, 2014, p. 9), while *methodology* can be seen as “concerned with the logic of scientific inquiry” and in particular, consideration of “the potentialities and limitations of particular techniques or procedures” (Grix, 2002, p. 179). Blumer (1954), for example, believed that some social theories exist independent of research methodology, and one does not prescribe the other. Another way to think about the connection between theory and methodology in the research process is as a sequence of critical decisions beginning with the choice of research methods (i.e., research techniques or procedures), which is framed or shaped by the methodology, which, in turn, is governed by the theoretical perspective, which reflects epistemological assumptions (i.e., a theory of knowledge) (see Crotty, 1998).

Crotty (1998) used the connection between objectivism (epistemology), positivism (theoretical perspective), survey research (methodology), and statistical analysis (methods) as an example of such a connective chain of research process. Crotty’s conceptualisation of the research process is shared by Grix (2002), who argued that “it is our ontological and epistemological positions that shape the very questions we may ask in the first place, how we pose them and how we set about answering them” (p. 179). In particular, Grix asserts that “we should guard against ‘method-led’ research, that is, allowing ourselves to be led by a particular research method rather than ‘question-led’ research, whereby research questions point to the most appropriate research method” (p. 179). Grix therefore suggests that theoretical considerations should lead or govern methodology and, thereby, methods in the research process.

Also emphasising the importance of theory in the research process, Neuman (2014) presented alternative sets of research procedure for quantitative and qualitative research processes. In his schematic depiction, the qualitative research process starts with acknowledging the social self and ends with informing others, with each step guided or informed by theory (see Figure 1).

The quantitative research process according to Neuman (2014) takes on the same structure as Figure 1, beginning with topic selection (Step 1) and ends with reporting (Step 7), with each step guided, shaped or informed by theory. Different from Grix (2002) who believed that “methods themselves should be seen as free from ontological and epistemological assumptions” (p. 179), Neuman’s depiction of the research process is less linear than Crotty’s, and has theory identified as influencing every step in what is conceived to be a cyclic research process. However, as can be seen in Figure 1, the relationship between theory and the individual research steps represented by Neuman is unidirectional where theory “radiates” outwards to influence each research step. None of the research steps appears to influence theory.

In conducting the Social Unit of Learning project, we found the connection between theory and methodology differs from the research process characterised by Crotty (1998) or Neuman (2014). The combined use of the laboratory classroom and the employment of a multi-theoretic research design (Clarke et al., 2012) in the Social Unit of Learning project offer a unique opportunity to reflect on the connections between theory and methodology and the concomitant implications for ontology and epistemology in the study. Further description of the project is provided below.

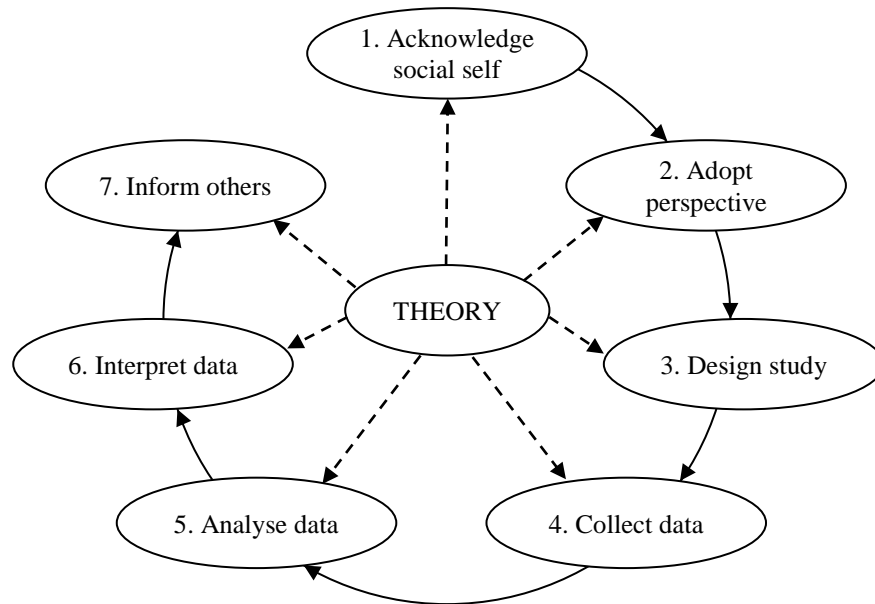


Figure 2: Steps in the qualitative research process depicted by Neuman (2014, p. 21)

The Social Unit of Learning project

The University of Melbourne has set up a laboratory classroom, the Science of Learning Research Classroom (SLRC), to study classroom teaching and learning. The facility has the capability to capture classroom social interactions with a rich amount of detail using advanced video technology. With 10 built-in video cameras and up to 32 audio inputs, the comprehensive and detailed recording of every participant in the classroom offers the possibility for systematic examination of the link between the processes and products of learning activities within the classroom setting. The facility has made possible research designs that combine a good approximation to natural social settings with the retention of some degree of researcher control over the research setting, task characteristics, and possible forms of social interaction afforded or encouraged. Such designs allow conclusions to be drawn with greater confidence about connections between interactive patterns of social negotiation and associated knowledge products (learning).

Using the SLRC, the Social Unit of Learning Project aimed to investigate the social aspects of learning and, particularly, those for which “the social” represents a fundamental and useful level of explanation, modelling and instructional intervention (Chan & Clarke, 2017). The project design can be seen as more akin to design experiments (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003) which involve “both ‘engineering’ particular forms of learning and systematically studying those forms of learning within the context defined by the means of supporting them” (p. 9). The project was designed to specifically serve the purpose of theory generation and testing through the application of a multi-theoretic research design (Clarke et al., 2012), taking advantage of the rich data that can be generated by the laboratory classroom facility.

The multi-theoretic research design adopted by the project involved the construction of a complex data set composed of video records and other supplementary data. The design allows an analytical team to juxtapose different interpretive accounts arising from different theoretically-grounded analyses in order to compare and contrast the capacity of different theories to characterise different aspects of the research setting. The theory generated from the research is intended to be a direct

reflection of an attempt to provide explanatory accounts in relation to a specific data set, so in its first instantiation would be most similar to what might be called a “local theory”. However, an accumulation of several such analyses of different situations might reveal similarities in the emergent local theories that suggested sufficient generalisability and commonality for more general theory, which would be less specifically tied to the data of any particular project.

Data generation

Intact Year 7 classes from a secondary school in metropolitan Melbourne were recruited with their usual teacher in order to exploit established student-student and teacher-student interactive norms. By *intact*, we are referring to the existing social relationships between students, and between the teacher and students, which are left intact and not interrupted by a selective process introduced by the researcher. Eleven classes of Year 7 students (12 to 13 years old; 264 students in total) participated in the project. The students in each of the classes completed problem solving tasks individually, in pairs, and in small groups (four to six students) within a 60-minute session in the laboratory classroom. The problem solving tasks used in the project were drawn from previous research (e.g., Sullivan & Clarke, 1991) and were purposefully chosen to make the thinking and/or social processes of the problem solving activity more visible. The tasks have the characteristics of allowing students to express their thinking through multiple modes (e.g., verbal, graphical, textual, etc.) and approach the task using different strategies or prioritise different forms of knowledge or experience. For example, two classes of students were given the following three tasks:

Task 1 (individual task) provided students with a graph with no labels with the following instructions: “What might this be a graph of? Label your graph appropriately. What information is contained in your graph? Write a paragraph to describe your graph”.

Task 2 (pair task) was specified as follows: “The average age of five people living in a house is 25. One of the five people is a Year 7 student. What are the ages of the other four people and how are the five people in the house related? Write a paragraph explaining your answer.”

Task 3 (small group task) stated that “Fred’s apartment has five rooms. The total area is 60 m². Draw a plan of Fred’s apartment. Label each room, and show the dimensions (length and width) of all rooms”.

The resulting data collected in the project included: all written material produced by the students; instructional material used by the teacher; video footage of all of the students during the session; video footage of the teacher tracked throughout the session; transcripts of teacher and student speech; and pre- and post-session teacher interviews.

Investigating the social aspects of learning

A multi-theoretic research design (Clarke et al., 2012) was employed to examine the complex data set from the project from multiple perspectives by multiple researchers, as well as interrogate the different theoretical perspectives through answering research questions such as the following:

1. What commonalities and differences in process and product are evident during problem solving activities undertaken by learners as members of different social units (individual, pairs, small groups, and whole class groupings)?

2. Which existing theories best accommodate (that is, provide a coherent and plausible explanation for) the documented similarities and differences in process and product and in what ways do the accounts generated by parallel analyses predicated on different theories lead to differences in instructional advocacy?

An international multi-disciplinary research team (combining education, cognitive and emotive psychology, learning analytics, and neuroscience perspectives) was recruited to develop analytical frames for coding the data.

Ontological and epistemological positioning

A major consideration regarding the validity of research findings and research evidence in educational research is the issue of *ontology*, which is “an area of philosophy that deals with the nature of being, or what exists” (Neuman, 2014, p. 94). The issue is distinguished from *epistemology*, which is “concerned with the theory of knowledge, especially in regard to its methods, validation and ‘the possible ways of gaining knowledge of social reality, whatever it is understood to be’ (Blaikie, 2000, p. 8)” (Grix, 2002, p. 177). In the Social Unit of Learning project, we recognise the active role that the researchers play in constructing the research setting to make the social aspects of learning visible as well as in data selection and interpretation (Chan & Clarke, 2019). Ontological considerations place limits on the authority of any claims the research team might make regarding the generalisable characteristics of classroom learning. Any such claims must acknowledge the researchers’ role in shaping the research setting to optimally simulate the common features of institutionalised classroom settings. Of course, it is the researchers’ intention that such generalisability of findings be afforded by the optimised setting. We consider regularities in the multiple student interactions (e.g., across many pairs of students or across different social units) to suggest generalisable characteristics of the social aspects of learning.

With regard to the epistemological position of this project, we construct knowledge by considering both the regularities and differences in the interpretive accounts generated by the research team (cf. complementary accounts, Clarke, Emanuelsson, Jablonka, & Mok, 2006), and reconstructing these regularities as propositions. In this project, knowledge about classroom learning is generated inductively through the aggregation of these propositions to create new theory.

Mutual affordances of theory and methodology

Different from the research process depicted by Crotty (1998) and Neuman (2014), the relationship between theory and methodology we are positing for the Social Unit of Learning project resembles a symbiotic one. In as much as the chosen theory highlights particular constructs, analytical consideration of these constructs is afforded by the data set generated through the research design (methodology) which has anticipated the need for such data (see Figure 2).

We characterise this symbiotic relationship as one of mutual and reciprocal affordance, since the chosen theory frames and affords the consideration of the constructs (such as engagement) that are the focus of the research and these in turn place anticipatory constraints on the forms of data required from the methodology. This mutual affordance can be illustrated by the consideration of questions such as:

- What (theoretically-grounded) analyses are afforded by the data produced by the researcher’s methodology?
- What constructs are foregrounded or prioritised by the chosen theory?
- How do we connect the constructs to the data?

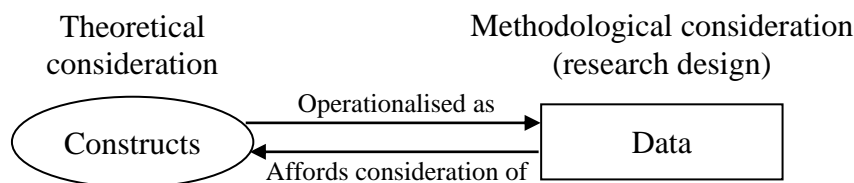


Figure 2: Mutual affordances of theory and methodology as illustrated by the reciprocal relationship between constructs and data in the Social Unit of Learning project

The investigation of the social aspects of learning does not necessarily prescribe a particular methodology. However, when the research is conceptualised through a particular theory with its sets of interrelated constructs, researchers need to draw selectively from existing research traditions and established methodologies with their tenets for appropriate and rigorous investigative methods.

To provide further examples, multimodal learning analytics (Ochoa, 2017) was used in the project to extract features in the video and audio data to characterise behavioural student engagement. Learning analytics is “the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs” (Conole, Gašević, Long, & Siemens, 2011, p. 3). While learning analytics generally involves analysing log-file data captured by online systems (e.g., Learning Management System), multimodal learning analytics also includes the coding of more natural activities such as gestures, gaze, speech, or writing (Ochoa, 2017). Applying advanced techniques, Ochoa and his research team were able to automate the coding of student gaze direction, student posture, teacher position, student talk, and teacher talk to create indicators of student engagement, student attention, and teacher attention during various task conditions (individual, pair, and small group) (Chan, Ochoa, & Clarke, in press).

Another analytical thread applied in the project was interactivity analysis. The analysis of student interactivity was drawn from the theory of Commognition developed by Sfard (2015). Commognition theory resolves the thinking-communication divide by equating communication with thinking. The theory is particularly powerful for conceptualising how learning occurs and has led to the development of particular analytical tools for investigating learning, specifically in the classroom context. Interactivity analysis involves fine-grained analysis of student utterances to identify patterns of interaction between the students, such as instances where one person consistently ignores or responds (reacts) to the other person’s utterances or frequently initiates new topics (Sfard & Kieran, 2001). The interactive patterns can be seen as indicators of student engagement (both social and cognitive) in terms of the level of interpersonal correspondence between two people in their dialogue.

The investigation of a superordinate construct such as “engagement” can stimulate the use of a set of related mediating constructs (e.g., shared attention, participation, etc.) in psychology (Shernoff, 2013) in the case of the multimodal learning analytics work, while also stimulating the use of

another set of constructs (e.g., communication, discursive interactions, etc.) within a specific sociocognitive theory (Sfard & Kieran, 2001) in the interactivity analysis. These constructs shape the way in which the multimodal material is reconstructed as data amenable to particular forms of analysis. The specific analyses carried out were afforded by the complex data set available to the project, subject to the theory affording the consideration of specific constructs of relevance to the setting and the interactions recorded.

Implications

The recognition of the reciprocity between theory and methodology has significant implications for the detailed design of any research project, since it cannot be assumed that by making the decision on one (theory or methodology or methods), the consequent decisions are thereby prescribed. The relationship must be seen as progressing in both directions taking us not only from theory to methodology and then to methods but also from methods back through methodology to theory. A researcher engaged in planning the minutiae of any one of these critical decision points is reminded in our paper to take into account those decisions in both directions throughout the research process because of the mutually affording nature of all connections.

Conclusion

It is the combination of unusually rich data that can be generated by the laboratory classroom facility and a multi-theoretic research design that has highlighted for us the necessity of considering the affordances offered by each of the selected theories, the chosen methodology, the resultant data set, and the dynamic mutuality of these affordances. As argued in this paper, the research process is not simply algorithmic with each step prescribing the form to be taken in any subsequent step. The reflective researcher must instead engage in a continually recursive reflection in the nature of the connection between any key decision and those adjacent to it in their research process in either direction.

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